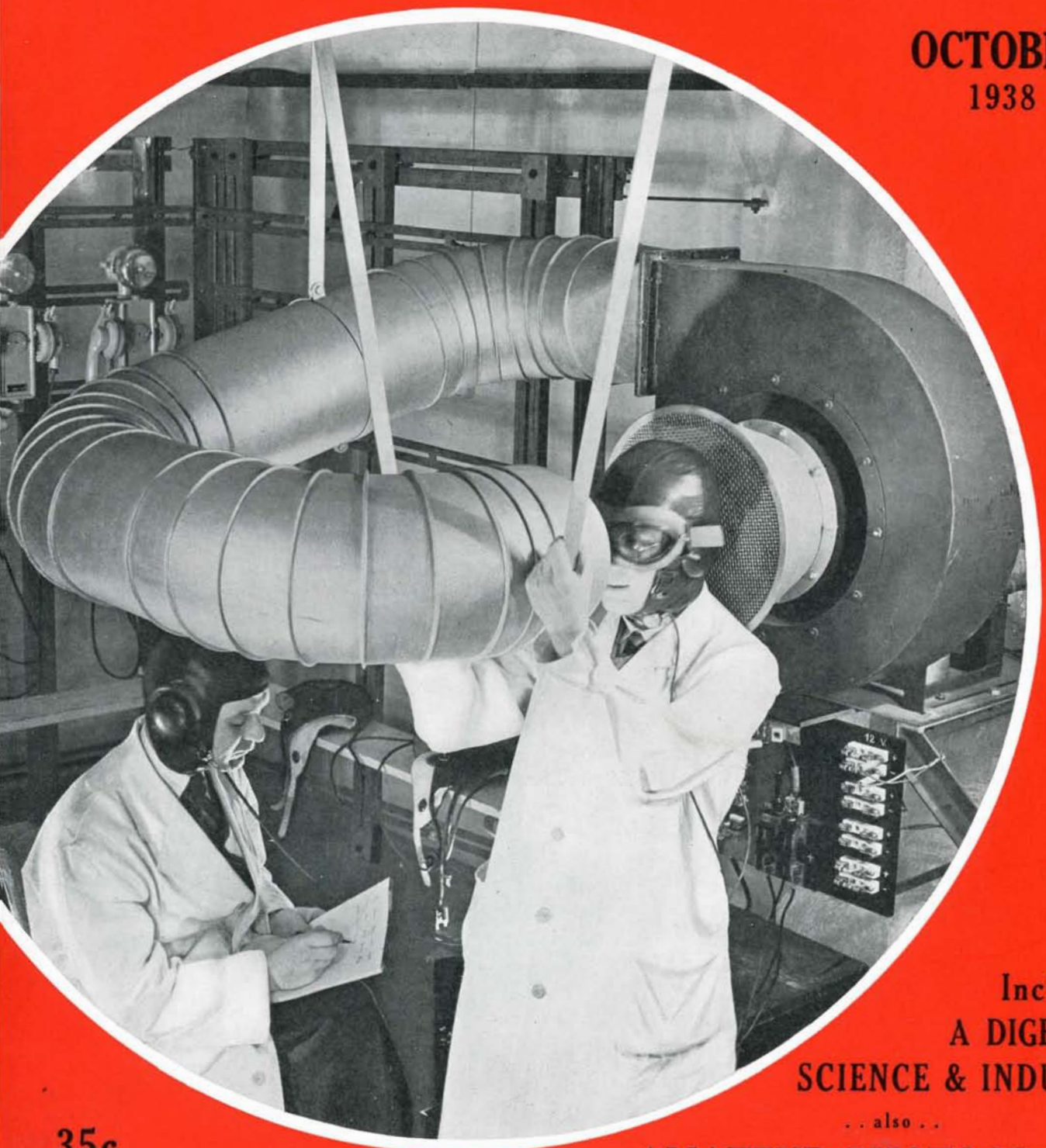
FLOODS GIVE FAIR WARNING

SCIENTIFIC AMERICAN



OCTOBER
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The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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NINETY-FOURTH YEAR • ORSON D. MUNN, Editor

CONTENTS • OCTOBER • 1938

TESTS of communication systems for open-cockpit airplanes are conducted in the "noise chamber" of Siemens and Halske, illustrated on this month's cover. A small wind tunnel forces a blast of air against the experimenter's face, simulating aircraft operating conditions. Motor and other noises are produced by means of phonograph records which are amplified and reproduced by the large loudspeaker directly behind the experimenter. A "contact" type microphone is placed against the experimenter's throat to insure a maximum transmission of his voice. *Photograph: German Railroads Information Office.*

SCIENTIFIC AMERICAN, October, 1938. Vol. No. 159, No. 4, entered at the New York, N. Y., Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City.

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50 YEARS AGO IN . . .

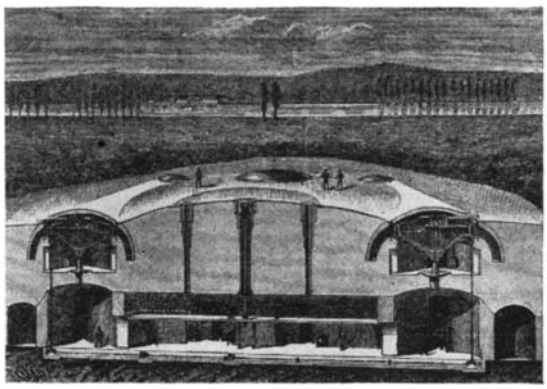
SCIENTIFIC AMERICAN

(Condensed From Issues of October, 1888)

STREET CARS—"Electric traction cars, in the place of horse cars, began making trips in the public service on the Fourth Avenue line, New York City, on September 17, the Julien storage battery system being employed. The battery for a car consists of 144 cells."

ARMS—"The idea of a nation with the wealth and mechanical skill of the United States having to go abroad for its guns for warfare is ridiculous. Sporting arms, equal in workmanship to any manufactured in the world, are made in this country, and there is no reason why the heavier ordnance should not also be made here."

DEFENSE—"The neo-modern fort, conformable to the type devised by Commander Mougin . . . the construction of which upon a certain position selected near the [French] frontier has been ordered by a ministerial decision of July 23, 1887, has a singularly original character. Let one imagine to himself a bulging of the earth, recalling on a large scale one of those hillocks produced by the subterranean work of the mole. We have not here, however, a mass of earth, but rather a block of beton. This artificial rock, measuring fifty yards in length by from thirty to forty in width, rises from a dozen yards beneath the natural ground. Its maximum projection above the earth does not exceed three or four yards. . . . At the center of this rock rise, flush with the surface, three armor-clad turrets . . . each armed with guns of large caliber; at the circumference, four small disappearing turrets, each armed with rapid-firing guns; and at three other properly selected points, armor-clad observatories. . . . The underground machinery department includes a powerful steam engine, with cistern and duplicate boiler, a battery of ventilators for renewing the air, accumulators with pumps, and hydraulic motors for raising, lowering, and revolving the turrets and elevating the ammunition, etc., and, finally, dynamos and electric accumulators for internal lighting and projecting light externally."



MEXICAN—"Rapid progress has been made this summer toward the completion of the Mexican National Railroad Company's 'International' line, and President Raoul informs us that it is expected to open it for traffic before November 1, and possibly by October 15. This will make a second independent all-rail route from the Rio Grande to the city of Mexico."

PRE-MIXED—"A new idea has been developed in Germany, in the shape of the manufacture of mortar, to be sold at retail to small builders and private individuals. The business requires very little capital, and the mortar, which is mixed by machinery, and of excellent quality, finds a ready sale, something like two million barrels having been disposed of last year in Berlin alone."

STARS—"In the whole celestial sphere, there are about six thousand stars visible to an ordinarily good eye. Of these, however, we can never see more than a fraction at any one time, because a half of the sphere is always below the horizon. . . . In all, 314,926 stars, from the first to the ninth and one-half magnitudes, are contained in the northern sky, or about 600,000 in both hemispheres. All of these can be seen with a three-inch object glass."

MAN-MADE DIAMONDS—"The Hon. C. A. Parsons describes . . . a number of experiments which he has recently made on carbon at high temperatures and under great pressures, and in contact with other substances. The primary object of the experiments was to obtain a dense form of carbon for use in arc and incandescent lamps. . . . Looking at the experiments from this point of view, it may be stated that the experiments were not entirely successful, though a very dense form of carbon was in one case obtained, but nevertheless some results are of very great interest, as, though the author expressed himself very cautiously, it would appear that he has succeeded in producing diamond dust artificially. . . . There was obtained on the surface of the carbon . . . a powder of a gray color, harder than emery, and capable of scratching the diamond. This powder is, therefore, very probably the diamond itself."

TREE MINING—"An industry the like of which does not exist anywhere else in the world furnishes scores of people in Cape May County, New Jersey, with remunerative employment, and has made comfortable fortunes for many citizens. It is the novel business of mining cedar trees—digging from far beneath the surface immense logs of sound and aromatic cedar."

CENSUS—"The census of 1890, preparations for which are already being made, promises to show in the United States a population of more than 70,000,000. The population in 1880, according to the census of that year, was 50,155,783 persons, of whom 43,475,840 were native and 6,679,943 foreign born."

BALLOONS—"While experiments are being made in England to solve the problem of the manufacture of balloon hydrogen by electrolysis, *Iron* informs us that Messrs. Majert and Richter have devised and successfully experimented with, at Berlin, an apparatus that does away with the inconveniences of former processes. The hydrogen is obtained by heating a mixture of slaked lime and powdered zinc, the carriage of which on a campaign is rendered easy by inclosing it in tin cartridges."

COAL—"The principal coal mines in Japan are situated on the island of Takashima, outside the harbor of Nagasaki. They form one of the principal centers of coal supply in the East, and have now been worked by a lessee of the government's with all the more recent and improved appliances for about sixteen years past. According to a recent official report, 2,500 miners are engaged, the total population of the island being 10,000."

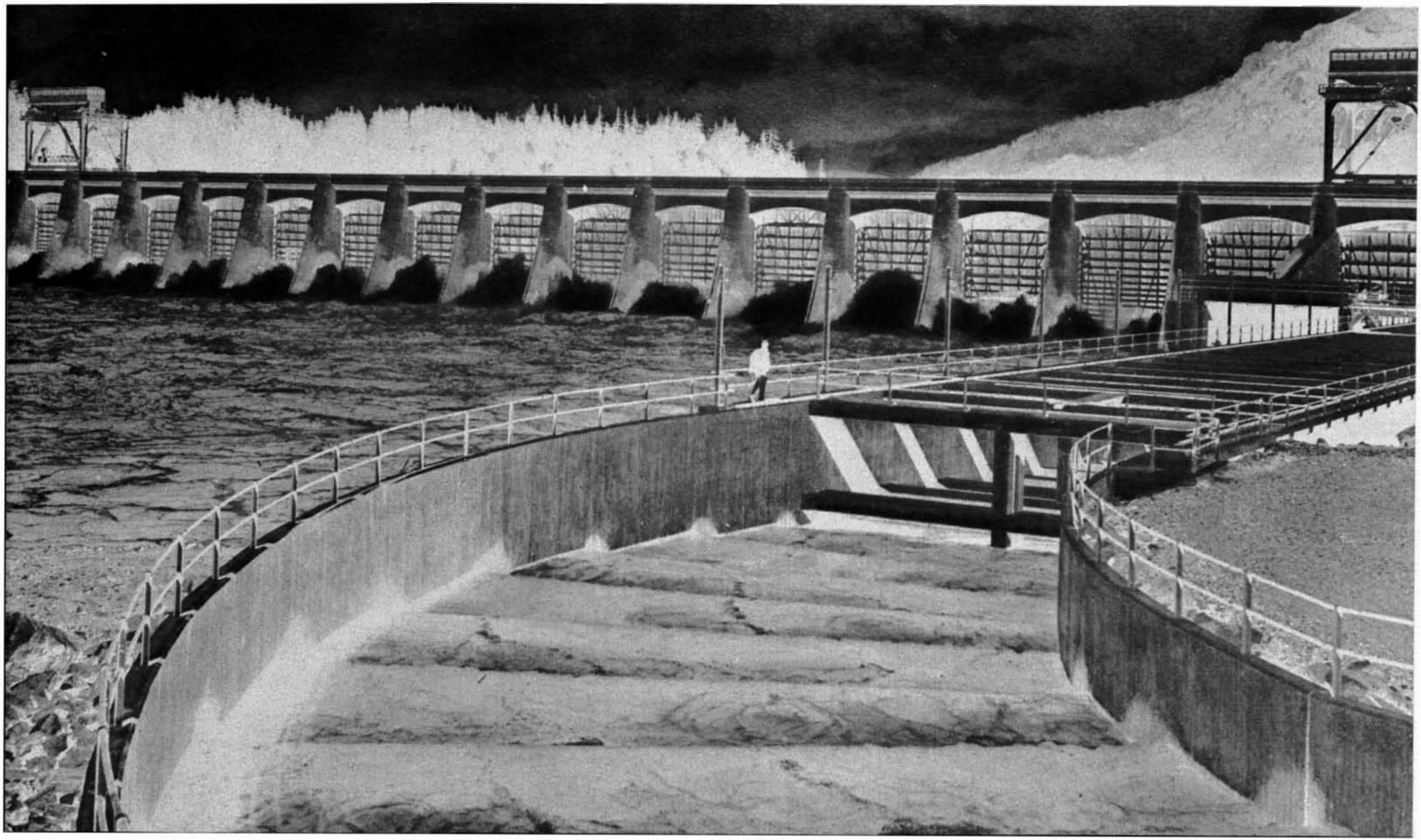
AND NOW FOR THE FUTURE

¶Cotton picking machines—the practical and economic aspects of these devices—by F. D. McHugh.

¶The Italian Navy at a glance—two pages of drawings with explanatory text.

¶Potash and other valuable salts are being obtained on a commercial scale from the Dead Sea—by Harold J. Shepstone.

¶Industry profits greatly by the use of new hard alloys in tools and wearing surfaces.



MAN-MADE CATARACTS FOR FISH HURDLERS

BROAD as a four-lane highway: one of the fishways at Bonneville Dam, the lower end of which is in the distance near the main, or spillway dam (see map on page 182). Salmon migrating upstream hurdle these steps, from pool to pool, finally reaching the higher level whence they swim on upstream to their spawning areas. Reports by official enumerators indicate that these fishways present no obstacle to this regular migration.

DEATH FROM THE SKY ?

Official U. S. Navy Photograph

"Regrettable" Violations of Rules of Warfare . . . Bombing to Shatter Morale of Civilians . . . Inaccuracy Makes the Airplane Bomb a More Fearful Weapon of Offense

By ARTHUR E. OXLEY, M.A., D.Sc.
Major, Royal Air Force

A BOMB released from an airplane has but a remote chance of hitting the prescribed objective. Many factors are involved in determining the flight of a bomb, several of which are either not known or are difficult to ascertain. In many cases, particularly during a daylight attack, the activities of enemy pursuit planes and anti-aircraft gunnery prevent a bomber from using even the scanty data available, and frequently compel him to "lay his eggs" without taking a sight at all. In night bombing, these interfering factors are partly eliminated but a "black-out" adds enormously to the bomber's difficulties. Not until he looks down, perhaps half a minute later, and sees the cloud of black smoke by day or the pin-point flash by night, does he realize "where that one went."

Knowledge of these facts makes aerial bombing a fearful weapon in the grasp of relentless modern commands. It allows them to commit crimes against hitherto established international rules of warfare; to kill or maim non-combatants; to destroy non-military structures. Under cover of the plea that his objective was a legitimate one, that his efforts were directed honorably, that the results—alas! so "regrettably" wide of his intentions—were accidental or unavoidable, a ruthless command may plan to shatter the morale of an enemy's civil existence in the hope of insuring indirectly an economical military conquest.

Within the past 25 years, airplanes have revolutionized the military and naval conduct of war. Their outstanding contribution to warfare admittedly lies in the sphere of reconnaissance—acquisition and transmission of intelligence. Airplanes are the eyes of a fleet or army, displacing the less agile sea-scout or destroyer and the relatively slow-motion cavalry. They constitute the gunners' range-finder for unseen craft and battery emplacements. They are the tipsters of the invisible knock-out.

TODAY the airplane has largely dissipated what the strategist aptly called the "fog of war" of yesterday. That it may be the means of creating a fog of its own, infinitely more disastrous than any fog yet conceived, is also probable. This we shall discuss later.

Such a valuable adjunct to land and sea forces must naturally create a rival. This appeared in the form of the fighter plane—a perfectly legitimate device—the object of which is to protect its own reconnaissance units and destroy those of the enemy. And so the airplane was transformed from a non-aggressive adjunct of the fighting forces to a weapon of offense. The next step in the evolution of the airplane as an offensive weapon was the attempt to make it simulate long-range artillery, resulting in the birth of the bomber. The projectile to be launched is comparable with that of a howitzer. The range of the aerial bomb corresponding to that of the latter is provided by the flight of the airplane but, instead of the projectile traveling throughout its flight in a calculable trajectory, like the howitzer shell, the aerial bomb is merely released with a velocity exactly equal to that of the plane at the time of release. In fact, we may regard the bomb as being fired from a platform at the height of the plane, the muzzle velocity of the bomb being the actual velocity of the plane relative to the ground.

The height of the plane above the objective is readily obtained from the altimeter reading, correcting, if necessary, for the elevation of the objective above sea level as indicated on a contour map. The determination of the velocity of the plane relative to the ground is a more difficult problem. It depends on the airspeed of the plane—that is, the speed at which the plane flies horizontally in still air—as well as on the velocity and direc-

Official photograph, U. S. Army Air Corps

Attack plane dropping gas bombs on "enemy" anti-aircraft battery during recent maneuvers

tion of the wind at the height of the plane. These last factors are characteristic of the spot *near* the objective *at the time* of release, and are usually not known with any degree of accuracy. Some idea of their value over the objective may be obtained by preliminary flights, or from balloon observations, at a safe distance from enemy interference—trusting, from judgment of weather conditions, that similar or only slightly modified conditions may exist over the objective.

NOW, if the bomber knows all details of air speed and ground speed, wind direction and velocity, it is possible for him to set his bomb-sight either for an upwind or downwind approach to the objective. The range—the horizontal distance between the objective and the position of the plane at the instant of release—will be very different (Figure 1) according as to whether the plane is flown up- or downwind. The trajectory of the bomb is approximately that of the parabolas shown. The diagram in Figure 1 represents the following concrete case:

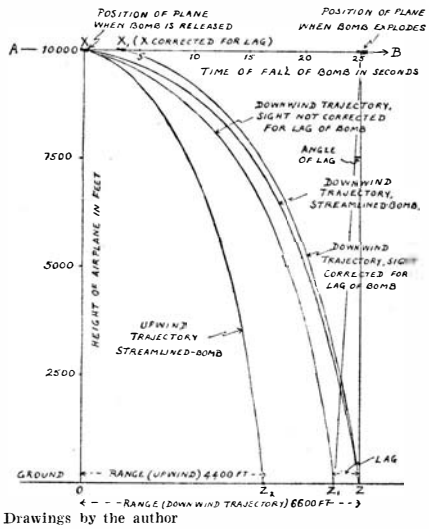
Air-speed of plane=150 miles an hour.
Height of plane above objective=10,000 feet.
Wind velocity at this height=30 miles an hour.
Ground-speed of plane (downwind)=180 miles an hour; 264 feet per second.
Ground-speed of plane (upwind)=120 miles an hour; 176 feet per second.
Theoretical range of bomb (downwind), OZ=6600 feet.
Theoretical range of bomb (upwind), OZ_2=4400 feet.

The parabolic trajectory XZ would be traced by an ideal *streamlined* bomb released with its axis parallel to the line of flight and so stabilized that, in its forward and downward flight, it does not wobble. In actual practice, none of these conditions is realized. Most bombs are only approximately streamlined, except for their tail stabilizing fins, which, like the feathers of a dart, are necessary to prevent undue wobbling as the speed of descent increases and the curvature of the trajectory changes. No aerial bomb is favored with the stabilizing gyroscopic spin imparted to an artillery shell, as its copper band threads its way through a rifled bore. Therefore the bomb wobbles—it can be seen to do so as it leaves the plane—and in so doing it, in effect, becomes less streamlined. Owing to the resultant head-resistance, the horizontal speed of the bomb during each second of its fall is gradually reduced below that of the speed at the time of release. The plane keeps up this speed because of its engine power; the bomb, having no such propelling power to counteract the head-resistance, lags behind a direct vertical drawn through the plane.

From a height of 10,000 feet, a well streamlined bomb takes a little over 25 seconds to reach the ground. Each type of bomb has its own lag, and all that can be done to compensate for the intricate variants due to bomb shape, height and speed of plane, and so on, is to modify the height and time-scales of the sighting mechanism so as to allow for an average lag representative of an average-most-commonly-used type. This lag, ZZ_1 in Figure 1, is measured by dropping either dummy or unfused actual bombs.

A CAMERA obscura which, curiously enough, originated in the 13th Century through the genius of Roger Bacon, and which was conceived by him for developing the arts, may be used for measuring bomb lag. A sketch of this device is shown in Figure 2. It consists of a darkened chamber in the roof of which is inserted a convex lens L. Below the lens is a table on which is pinned a sheet of white paper, the distance from the center of the lens to the paper being equal to the focal length of the lens. Any object, say a cloud or an airplane, may be considered as at infinity and will form a sharp image on the paper. If a plane flies over the camera obscura in the direction AB, an image of it will move across the paper in the opposite direction, *ab*. The pilot is instructed to fly upwind and downwind, these directions being obtained through use of the drift indicator. A metronome is set to beat one-second intervals and an observer places a pencil dot, at the beat of each second, on the image of the nose of the machine, tracing the image (Figure 3) in both its up- and downwind tracks. For the upwind track, the ground speed is low and the dots are close together; for the downwind track, the ground speed is high and the dots are far apart.

As the plane moves from A to B, the image moves from *a* to *b*, the similar triangles ABL and *ab*L (Figure 2) giving the scale of flight reduction by *ab*/AB=*a*L/AL. From this, knowing the number of seconds required to trace the track *ab*, we get the ground speed, upwind and downwind, respectively. Suppose the bomber is aiming at a target, the bearing of which relative to the camera obscura O is marked to scale on the camera table. The bomber signals by radio the instant he releases the dummy bomb and the observer marks the instant of this signal at X (Figure 3) on the track of the plane's image. A tangent to the track at X gives the projection of the bomb's line of flight on the ground and the point of impact of a theoretically streamlined bomb is found by measuring a distance XZ equal to distance between second dots at X multiplied by time of descent of bomb in seconds. The actual point of impact of the dummy bomb is measured on the ground outside and its position transferred to the camera obscura chart. The difference between the range calculated and that measured gives the lag which is required. The average of about 20 tests gives a sufficiently accurate estimate of the lag, and allowance is made for this amount in the graduation of the sights



Drawings by the author

Figure 1

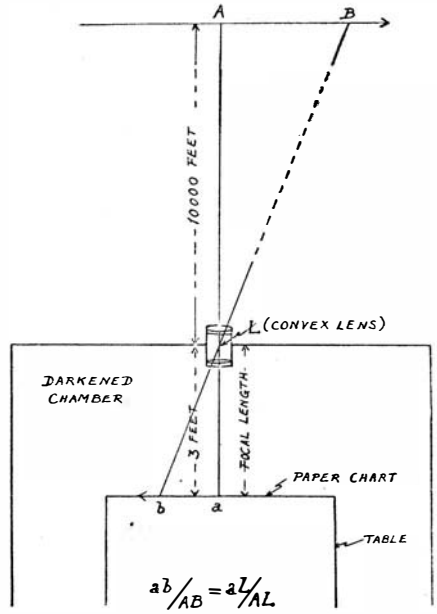


Figure 2

that are used on the bombing plane.

With these corrected sights, the bomber would now release his bombs (Figure 1) at X_1 instead of at X; that is, he would release late to compensate for shooting short due to the head-resistance of the bomb.

Even when every effort has been made to evaluate these variables, there still are unknown factors with which the bomber has to contend. From heights of 15,000 to 20,000 feet, now chosen by bombers, there is little to fear from anti-aircraft guns; but as height increases, errors increase, and prevailing air currents in lower strata of the atmosphere may even oppose those above. Enemy pursuit planes have still to be faced. They are faster and can fly still higher, harassing the bombers at critical moments and vitiating their aim.

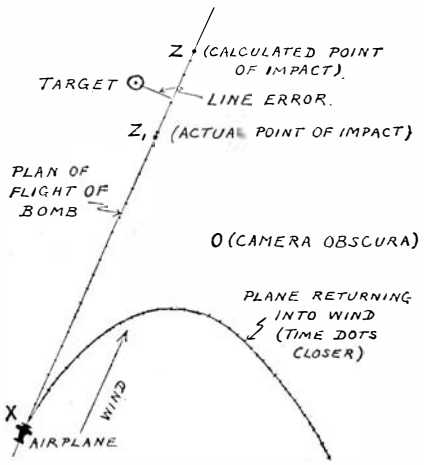


Figure 3

Errors of the order of 20 percent in range, over or short, also right or left, of an objective are common; this percentage is usually greatly exceeded under exigencies of war where the bomber is threatened with attack. On a range of 5000 feet, the minimum error may be set at 1000 feet north, south, east, and west of a target. Quite large buildings are therefore too small, as individual objectives, to be hit by direct skilful sighting. More reasonable objectives are dockyards, large camps, factories, and aerodromes.

During the World War and in a few recent attacks, bombs have been launched while diving to low altitudes. As in the case of low-altitude machine gunning, this practice eliminates almost all the unknown variables referred to above, the line of flight of the bomb being approximately the line of flight of the machine over its short trajectory as shown in Figure 4. In such cases the bombs must be equipped with delay fuses to allow the bomber time to zoom clear before explosion takes place. The risks entailed by low-altitude bombing, except in the cases of attacks on unarmed populations or savage tribes, are too great to make this a popular mode of aerial attack. In most of the calamitous raids of the last two or three years, greater and greater altitudes have indicated a growing respect for the defender. And poorer and poorer become the efforts of the attacker until we may say that they have ceased to be discriminative!

Another way of reducing the uncertain factors affecting the trajectory of a bomb is that based on the vertical dive. A plane diving vertically will reach a terminal velocity of 500 to 600 miles an hour. At this speed the upward head-resistance counterbalances the weight of the plane and the plane falls without further gain of speed. This is approximately the speed at which the bomb of Figure 1 strikes the ground. Such a speed would not add appreciably to the accuracy of bombing, but it would have very serious effects on a pilot's endurance in executing the maneuver out of the dive, to say nothing of the probable collapse of his machine! Such vertical speeds can be avoided by taking advantage of the reversible pitch propeller. With this, the vertical speed downward can be reduced to approximately the speed of horizontal flight. In dive bombing of this type, the bomber executes his dive vertically above the target—a definite drawback to the method. In bombing from horizontal flight, the bomber need not approach his target much closer than a mile, and, immediately he has released his bombs, he may bank away and return to his aerodrome.

THE vertical dive method only partly solves the difficulties of the bomber. A plane so falling is still drifting with an uncertain wind velocity. For example, in the concrete case cited above, a wind drift of 30 miles an hour is assumed. If this is not allowed for, a bomb released when diving at 10,000 feet will drift about 1100 feet from the vertical; that is, from the target. Here is very large error when the dangerous maneuvers involved are taken into consideration! In addition, the acknowledged military advantages of formation flying would be sacrificed, at least during and subsequent to the dive.

The use of bombing airplanes as long-range heavy-artillery units has completely revolutionized warfare, particularly in the early stages of attack. The

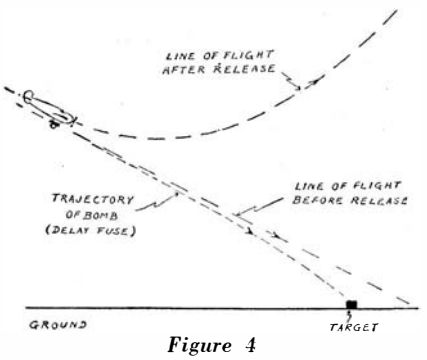


Figure 4

Official photograph, U. S. Army Air Corps

Loading a dummy "bomb" preparatory to conducting camera obscura tests as described

inception of the reconnaissance plane automatically dispersed the then extant "fog of war." Reprisals against this efficient reconnaissance system have resulted in plane armament, finally evolving a purely offensive plane—the long-range bomber, whose swift, unascertainable deployment has created a higher, wider, deeper, and more impenetrable "fog of war" than mankind has ever hitherto conceived. This new monster is the more terrifying because the very fog itself is the destroyer. Some of the powers that embrace this unbridled scourge on humanity will not stop at high explosive and incendiary bombs. The policy to which they are addicted demands the destruction of all and sundry—annihilation! The aim of aggressors is to add to the new "fog of war" every destructive agency that can be adapted to military use. Experiments in earmarked laboratories and over selected flying areas are reported to be making rapid advances toward this monstrous achievement.

The bewildered man-in-the-street may well ponder: "Will the airplane, and particularly the modern long-range bomber, succeed as a unit of offense?" It appears that certain present-day high commands are willing to gamble on the effect of thrusting the hellishness of war directly into the faces of civilian populations. Thus they hope that these helpless people may be forced to plead for even unconditional surrender of rights so that the way will be paved for a cheap military victory.

On the other hand, this modern and inhuman way of conquest may have precisely the opposite effect. It may stiffen backs under the goad of pitiless slaughter of compatriots and engender a potential vengeance which one day will result in an eclipse of the ephemeral military conquest.

Although the outcome of the airplane offensive by means of aerial bombings remains an unknown, indeterminate quantity, the world may be sure that the unwholesome atrocities which are happening today are but curtain-raisers on insane dramas to come.

THE X-PARTICLE'S NEW BROTHER

Still Another Atomic Entity Threatens to Add Itself to the Physicist's "Who's Who in Atomic Society" . . . Is It Real or Is It a False Alarm?

By DOUGLAS W. F. MAYER

UNDER the title "And Now the X-Particle," in the July number of Scientific American. Jean Harrington reported the discovery of two new sub-atomic particles—the positive and negative heavy electrons. Owing to the fact that these particles—which were found to occur in cosmic-ray showers—had a mass *intermediate* between that of the proton group of particles and that of the electron group, the discovery of these new entities, by Anderson and Neddermeyer, of the California Institute of Technology, aroused tremendous interest in physical circles. But science never stops to gain its breath, and hot on the heels of these new offspring has come yet another—the "neutretto."

Just as the neutron is the neutral particle of the proton group, so is the "neutretto" the neutral particle of the heavy electron group. Its presence has, it is true, not yet been confirmed experimentally, and the particle at present is merely a postulation by W. Heitler, produced as a result of some brilliant mathematical work. So well, however, do the predicted properties of this "little stranger" fit in with our existing knowledge, that most physicists are in favor of accepting it, and look upon its concrete isolation as merely a matter of time.

Heitler, of Bristol University, England, is already well-known for his theoretical work on various aspects of nuclear physics, and was led to his neutretto hypothesis by a study of a particularly penetrating type of cosmic-ray radiation, which is capable of producing charged secondary particles and showers. As was explained in a footnote to Jean Harrington's article, these showers are bursts of electrons, which are sometimes exploded simultaneously from the same nucleus by the violent impact of a cosmic-ray projectile, but which are more commonly cumulative, and build up in steps from a single impact. Thus, by interacting with the nucleus, the incoming particles produce a photon, which in turn produces positive and negative electron pairs, which radiate new photons, and so on until the energy is absorbed.

Owing to the high rate of absorption of the electrons and positrons, these particles cannot travel far. But in 1936, Barnóthy and Forró found that, after cosmic rays had traversed absorbing material equivalent to 800 meters of water, practically the whole ionization produced in their detection chambers was due, not to radiation, but to shower particles. From this they concluded that whatever was producing the showers must be due to some non-ionizing particle—that is, a particle with no charge—and suggested that these particles might be neutrinos.

Similar research was performed by Heinrich Maass, who investigated the formation of secondary ionizing particles by "neutral rays" passing through iron, and their subsequent absorption. It was found that the initial neutral radiation had an absorption coefficient of about 9×10^{-3} per centimeter of iron. This was practically the same as that of charged heavy electrons, which also occur in these showers. The secondary charged particles had absorption coefficients of about ten times greater, which suggested that they were heavy electrons moving relatively slowly, and hence more likely to be absorbed.

HEITLER wanted to know what the particles in this neutral radiation were, and realized that, since they were neutral, there were only three things they could be. They were either neutrons, neutrinos, or some new neutral particles hitherto unknown. They could not be neutrons, which have a smaller penetrating power, nor was there any process known in theoretical nuclear physics by which the mysterious neutrinos could produce heavy electrons in the large numbers in which they occur in these showers. Heitler was forced to the conclusion that they were some new type of particle and, remembering that they were absorbed in a similar manner to ordinary heavy electrons, postulated that they were the *neutral counterpart of the heavy electron*, and proposed for them the name neutretto.

Additional support for his suggestion was found in a slightly different sphere. In recent theories of nuclear forces, the heavy electron has been made responsible for the exchange forces between a proton and a neutron. This may sound rather vague at first, but becomes intelligible when we remember that these particles may be looked upon—to put it rather crudely—as lumps of "solidified energy." It was found that the forces between two protons were similar to those between a proton and a neutron, and a similar explanation was sought. Such an explanation, however, required the existence of a particle with the same mass and with similar properties as the heavy electron, but with no charge. Heitler's neutretto supplies the missing link admirably.

Heitler believes that, apart from processes where charge is involved, such as in ionization or the production of light, the neutretto will produce the same kind of showers as those produced by heavy electrons. He denotes this symbolically—as follows—and suggests that a neutretto (Y^0) can be transformed into a heavy electron (Y^+ or Y^-) by colliding with a proton (P) or a neutron (N). The double arrows indicate that the process will work in either direction.

$$Y^0+N \rightleftharpoons P+Y^- \text{ or } Y^0+P \rightleftharpoons N+Y^+$$

He has also shown mathematically that for energies of about 10^8 electron-volts, neutrettos and heavy electrons would have cross-sections permitting them to traverse about 7 centimeters of iron, 5 centimeters of lead, or 50 centimeters of water before such a collision took place. With higher energies, more complex showers, resulting in the formation of heavy electrons in large quantities, would take place. These theories are in excellent accordance with experiment.

It thus seems reasonably certain that these new neutrettos definitely exist, and that the heavy electron family has now its full trio of negative, positive, and neutral particles. The electron family, consisting of electron and positron, is still one member short, as is the proton group, consisting of proton and neutron, though several experimenters, at one time or another, have claimed to have detected a negative proton, which would complete the latter group. As for the neutrino, this is still as problematical as ever—the joy of the mathematicians, who ascribe to it all sorts of mysterious properties, and the bane of those who like to have an intelligent comprehension of the things they read about. The only certain facts about it seem to be that it has no charge, and that its mass is very minute.

OUR POINT OF VIEW

Progress Report

"WHEN will television turn the long-talked-about corner?" is the composite sum and substance of numerous letters that have reached this writer's desk. There is no pat answer; no date can be set. And when the corner is reached it will be found to be a long, sweeping curve rather than a sharp right-hand turn. Although research technicians are working constantly to iron out the wrinkles of this new art-science, they realize more and more that the ultimate goal is still far in the future. Standards of transmission are being set, so that there will be no Tower of Babel when television is presented to the general public. Problems of screen detail and illumination, of synchronization and transmission, are being spread out on laboratory tables, knelt upon, and attacked hammer and tongs. Field tests are showing the way to overcome difficulties that will arise when television is finally released. Program possibilities and problems are being studied with a view toward ultimate production of the finest possible eye entertainment and commercial sponsorship.

Television is here—in the laboratory. This writer has made similar statements in these columns in the past, and repeats himself now with even greater emphasis. A recent demonstration of RCA television revealed an image some seven by ten inches in size that had all the clarity, detail, and screen illumination that could be desired. The old criterion of comparison with home movies has been met—and surpassed. The reproduced image was a far cry from the blurred, indistinct and jumpy images in tests of only a few years ago. The only fly in the ointment, from the standpoint of the man in the street, was that this was a laboratory demonstration, staged under laboratory conditions, and with a staff of laboratory technicians present to see that the elusive image behaved itself for company.

But it showed what can be done in the matters that more directly concern the ultimate consumer. It was in the nature of a dramatic progress report that showed definitely what can be expected in the future.

Co-oxial cables for television networks, short-wave transmission experiments (even into the region of a billion cycles), high-efficiency reproduction units—all are contributing their parts to the ultimate television system. Engineers hesitate to say how soon you will have perfected television receivers in your homes, and when there will be available adequate television programs, but sound progress is being made. And such sound progress is far preferable to a mushroom growth based on scanty technical knowledge; such growth would be bound to end with a dull and sickening thud.—*A. P. P.*

Surely They Stumble . . .

ASSUMING that man's evolution from his ape ancestor has occupied about 1,000,000 years—some now say longer—we may say that as recently as the point 99 percent along his road he had only his own muscles as engines of energy for doing his useful tasks. At about this point—roughly 10,000 years ago—he learned to control and use for his purposes the energy engines of the horse and the ass and the ox, a multiplication of muscle of about ten.

Going on with the same scale, which of course is oversimplified but comes within orders of size or duration, man had lived 99.99 percent of his whole career before he discovered and widely applied the steam engine. Now the horse itself was multiplied by something else.

Finally, a decade or so ago, at about the point in his total history indicated by the fine decimal fraction 99.999, the machine age had brought each individual in this nation control of the energy of something like 30 slaves—some say more.

At about this point in human history something entirely new came into being. Strong-willed individuals — dictators, men plentifully provided with the three lusts of possession, prestige, and power —for the first time came potentially into control of nations, hemispheres, and the whole world. This was made possible through the perversion of the energies made available as never before by science—the energy stored in gasoline and high explosives controlled on an unlimited geographical and instantaneous time basis by those other gifts of science, the telephone and radio. There is danger already that, through this unique combination in history, all our past gains may be reduced to ashes.

Now there is a movement afoot among scientists to multiply man's available might once more by converting the energy of coal direct to power, also by utilizing the power of the sun direct (the dream of atomic energy, far more vast than either of these, having happily vanished). May it not perhaps be wise for man, before making this second great adventure in "playing with fire," to hold off for a while and learn how to digest and control what he has, including his own nature? Otherwise we may discover, before we have added another ten years to our million, that we are suddenly pretty well back toward where we started.—*A. G. I.*

Home Again?

AFTER more than a decade of relegation to limbo, the question of bringing back to this country the original plane of the Wright brothers, first to conquer the air at Kitty Hawk in 1903, has been brought to the fore again. Controversy waged bitter some years ago when the Smithsonian Institution installed as a permanent exhibit Professor Langley's machine which did not fly until after that of the Wrights (and after it was equipped with a different engine). When Smithsonian exhibit-labels and literature indicated that this was the first successful airplane, the Wright machine was shipped abroad and has since been exhibited in the Kensington Science Museum in London.

Chief Justice Charles Evans Hughes will soon be petitioned, in his capacity as Chancellor of the Board of Regents of the Smithsonian Institution, to correct the "historical inaccuracies" of the records so that the Wright plane may be brought home. The organizers of this new effort are well-known aviators, members of the newly incorporated Association of Men with Wings. Their petition is to be circulated throughout the nation to obtain numerous signatures.

It is no exaggeration to say that the situation as it stands today is distorted history. The new Association is correct when it says that the contribution of the Wrights is accepted by scientists and technicians of the world—with few exceptions. And its desire to bring out the true facts is meet and proper, for the Smithsonian is the official museum of the nation, accredited as the historian of our progress. Therefore the aim of the Association to correct the "inaccuracies" which "prevail in Smithsonian papers in the libraries of the world" so that the facts "may be described unquestioned to posterity," is indeed a laudable one. Once these official papers are corrected, an important step will have been taken toward the success of efforts to bring the Wright plane home.

The least said about the old arguments on this question, the better. Recriminations will be useless and in bad taste. Blaming any individual or group for the earlier decision will not help now. The Association of Men with Wings will do well to remember that only a calm appraisal and a judicial attitude will settle the question to the satisfaction of all. —*F. D. M.*

MAN-MADE DIAMONDS

Making Diamonds Synthetically... Difficulties... 90 Tons per Square Inch, 7000 Degrees Fahrenheit... The Experiments Give Every Appearance of Success

IN the past nine years, more than 50 diamonds have been made synthetically at McPherson College, McPherson, Kansas, ranging in size from the smallest, one millimeter (about 1/25 inch) in diameter, to the largest, which is two millimeters by one and one-half millimeters by one millimeter, and weighs 1/30 carat. This is still the largest synthetic diamond on record. Six smaller diamonds were made in the same experiment, in which gum arabic carbon was added to molten iron and the mass cooled in an ice-brine solution.

It is the opinion of Dr. J. Willard Hershey, head of the chemistry department at McPherson Collge, that only technical difficulties stand in the way of the commercial production of diamonds. Dr. Hershey is supervising student work in synthesizing diamonds, with the hope that some day science will discover a method of making larger synthetic diamonds. A great deal of work still remains to be done before diamonds can be produced on a commercial basis.

The diamond is one of the most fascinating forms of carbon, itself one of the most interesting of the 92 elements because of the many forms in which it is found pure and the infinite number of compounds of which it is a component part.

Many attempts have been made to synthesize diamonds. Among the first was that of J. B. Hannay, of Glasgow, who began his experiments in 1879 and, after many trials, is said to have produced some diamonds.

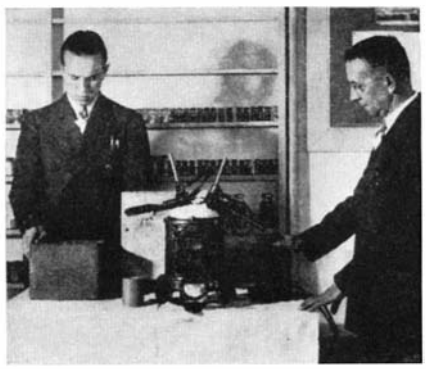
THE most successful of the early attempts was that of Henri Moissan, a Frenchman who, after patient and careful experiments, succeeded in 1896 in obtaining minute particles which he believed to be diamonds. His largest specimens were 3/100 inch in diameter. Moissan's method was to heat carbon and iron in an electric furnace, at a temperature which seldom exceeded 2000 degrees, Centigrade. The carbon was dissolved in the liquid iron and, by cooling this molten mass rapidly, he attempted to change the black amorphous carbon into a diamond crystal by the pressure exerted by the rapidly cooling iron.

In 1923 an article appeared in a McPherson, Kansas, newspaper to the effect that diamonds had never been manufactured and, in the opinion of its writer, a noted scientist, never would be. Dr. Hershey read the article with interest because, secretly, for years, he had believed that someday science would succeed in what then seemed to the best trained minds in the field to be an impossible task. He determined to conduct experiments along lines which he had already thought out. He agreed with the views of Moissan that diamonds were made by the compression of carbon, but he believed that he could improve upon the methods of Moissan.

THE accompanying article is composed of data obtained from McPherson College, through the American Chemical Society. In publishing it, Scientific American does not necessarily concur in all the claims made in it. In the long past, so many of the apparently final successes in this quest have later proved to be disappointments that an attitude of defensive caution, even when not warranted by the facts of any given instance, will perhaps be understandable.

Much time and money have been spent by many scientific men in searching for the true method of making diamonds. Once Sir Charles Parsons, of turbine and telescope fame, carried out many lengthy experiments. Unknown to him at the time, so did Sir Richard Threlfall. Years later the two met. Said Sir Richard to Sir Charles: "Parsons, I don't mind telling you that my diamonds were graphite." Said Sir Charles to Sir Richard: "So were mine!"

—The Editor.



Lewellyn D. Lloyd (*left*) and Dr. J. Willard Hershey. On table (*left to right*): Graphite jar for ice-brine solution, chemically pure graphite crucible, the electric furnace with coils behind it, and power switch

Dr. Hershey outlined a plan of procedure and gave the assignment to senior students working in the chemistry department. The first step in the plan was to secure an electric-arc furnace capable of producing a temperature of 4000 to 5000 degrees, Centigrade—more than twice the temperature obtained by Moissan.

It was soon learned that no such furnace could be obtained from laboratory equipment companies in either the United States or Europe. The use of an oxygen-hydrogen blow torch was next suggested, and the necessary equipment was transferred to a local welding shop for an experiment. However, it was found that the oxygen from the torch burned away all the carbon from the mixture of carbon and iron before the desired temperature could be obtained.

NEXT, Dr. Hershey and his students secured firebrick from a steel foundry and attempted to build their own electric-arc furnace. A neat furnace was constructed, but its first trial proved that its current consumption was too great for the ordinary power lines leading to the college. The equipment was transferred to the municipal lighting plant, where sufficient current could be obtained. Here the furnace was reduced to a glazed mass of molten rock by its own heat. The outlook was very discouraging.

The next five years were spent in gathering equipment and information. At last, a man was found in Chicago who was confident that he could build a furnace of the required type. Special steels were generously contributed by steel companies and after a great deal of work and research, the furnace was completed—a simple affair no larger than a two-gallon pail, but capable of exceeding 4000 degrees, Centigrade. Crucibles and electrodes of chemically pure synthetic graphite were secured for use in the furnace. It was necessary to install a special transformer and a heavy power line, since the power consumption of the

electric furnace was extremely high.

On June 7, 1929, a mixture of two parts of chemically pure iron filings and one part of pure sugar carbon by volume was placed in a graphite crucible, which in turn was placed in the furnace and heated continuously for one hour, seven minutes, after which the crucible was removed and plunged into a freezing mixture.

As white hot molten iron cools to a red solid, it expands. As it cools from a red solid to room temperature, it contracts. Thus the outside surface of the iron, which cools more rapidly than the inside of the mass, is contracting while the inside is still expanding. The carbon which is dissolved in the iron is thus subjected to a pressure estimated at 180,000 pounds per square inch.

The hardened mass of carbon and iron was removed from the freezing mixture and treated with hot aqua regia for 300 hours to dissolve the iron. The residue, mostly amorphous carbon and graphite, was digested as much as possible in various acid solutions. The search for diamonds was then begun in the black carbon dust.

After two days of searching with microscopes, Dr. Hershey and his assistants received the first reward for their labors. Two stones were found, which, after being tested, were sent to the National Bureau of Standards, at Washington, where they were tested again and declared to be pure transparent diamonds of the first quality. These diamonds, although quite small, were the largest synthetic diamonds on record.

SINCE that time, McPherson College chemistry students have continued the experiments under the guidance of Dr. Hershey, using different forms of carbon, different metals as solvents for the carbon, and different methods of procedure.

Some of the solvents recently used, besides pure iron, are meteorite iron, copper, silver, lead, nickel-steel, manganese-steel, tungsten, aluminum, and blue ground from the South African diamond mines. None of these proved to be so suitable as pure iron filings. Carbon did not dissolve in copper. It took about two hours to melt the tungsten because of its high melting point, and by that time most of the carbon was burned away. No diamonds were formed when lead was used. Rather, the lead and carbon seemed to form carbide of lead. Carbon did not readily dissolve in molten silver. When aluminum was used as a solvent for carbon, some hard crystals having the appearance of diamonds were formed, but these would not withstand the tests to which they were subjected. Probably they were carbide of aluminum.

In the diamond mines of South Africa, diamonds are found in a hard blue

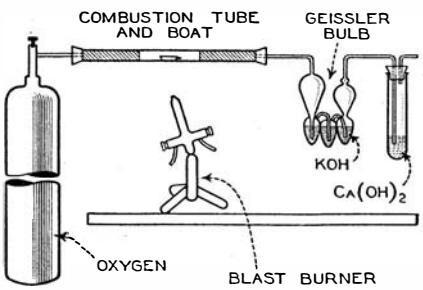
The high-temperature electric arc furnace when in actual operation

ground which may have had some part in forming diamonds in nature. With this in mind, some blue ground was obtained from South Africa and used in an experiment as a carbon solvent. This blue ground worked much like iron until it was treated with acid in an attempt to dissolve it. The mass then became as hard as concrete and nothing more could be done with it.

Recently, other substances have been substituted for sugar carbon, especially gum arabic, since this has a larger number of carbon atoms per molecule. Coal, wood-charcoal, coke, and other forms of carbon were used, but the most successful has been gum arabic.

An ice-brine solution has been used in most of the experiments to cool the hot molten mass from the furnace, but various other methods of cooling have been tried. In several experiments, the fused mass has been allowed to cool slowly to room temperature, but it appears that rapid cooling is necessary in order to form diamonds. In an attempt to secure more rapid cooling, liquid nitrogen and solid carbon dioxide have been used. Neither was satisfactory. The instant hot molten iron was dropped into liquid nitrogen, the nitrogen changed to a gas, immediately forming an insulating atmosphere around the iron which prevented rapid cooling. When solid carbon dioxide was used it was impossible to secure a surface contact which would cool the iron effectively. Many other methods of cooling have been tried, but none has been as effective as the ice-brine solution.

It appears that it is not the extremely low temperature of the cooling agent which forms diamonds, but rather it is



Laboratory equipment used in the burning test for diamond (see text)

the acceleration of the temperature downward; or, in other words, it is the rate of change of the temperature of the molten iron that determines the pressure and the inner contraction of the iron and carbon mixture.

In the nine years since the first diamonds were made, a great deal has been accomplished. The procedures have been greatly improved and shortened. At present the iron from the furnace is dissolved in hot aqua regia. The residue—amorphous carbon and graphite—is digested first in hot concentrated hydrochloric acid with dissolved potassium chlorate, and then in hot concentrated sulfuric acid with dissolved potassium nitrate. Considerable residue still remains. This is washed with water for several days and then searched for diamonds.

Recently a student proposed a new plan which may save a great deal of work. He suggested that, after the residue is washed with water, it be fused with potassium bisulfate, which has a specific gravity between that of graphite and diamonds. This allows the diamonds and a few particles of carbon to sink to the bottom, while the graphite floats on top. After the mass hardens, the diamonds, if there are any, with a slight amount of carbon, can be removed from the bottom of the solidified mass.

THE identification tests used on the diamonds are as follows: insolubility in hydrofluoric acid, hardness, density, index of refraction, and burning in an atmosphere of oxygen. A diamond is insoluble in hydrofluoric acid, although this dissolves most other substances. The hardness of a diamond is tested by scratching on Carborundum. The density is tested in methylene iodide, which has the same density as a diamond (3.51). A genuine diamond will hang suspended in methylene iodide. Diamonds burn in oxygen at 800 degrees, Centigrade.

In the burning test, the specimen is placed in a platinum boat, which in turn is placed inside a silicon tube and heated to 800 degrees, Centigrade, while oxygen is passed in one end of the tube and out of the other end through a Geissler tube containing potassium hydroxide. If the specimen is a diamond it will burn, forming carbon dioxide, which is absorbed in the Geissler tube. A pure diamond leaves no ash in the platinum boat, hence any ash remaining in the boat is positive proof of impurities in the diamond. These impurities are generally metallic oxides and can also be detected by the color of the diamond—a pure diamond is transparent, while impure diamonds are tinted various colors. A number of the smaller diamonds have been burned and most of them left no trace of ash. A number of natural diamonds have also been burned for comparison.

ALPHA URSAE MAJORIS

Recent Research on the Binary Star at the Lip of the Great Dipper Reveals the Orbits of Its Components and Rounds Out Our Understanding of It

By HENRY NORRIS RUSSELL, Ph.D.

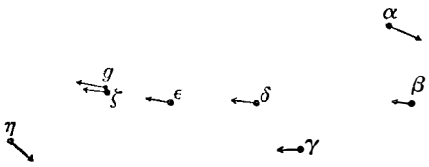
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

EVERYONE knows the Pointers—the stars at the end of the bowl of the Great Dipper whose joining line points (not very closely) to the Pole-star. A careful look at them shows that they are of different colors—the one at the bottom of the bowl, farther from the Pole, is white, and the other reddish. The former, with the other stars of the bowl and handle (except the end), belongs to a well known cluster of stars moving together, distant about 60 light-years. The red star, Alpha Ursae Majoris, is moving in the opposite direction, and is much more distant. The measures of parallax give a value of 0″.022±0.007—which corresponds to a distance of 150 light-years with a margin of error which is as likely as not to be 50 light-years. Despite this uncertainty (which repeated precise measures should diminish) there can be no doubt that this star is really much brighter than the others of the Dipper. Could it be brought to the same distance, it would look about as bright as Capella and would far outshine the rest. Indeed, it has probably about twice the real brightness of Arcturus and considerably exceeds the average for red giant stars.

Almost 50 years ago, in 1889, Burnham, with the great Lick refractor, found that this star was double; it had a companion at a distance of 0″.9, barely visible in the glare of the bright star. From the moment of discovery it was certain that the pair was a true binary, for the bright star is moving in the heavens at the rate of 0″.14 per year, and, if the faint star had not been moving with it, the pair would have been twice as widely separated ten years earlier, and must have been discovered long before.

A FEW years' observations showed that the smaller star was actually moving around the bright one. By 1902 its direction from the primary had changed more than 50 degrees, while its distance diminished, until it became almost impossible to see. Then, despite careful watching by the best observers with the greatest telescopes, nothing more was seen of it for 30 years. Finally, in 1933, Aitken, again with the Lick telescope, saw and measured it once more, very close to the position in which it was discovered. In the 44 years it had completed a revolution; but for most of the time it had been lost in the light of its great neighbor. Since then it has been regularly observed retracing the same path which it followed in the 'nineties.

Were it not for the close proximity of the bright star, the companion would be easy to see. The only *measures* of its brightness were made by Kuiper in 1933, with an ingenious device by which a small and measurable fraction of the light of the bright star could be diverted into a subsidiary image, which could be set at any desired distance from the principal one. By putting this image at the same distance as the real companion, so that the effect of the glare was the same for both, Kuiper found that the companion was of magnitude 4.9, or 1/15 as bright as the primary. The earlier observers had estimated it as very much fainter—of the 9th, or even the 11th magnitude. But these estimates really describe how hard the companion was to see—allowing, by a sort of well-trained guess-work, for the effect of the glare—and the recent measures are, of course, far more reliable. If, then, the companion stood alone, it would be easily visible to the naked eye. It is by no means an inherently faint object. With this assigned distance, its real luminosity comes out 19 times that of the Sun, and that of the primary 280.



Courtesy Ginn and Co.

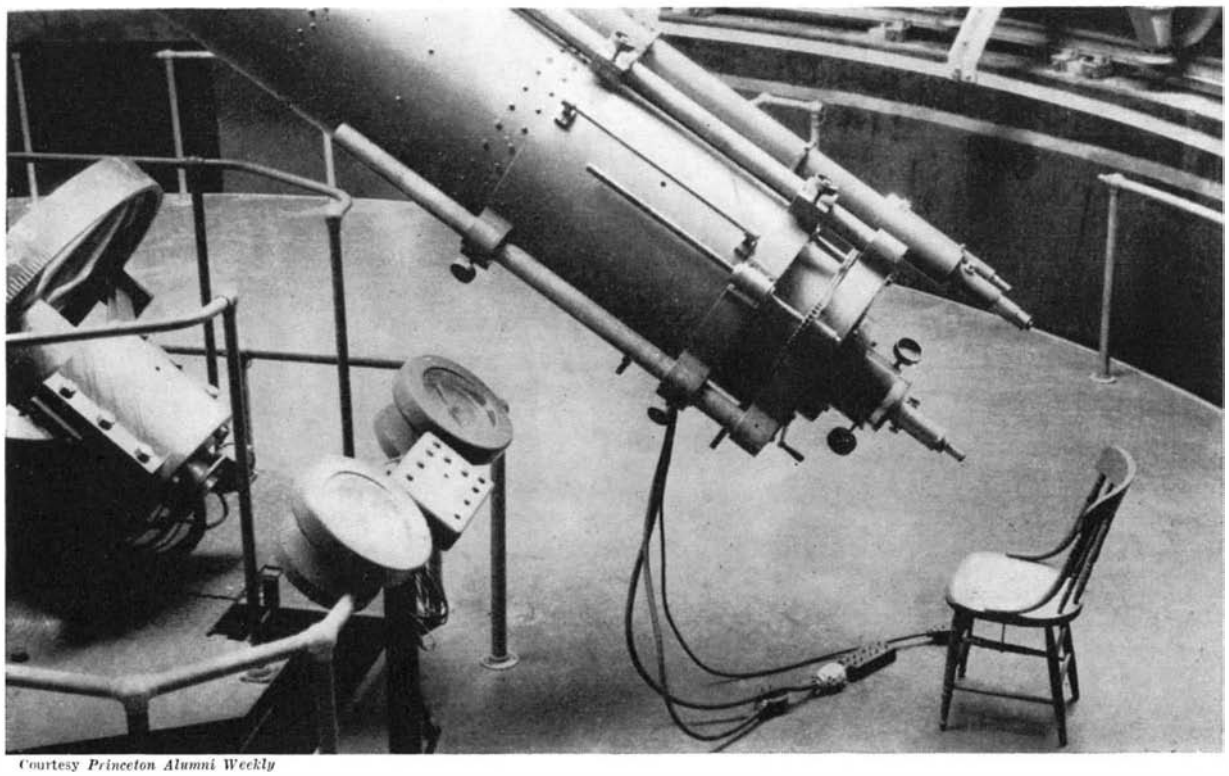
Ursa Major, showing direction of proper motions and amount in the past 50,000 years. From Russell, Dugan and Stewart's "Astronomy"

When a double star has been followed for a complete revolution, it is usually easy to calculate its real orbit. The observations give the apparent orbit of the companion about its primary, but, since the true orbit is usually not seen in plan, but more or less edgewise, allowance must be made for this foreshortening—which can be done in a couple of hours' calculation. But, in this case, the companion was unobservable for more than three quarters of its track. There was no doubt about the period, but only a small part of the apparent orbit could be drawn—not enough to be sure about the rest.

The difficult problem thus presented has been solved by Dr. H. Spencer Jones—the Astronomer Royal—and Mr. H. H. Furner of the Greenwich staff. Two other sources of knowledge were available—the meridian observations of the star, and the radial velocities.

Since Newton's day it has been known that, in such a pair, the center of gravity of the two stars moves uniformly, while the two stars describe orbits about this point, keeping on opposite sides of it. Accurate observations of the right-ascension and declination of the principal star should therefore show, in addition to the uniform motion, a regular oscillation, repeating itself in a period of 44 years. By good fortune this is one of the "clock-stars" which are regularly observed as standards, so that thousands of observations have been recorded and published, dating from 1806 till the present time.

TO eliminate various possible errors, the observations of Alpha Ursae Majoris were compared with those of a number of other bright stars, taken at the same observatory and with the same instrument. Each particular set of observations gave values differing slightly from those calculated with the aid of Boss's Catalogue—the differences arising partly from instrumental errors and partly from real causes. By taking the difference between the discordance for Alpha Ursae Majoris and the others, a great part of the instrumental errors was cleared out. In this way 114 positions in right ascension were obtained, and 96 in declination—each representing the mean of a large number of observations. When these were plotted, after allowing for uniform motion, a wavy displacement, with a period of about 44 years, was clearly shown.



Courtesy *Princeton Alumni Weekly*

The 23-inch refracting telescope within its observatory dome at Princeton University. The objective lens is one of the famous Alvan Clark's unexcelled (in fact, unequalled) creations, but the mounting is a recent one by Fecker. The objective was designed for visual use. In a telescope designed for photographic use, varieties of glass having different compositions are selected from which to make the two lenses of the objective, also their surfaces are given curvatures, such that the shorter wave-lengths—violet and blue—because these are the most photo-sensitive, will be brought to the same focus. For visual work such a telescope is, however, practically useless, and the aim is to bring the whole gamut of rays from the violet to the red, as nearly as possible to one focal distance

As the bright star moves around the center of gravity, its velocity of approach toward the Sun must change. A long series of observations at the Lick Observatory, for the last 40 years, were available—partly from previous publications, partly sent to Greenwich as a friendly contribution to the work. They, too, show a slow oscillation, running its course in about the 40 years covered by the observations. By combining these three sets of data, Jones and Furner—after a skilled and laborious study—have succeeded in calculating an orbit which represents all the data.

The mean distance of the stars in the true orbit is 0″.63, corresponding, with a parallax of 0″.022, to 29 astronomical units, or a little less than Neptune's distance from the Sun. The eccentricity of the orbit is 0.35 and the inclination to the "plane of the sky" is 18 degrees. The stars were closest together in 1910, and are at present returning from their maximum separation. Since the inclination is small, the range in radial velocity is also small—only two kilometers a second on each side of the mean value.

With the period of 44 years, the combined mass of the pair comes out 12.4 times that of the Sun. The mean distance of the bright star from the center of gravity is 0″.196, 31 percent of this separating the components. It follows that the mass of the companion is 31 percent of the total, or 3.8 times the Sun's, while that of the principal star is 8.6. Both these values are in good agreement with Eddington's relation between mass and luminosity, which is thus once more confirmed, though with no great accuracy, as the parallax is too small to be directly measured with high percentage accuracy.

This fine piece of work leaves this star one of the best known in the heavens—and one of the most interesting. It is the first red giant star (Class K0) for which we have a visual orbit, and a directly measurable mass. The only other giant for which we have these is Capella, which is of Class G0, at the very end of the sequence of giants, while Alpha Ursae Majoris is in the middle.

ASSUMING, with Jones and Furner, a surface temperature of 4000 degrees, we find that the bright star should give out one eighth as much light per square mile as does the Sun. Being 280 times as bright as the Sun, its surface area would be 2200 times as great, and its diameter 47 times the Sun's—as big as Mercury's orbit. Its volume is 100,000 times the Sun's, and its mean density 1/12,000 the Sun's or a little less than one tenth that of air under standard conditions. These are just such values as we now expect for a giant star, but the direct confirmation is nevertheless important.

The companion, with its mass nearly four times the Sun's and its visual brightness some 20 times, is very far from being a dwarf star. Jones and Furner consider that it is probably itself a giant star, of spectral type much like the primary, but perhaps a little redder. It would be considerably fainter than the average giant star, but would fit very well with the fainter group called by Strömberg the sub-giants. The only objection that could be raised to this is that, when a red giant star has a companion, considerably fainter, far enough away to permit its spectrum to be observed separately, the companion is almost always of early type (Classes A or B). A hot star of the same mass would be brighter visually, and fit the observed data less satisfactorily—though perhaps within their limits of error.

Whether the companion is actually of early or late spectral type might be determined by photographs of the farthest accessible ultra-violet end of the spectrum. If the companion is of Class K, like the primary, its spectrum would be completely drowned out; but if, like that of Zeta Aurigae, it turns out to be of Class B, it should be as strong as the primary.

Such observations, and also additional series of measures for parallax, should add a little more to our information regarding what is already one of the best-known systems in the sky.—*Chamonix, July 1, 1938.*

Fish Over a Dam

Bonneville Dam... Many Novel Features... Generates Power... Extends Inland Waterways... Greatest Fishways... Fish Can Go Upstream or Down

By R. G. SKERRETT

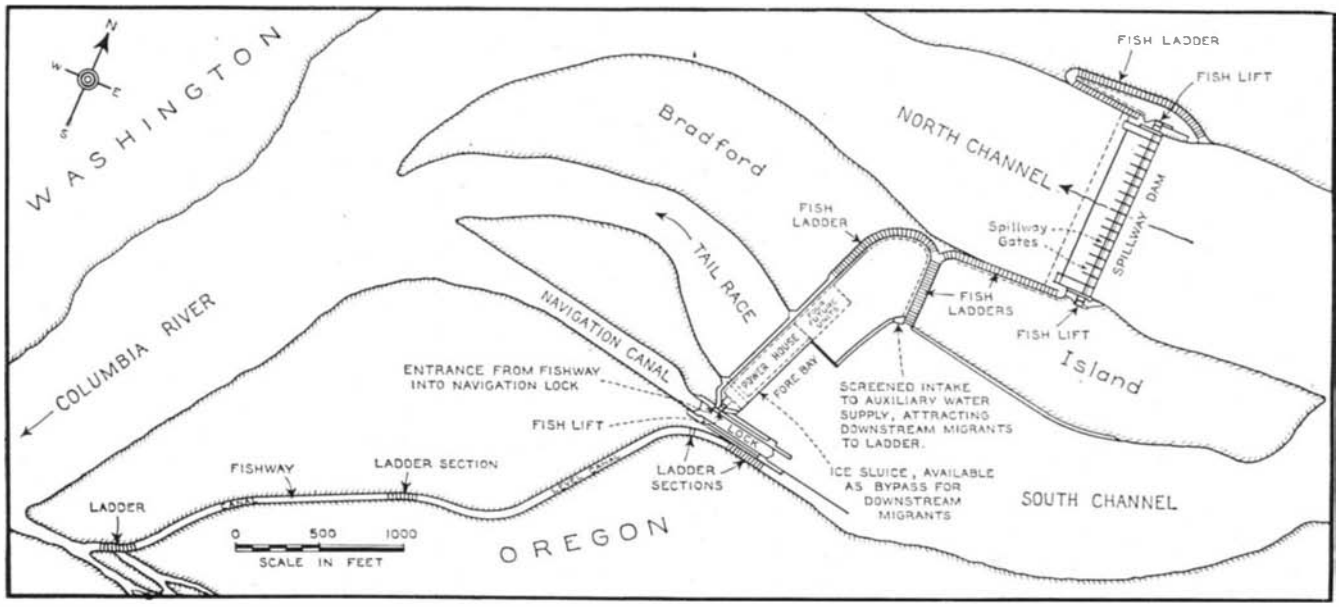
SAFEGUARDING the salmon fisheries of the Columbia River system; generating more power from the seaward flow of the main stem of that magnificent stream; and extending the inland penetration of deep-sea shipping constituted the threefold problem that had to be solved in the planning and the building of the Bonneville Dam, lately completed.

Probably the protection of that river's historic salmon fisheries is the aspect of the undertaking that makes the widest popular appeal, because the Columbia is said to be the greatest of the salmon-producing rivers in the United States. Quite apart from self-interest in what salmon from that source have contributed to the satisfaction of our palates and to our physical well-being, the catching, packing, and otherwise processing of salmon have netted those engaged in the industry an annual return of about $10,000,000. Because the Bonneville Dam is strategically placed at the uppermost reach of tidewater on the Columbia, that structure occupies a key position in the path followed by perhaps 75 percent of the salmon in their accustomed migration to and from the sea. To halt or seriously to reduce those movements would directly affect the gainful employment of more than 21,000 persons. The aquatic biologist, other fisheries experts, and the engineer were therefore called upon to pool their knowledge and experience, and, with the further aid of research, to devise man-made facilities that would lure the salmon to new lines of travel past the dam, despite the interposition of that barrier.

Even at low stages, the Columbia River has a large volume of flow; and because of the snow-clad mountain sources of most of its water, the volume at flood stages is enormously increased. Nevertheless, ocean-going ships have not heretofore been able to ascend the river higher than Vancouver, Washington, 103 miles inland from the Pacific, or to Portland, Oregon, on the tributary Willamette River, 114 miles in from the sea. Those two ports, however, have a maritime commerce of fully 6,000,000 tons annually, with an estimated value in excess of $300,000,000. Above Vancouver, and within the tidal section of the river, light-draft vessels have moved yearly about 2,000,000 tons of freight; barges have been operated heretofore for some distance above the site of the Bonneville Dam, carrying in the course of a year approximately 85,000 tons of freight valued at more than $1,500,000.

BONNEVILLE Dam is 144 miles above the mouth of the Columbia and about 41 miles upstream from Vancouver. At an outlay of $2,300.000, a channel 300 feet wide and 27 feet deep at low water will soon be available throughout that stretch of the river. Above the dam, for approximately 50 miles, there is now ample depth of water for steamships of large capacity to continue on to The Dalles, nearly 190 miles from the sea. The improved route for shipping will lead to an annual carriage of possibly 2,300,000 tons of freight, which it is estimated can thus be transported at a saving of 40 cents a ton.

Unquestionably, the prime reason for the Bonneville project is the generation of hydro-electric energy to be sold at a notably low price, first to benefit a largely rural and agricultural population and then to serve existing communities within economical distributing distances. Eventually, cheap power is counted upon to draw a variety of industries to the region, on both the Washington and the Oregon sides of this boundary river. At the present time, the power plant is equipped with two main generating units, their turbines developing an average of 60,000 horsepower each. As the demand for current increases, additional units will be installed until the group numbers a total of ten; and at certain



General plan of the Bonneville Dam power-navigation project. Note especially the various fishways

stages of the river those turbines will have a combined output of 660,000 horsepower.

It should be recalled that Bonneville Dam is at the downstream end of a stretch of the river within which it is expected that ten dams will some day utilize to the utmost a drop of nearly 1290 feet between the Canadian boundary and Bonneville. With all ten plants provided with their designed maximum number of units and making full use of the river's abundant flow, the numerous turbines will be able to develop in excess of 11,000,000 horsepower! Well may the Columbia be called a wonderful river and the neighboring region exceptionally favored in its power potentialities.

The Bonneville development is composed principally of four distinctive features: a spillway dam that spans the main or north channel of the river; a second dam and combined power house, which blocks the lesser channel of the river (Bradford Island standing between the two dams); a large ship lock along the south side of the power house and contiguous to the Oregon shore; and a number of fishways, of two different designs, located at various parts of the dams where the migrating fish may seek passage, when bound either upstream or downstream, as habit urges them.

Courtesy U. S. Bureau of Fisheries

Salmon catching on the Columbia

The spillway dam has an over-all length of 1250 feet; between the terminal abutments, the intervening space is divided into 18 passages or bays by a succession of massive piers, spaced equidistant, which support 18 steel vertical-lift gates. All the gates are 50 feet wide, but 12 of them are 50 feet in height while the three flanking ones at each end of the spillway are 60 feet in height. When closed, or resting on the crest of the spillway, the gates will hold the pool above the dam at its maximum normal level, which is 82.5 feet above the sea; the gates will be raised to different heights, to let water run beneath them over the spillway, to regulate the level of the pool according to the volume of the stream's flow. At exceptional flood stages, all the gates may have to be raised to their full extent to let the excess water move with a maximum of ease on its course to the sea. The discharge of the river past the dam site may range from 40,000 cubic feet per second to a recorded extreme of 1,170,000 cubic feet per second. The ordinary rise and fall of the river between low water and high water is 21 feet, but the extreme fluctuation may be as much as 47 feet. This explains why the spillway has so many and such large gates, because they serve both to impound water and to act as safety valves under flood conditions.

The normal operating head at the water wheels is 66 feet, and the plant is classed as a low-head one in hydro-electric practice; but because of the marked fluctuations in the level of the river and the great extremes in volume of flow, the engineers adopted the Kaplan type of turbine, in which the angle of the blades can be changed to make the most satisfactory use of the water delivered under any condition of the river at the dam site. Each of these water wheels has a diameter of 23 feet four inches, and is of much greater power than similar units in service elsewhere. Each turbine drives an electric generator rated at 48,000 k.v.a; both the water wheels and the electric generators are engineering achievements of an outstanding order.

THE ship lock has a chamber width of 76 feet and a length of 500 feet; and the depth of water at the lower sill, or entrance, is not less than 26 feet. The lock is a single-lift structure, and at one operation can lift or lower a craft through a maximum vertical distance of 67 feet—an extraordinary performance.

The Columbia River is frequented by four species of salmon and by the steelhead trout, of which the chinook salmon is the most important. All these fishes spawn in fresh water, but spend most of their adult existence in the sea. Female steelhead trout are known to return annually over a period of several years to fresh water to reproduce their kind; but the full-grown salmon makes but one run from the sea to its fresh-water breeding ground, and dies shortly after spawning. The eggs are deposited in the gravel of the chosen spawning bed, and hatch in the course of from two to

To Aid an Important Industry

THE Bonneville Dam will prove to be a blessing instead of a curse to the fisheries of the Columbia River.

This statement is so challenging and so contrary to common belief that it bears examination. Bonneville Dam, located on the greatest salmon-producing river in the United States, is a 70-foot barrier of steel and concrete which must be surmounted by a large portion of the salmon runs seeking their ancestral spawning grounds in the upper tributaries of the Columbia, throughout Oregon, Washington, and Idaho. Failure to surmount this dam will destroy a 10-million dollar fishery.

Before the dam was built, however, the Columbia River fisheries were undergoing progressive depletion. The commercial fishery in the lower estuary of the river and at sea always takes a heavy toll from the stock, and those fish that escape this hazard encounter many minor dams used for power, irrigation, and other industrial purposes throughout the watershed. Many of them prevent the access of fish to their spawning areas. The waters of the river are also used for irrigation, and many tributary streams have dried up during low-water periods. Many of the irrigation canals are still unscreened and carry untold thousands of young salmon to their death in the fields. The pollution of streams by mining and manufacturing wastes, the erosion of deforested hillsides, and changes in the river course still further restrict the productive capacity of the Columbia River watershed. All of these conditions must be corrected.

The last session of Congress authorized an appropriation of half a million dollars to enable the Bureau of Fisheries to perform this task. Such action may never have been taken had it not been for the impressive dramatization of the hazards to Columbia's salmon by the construction of Bonneville Dam; hence the dam is a blessing!

Adult fish are using the Bonneville Dam fishways without delay, and young salmon are finding their way downstream through special fingerling passes. Accurate counts of each species of fish passing through the fishways are kept by trained enumerators. Now, for the first time, the number of fish caught by the commercial fishery and also the number passing Bonneville Dam to reproduce will be known. A system of bookkeeping can, therefore, be established that will show year by year the available balance of Nature's legacy held in trust for the future under the stewardship of the State and Federal Governments.—*Frank T. Bell, U. S. Commissioner of Fisheries.*

Courtesy Chief of Engineers, U. S. Army

Looking westward (downstream) from above Bradford Island. These fish ladders are on the island between the main dam (not visible—at right) and the power house at the extreme left

four months. Some young salmon migrate seaward shortly after hatching, while others may remain in fresh water a year or more before making their way to the ocean. The young salmon, commonly known as fingerlings, are from three to six inches long by the time they issue from the mouth of the Columbia. After reaching the Pacific, the salmon wander in schools in quest of plankton organisms and the small fish upon which they thrive; they grow rapidly during their stay in the sea, which, depending upon the species, may be from three to six years. While in the ocean, some Columbia salmon journey as far northward as the waters of Alaska before returning to the river to complete their life cycle. On their run up the Columbia, perhaps hundreds of miles, the fish do not feed but utilize the energy stored up in their fat, matured bodies to carry them back to the spawning area in which they were hatched. This urge is so strong that the fish may exhaust themselves and perish if untoward conditions hamper their progress.

SALMON invariably travel water courses swept by fairly strong currents, and the force of the current has a guiding influence in leading the salmon, going up or down river, to paths favorable to their advance. This well-known fact had to be given due consideration in planning the fishways at Bonneville. Salmon of one species or another are ascending the river almost continuously from about April to December of each year. On the other hand, the young of some of the species are found on their oceanward migration virtually throughout the whole year. Therefore special fingerling passes are provided at the Bonneville Dam: one at each end of the spillway and one at the south end of the power house—the latter connecting with the ice chute and receiving an overflow from the entire face of the power-house dam. The fingerlings may even descend through the spacious draft tubes for the turbines with comparatively little risk of injury in going by the water wheels which make only 75 revolutions a minute.

The mature salmon, bound upstream, present a radically different problem in getting them safely past the dam. Full-grown chinook salmon may weigh as much as 70 or even more than 100 pounds, but the average is 22 pounds. The blueback salmon may range from two pounds to six pounds in weight, and be from 16 to 22 inches in length. The steelhead trout may weigh as much as 30 pounds; neither the adult salmon nor the steelhead trout can ascend through the overflow water at the spillway.

Extensive experiments made separately and conjointly by the Army engineers, fisheries experts of the states of Washington and Oregon, and the United States Bureau of Fisheries furnished the basic data for the fishways built at the Bonneville Dam. In that way was obtained reasonably precise information about the velocities, eddies, and the turbulence of the natural water courses threaded by salmon and steelhead trout en route to their different spawning beds; it was thus possible to devise for Bonneville artificial settings that would subscribe to the inherent requirements of the fish, lure them, and then get them up and over the dam without exhausting them. The fish are attracted to the fishways by maintaining at the entrances of them outflowing streams of water having velocities such as those against which salmon and steelhead trout are accustomed to swim.

The structures at Bonneville are too complicated for a detailed description here, but in the main they consist of four fish ladders, three collecting traps, and three sets of double fish locks or hydraulic lifts. Each fish ladder is a walled channel or sluice, with transverse partitions of suitable height and proper spacing to create a succession of stepped pools, each 16 feet long and with a drop of one foot between its adjacent pools. Each ladder is about as wide as an ordinary four-lane highway; there is thus assured ample depth and plenty of room for many thousands of salmon to work their way up and over the dam daily through any one of these so-called ladders. At each end of the spillway, on the downstream side, there is a collecting trap so arranged that the fish can enter easily but are checked from retreating afterwards. These traps connect directly with their respective fish ladders; their primary function is to draw the fish to them by discharging streams of agreeable velocities and, in that way, discouraging the fish from exhausting themselves by battling with the higher and much swifter spillway overflow. The collecting traps are so placed that the fish after once entering them can make use of either the ladders or the nearby hydraulic lifts.

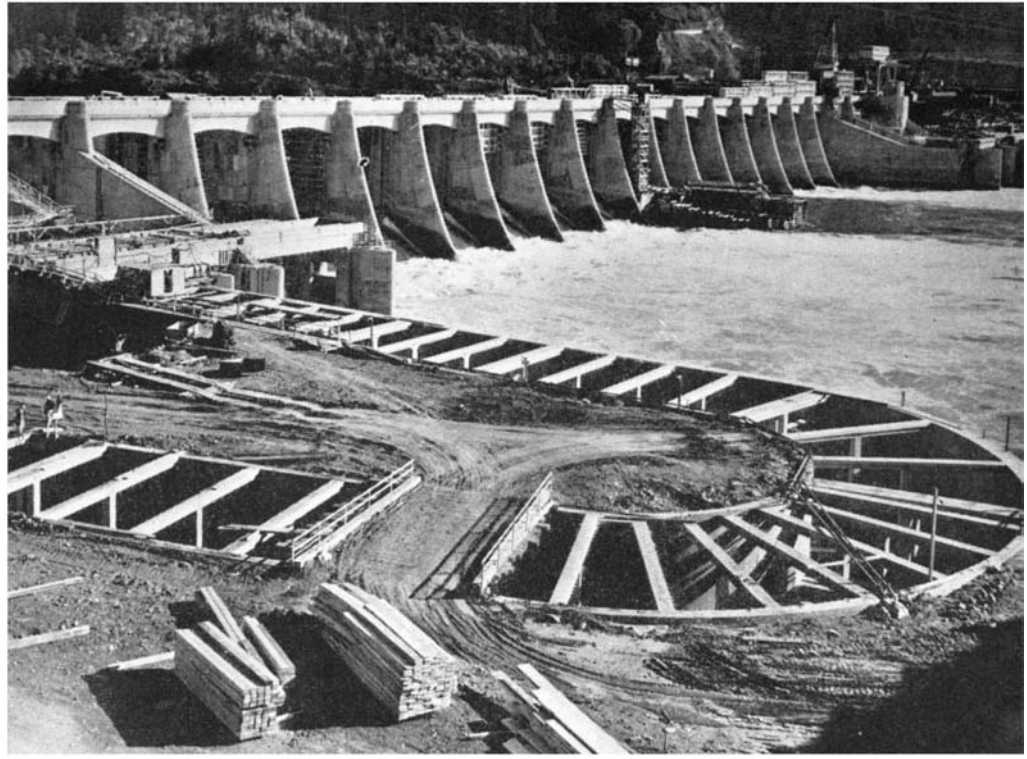
Courtesy U. S. Bureau of Fisheries

Fine adult male blueback salmon in spawning condition, caught by a government expert

On the downstream face of the power house, and built into that structure, there is a much larger collecting trap. That trap leads to a fish ladder at the

north end of the power house, while at the opposite end the trap affords the fish admission to a lift lock or to the neighboring ship lock. In any case, the great collecting trap is designed to draw the up-bound adult fish away from the turbine draft tubes and to make it possible for the fish to reach the pool above the dam and to continue thence to their respective spawning areas.

In simple terms, the hydraulic lifts are large rectangular shafts, with reinforced-concrete walls, which have openings, at various levels, both for the admission and the escape of the fish. These passages can be opened and closed as required; and sufficient water is admitted to a shaft to carry the fish from the intake level up to the pool level—a movable grating floor rising beneath the fish and causing them to flee from the shaft at the proper time. The column of water in each of the twin shafts is alternately raised and lowered to transfer succeeding lots of the fish.



Courtesy Chief of Engineers, U. S. Army

Downstream side of the main dam at Bonneville, viewed from the north, or Washington, side. U-shaped canal in foreground is the concrete channel of the northernmost fish ladder

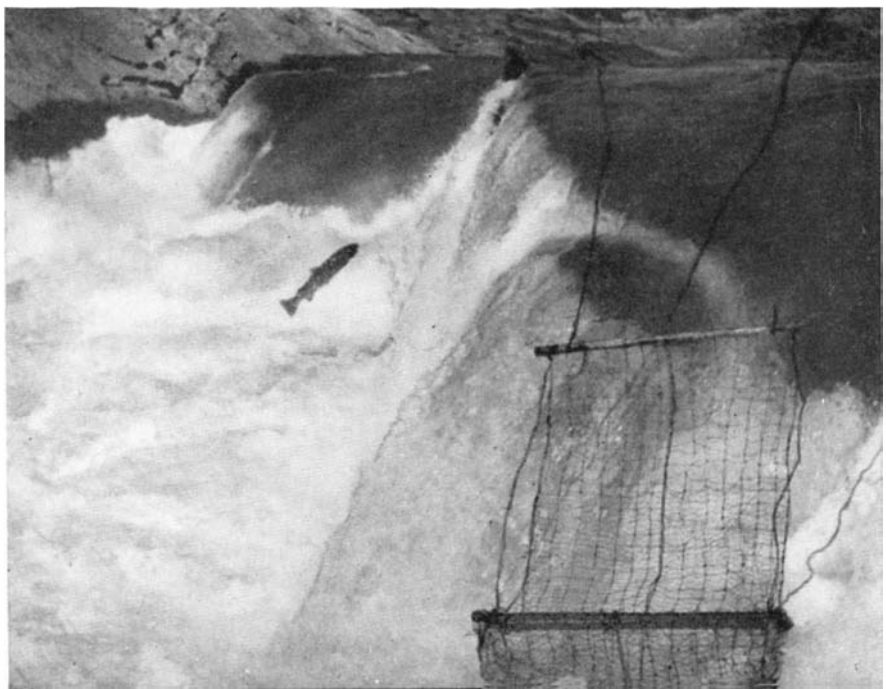
THE fishways at Bonneville Dam have cost about $6,553,000; the installation stands unique in its diversified and rounded features. It is undoubtedly the greatest thing of its kind reared anywhere up to date. The success of these fishways is a matter of world-wide interest, and it is recognized that they constitute an immense experiment which may be a conclusive solution of one aspect of our problem of food supply.

In designing Bonneville Dam, provision was made simultaneously for the incorporation of fishways; during the actual construction of the dam care was taken to leave ways open for the upstream and downstream migration of the salmon and steelhead trout, so as not seriously to disrupt their established habits. In the case of the Grand Coulee Dam, also on the Columbia River, the ultimate height of that structure and other circumstances will make it economically impracticable to provide fishways there. The number of salmon and steelheads normally spawning above the site of Grand Coulee Dam is not believed large; and the Government experts estimate that only 3.5 percent of the total run of spring chinooks, 13 percent of the bluebacks, and but 1 percent of the steelheads ascend the river above Grand Coulee. A passage still remains in the Grand Coulee Dam through which the fish can move up- and downstream, and other provisions will be made to compensate for these movements when that opening is closed.

The solution proposed by the qualified authorities is to capture the fish on their spawning runs at the existing ladders in operation at the Rock Island Dam, which is about 150 miles downstream from the Grand Coulee Dam. The adult fish will then be transferred to holding ponds on the Wenatchee River and Icicle Creek—tributaries of the Columbia—where the fish will be kept until they are ready to spawn. Spawning will be induced artificially in accordance with the usual hatchery procedure, and the young will be planted in tributary streams that have their confluences with the Columbia at points between Rock Island and Grand Coulee. Experiments have disclosed that mature salmon have an instinctive urge to return to the waters in which they were hatched—not necessarily to the original place of spawning. It should, therefore, be possible to change their habits so that the fish that have heretofore worked their way to the waters above the Grand Coulee site will, in succeeding generations, establish themselves in suitable streams that will be accessible to them below Grand Coulee Dam. Only time will reveal whether this can be done, and at a compensating cost.

A steelhead trout leaping up and over a cataract on the Columbia on its way to its spawning area. In this way both trout and salmon surmount fish ladders

Courtesy U. S. Bureau of Fisheries



Whatever doubts may have been entertained concerning the probable usefulness of the fishways at Bonneville Dam were completely dispelled by the action of the salmon during their upstream migration last spring. During that migration, trained checkers counted the fish passing upstream for several weeks. While their early reports showed a relatively small number over the Dam, indications are that the run was smaller than usual, for at no time was there any congestion of fish at the foot of the Dam. There is no question that the salmon made the fullest use of the fishways, and it is believed that what has been done at Bonneville emphasizes the possibility of protecting valuable fisheries in other inland waters.

ELECTRICAL RHYTHMS

From What Abysm of the Human Brain Come These Electrical Pulses, Our Brain Waves? Puzzled but Deeply Intrigued, Science Seeks Their Meaning

(In Two Parts—Part One)

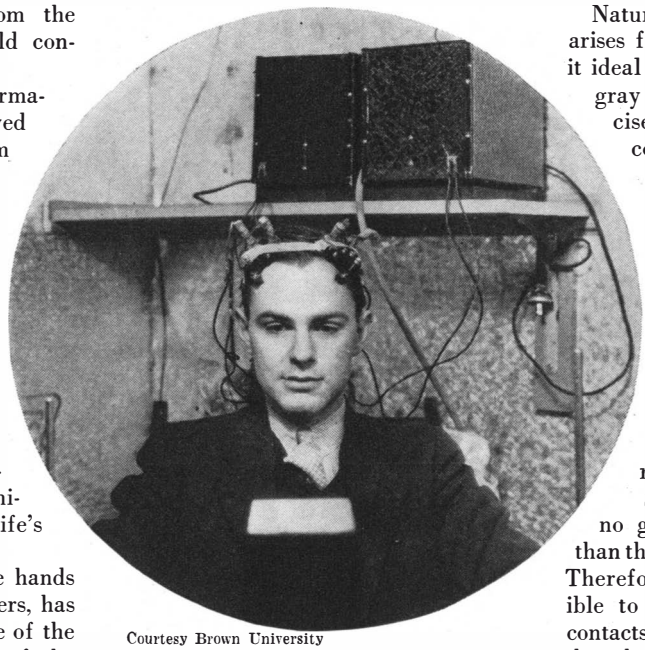
THE discovery of a new phenomenon, particularly of the brain, may have so unexpected a character as to be long incredible to seasoned investigators. In 1928, Dr. Hans Berger, of Jena, reported that it is possible to show and record a quite strange electrical rhythm of the human brain. Scepticism endured for years, so great were the implications of his report.

Electrical waves surging from the brain! What true scientist could conceive of such a phenomenon?

At last, however, repeated confirmation by eminent physiologists proved beyond doubt: The Berger rhythm is a reality, and immensely important.

Borrowing a vacuum tube, Berger built an amplifier powerful enough to magnify weak electric impulses a million-fold. Adrian, the great English physiologist, explains that such a superlatively sensitive aid as the electric amplifier means as much in the detection of life's physico-chemical activity, or physiology, as the invention of the microscope in the detection of life's architecture, or anatomy.

This powerful amplifier, in the hands of Berger and later of many others, has disposed of the old, static picture of the brain. Today, a motion picture of the true, the dynamic, brain can be exhibited as a fascinatingly novel mystery, far grander than the old. And already features of this cinema are being practically applied to common but heretofore completely baffling medical problems, such as epilepsy, man's fitful malady. New clues there are to insanity, too.



Courtesy Brown University

From electrodes on the subject's head, wires lead to an amplifier and the output of this is made observable in one way or another

BERGER attached his radio-like amplifier to a living human head. As his subject became calmer, a phenomenon leaped into scientific records. Pulses of electricity, shooting out from the gray matter inside, pierced skull and scalp. These waves beat out a rhythm in the detector, and the concept of the ever-restless brain was born.

In a simple, sample hook-up, two wires run out from the amplifier. At the end of each wire is a contact point, or electrode—often a pad moistened with salt solution, so that intimate electric contact is effected between wire and scalp. One electrode may be fixed by paste to the skin of the high forehead, and the other to the scalp at the back of the head.

Through these contacts and their wires, the brain-induced electricity is sent to the amplifier, which magnifies the delicate rhythm. The amplified surges can then be made to operate a pen which traces the waves on moving paper tape. The tape slides past at a steady rate—a few feet per minute—and upon it a second pen, part of an electric clock, notes the seconds. Thus, the count of waves per unit of time is accurately told off before the eye, and thus the Berger rhythm of the living human brain becomes a clear record in black and white.

In other hook-ups, several sets of electrodes and of amplifying devices are used to give simultaneous recordings of the waves from different portions of the brain—the contacts are variously placed on the scalp. Further, some amplifiers use an oscillograph in which a light beam is used as a pencil to write the wavy record upon a moving photographic film. Also, the cathode-ray oscillograph can be introduced to cast upon a small screen a visible, immensely magnified, standing undulation representing the electrical state of affairs below the scalp at a given moment.

Whatever the hook-up, the assemblage of instruments is an electro-encephalograph. And the record—tape or film—is an electro-encephalogram, or E. E. G.

Naturally, since the Berger rhythm arises from the brain, investigators find it ideal to place the contacts as near the gray surface as possible—best precisely on the brain's gray coat, or cortex. There are, however, no reports of human heads being broken for such research.

But needle contacts have been used, infrequently, instead of moist pads, and made to penetrate the scalp and meet the bone. Thus, slightly stronger waves are drawn off. Once or twice, brains exposed through injury have been available, and still stronger waves recorded.

Still, rhythms so obtained have no greater regularity of occurrence than those obtained from the intact scalp. Therefore, in the main, it has been feasible to use intact human heads, with contacts merely stuck to the outside—though shaven spots approximately the size of a cent are usually considered indispensable aids to research.

GUINEA pigs, rabbits, cats, dogs, and other creatures exhibit similar rhythms. Hence physiologists are not too impatient for the next great war's magnificent production of experimental material.

The electric pulses from the surface of the brain—that is, from the cortex, gray layer of nerve cells—constitute a comparatively strong rhythm, called the "alpha" rhythm, with a beat of about ten waves per second in man. There are, besides, other oscillations from deep within the brain. Concerning these more rapid and far weaker, almost undetectable waves, little is yet known. Surely, however, from the deep, central portion of the brain emerges the constant electric chugging known as "beta" waves, with a frequency of 25 to 30 waves per second. At present, when brain waves are popularly spoken of, alpha waves are almost invariably meant.

In the instance of the alpha waves, Berger points out the necessity for the complete exclusion of outside stimuli—if successful recording is the aim. The work of others, however, shows that outside disturbances do not invariably in-

OF THE HUMAN BRAIN

By BARCLAY MOON NEWMAN

terrupt the rhythm, though the waves are usually interrupted or abolished by light on the eye, by embarrassment, anxiety, and intense mental activity, as in the attempt to solve difficult problems in a hurry.

Hence, in ideal experimentation, the subject is induced to sit or lie down, and to relax, in a dark room—despite the fact that the rhythm generally appears anywhere and at any time, when a person merely closes his eyes.

The subject has been calmly resting in the dark for only an instant. The waves start up. They appear in broken series, or wave "trains" with brief intervals in between. Generally they run through their rhythm in from 1 to 30 seconds, and stop, only to start again after a minute or two.

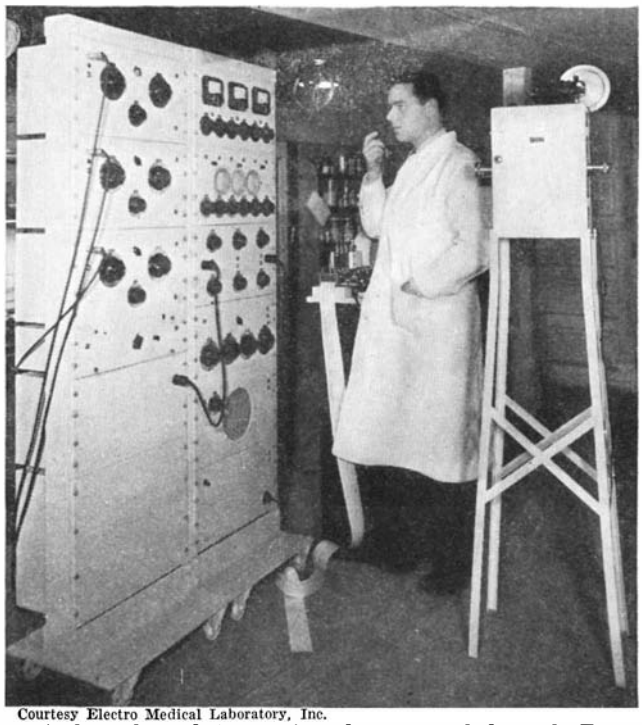
To human vanity, the recorded rhythm looks too simple to come from that vast and intricate fastness, the human brain. Very similar waves may be produced if you take a pencil and draw a wavy line between two points three or four inches apart.

A light shone in the eye almost invariably puts an end to the waves. But persons have been found who readily exhibit alpha waves even when illumination is striking the open eye, though their waves are stronger in the dark. Besides, any one will weakly manifest the phenomenon during exposure of the eye to light—provided that he has been lying quietly at rest for more than two hours.

Adrian predicted that blind people would not have the Berger rhythm. And he could find no rhythm in three blind individuals. Investigators Loomis, Harvey, and Hobart, however, demonstrated that the blind do show the waves. Adrian's subjects were undoubtedly ill at ease.

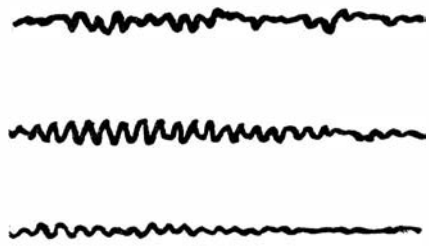
Many persons, before becoming accustomed to the electrodes and to the laboratory environment, do not have alpha waves. It may be an hour or two before the subject overcomes his mental unrest and permits his brain rhythm to appear.

A relaxed subject, showing strong waves, is given a difficult mathematical problem to solve quickly by purely mental effort. The resultant mental unrest largely inhibits, or wholly destroys the waves, as does any intense concentration. But poetry can be recited, or simple problems worked, or skilled hand movements performed, and the waves continue.



Courtesy Electro Medical Laboratory, Inc.

A three-channel, integrating electro-encephalograph. To localize the point of origin of the electrical waves generated by the brain, trace their progress, and map out the pathways of the nervous system, several separate amplifying systems are operated simultaneously, using electrodes on different parts of the head. Three sets of waves, like those shown below, show on oscillograph screens at breast height and may also be photographed by continuous-record automatic camera at right. Below, at center, is a short series of alpha waves from the cortex—beginning small, increasing, diminishing (spindle)



Two subjects, who usually had "good" waves, for a time had "poor" waves. Tactful inquiry elicited the information that, in one case, an important football game —no less—was approaching; in the other case, a secret engagement was playing havoc with the Berger rhythm.

An excessively self-conscious subject or one who is in some way embarrassed is likely to yield waves only spasmodically if at all, under experimental conditions. Loomis, Harvey, and Hobart mention a person who can abolish his waves by self-inducing a "phantasy of fear." The same workers remark upon the seemingly spontaneous interruption of the waves every few seconds. Are there periodic surges of emotion welling from some abysm of the brain? Here is an unknown. Or does an individual every few seconds become more alert, more tense, so that the waves are interrupted? A sudden loud noise, or any startlement, abolishes the undulation. And the stimulus of pain, suddenly felt, kills the phenomenon. Finally, deep anesthesia or normal slumber can make it sleep.

A REMARKABLE experiment is the conditioning of the response to light. The subject is sitting relaxed in the darkened chamber. His alpha waves are blithely writing their record with pen and ink, or with luminous pencil. So that the subject will not be startled, he is forewarned: then a bell is tapped. Unaffected, the vibrations continue on their happy way across the moving tape or film.

But now, several times in succession, simultaneously tap the bell and flash a light upon the subject's open eyes. At each flash, as we expect, the rhythm dies; and, a fraction of a second after the renewed descent of darkness, it comes to life again.

Following the association of flash with sound, tap the bell, but do not flash the light. Immediately, as though light struck the retina, the vibrations halt. From now, and for some little time, the association of light with sound endures within the brain, for sound alone can kill the waves. The response of the subject has been temporarily conditioned.

Further, Loomis, Harvey, and Hobart have, interestingly enough, looked into the matter of hypnotic "blindness." Temporary "blindness" can be induced by hypnotic suggestion, after a subject's eyes have been fixed open by means of adhesive.

"You are blind," the hypnotized subject is told, and whether or not light is

Courtesy Brown University

Prof. H. H. Jasper of Brown University and Prof. Leonard Carmichael of the University of Rochester viewing an oscillograph showing typical brain waves

shining in his eyes, alpha wave trains come along.

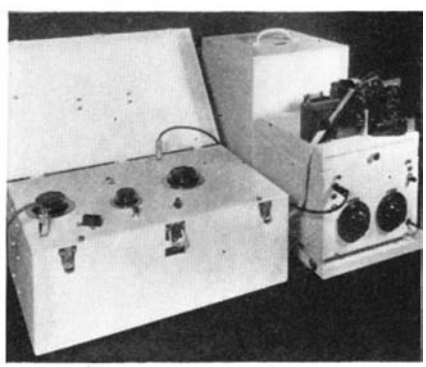
"You are not blind. You can see," it is next suggested. Each time such a suggestion is made, the waves cease, even amidst complete darkness.

And—equally remarkable—as these three physiologists discovered, the alpha rhythm of an unhypnotized subject in a dark room disappears upon the suggestion that he sees a light or a face. But trains cannot readily be started in a subject, unhypnotized and with his eyes open to light, when it is suggested that he cannot see.

IN the same series of studies, "hypnotic sleep"—the state of hypnosis—and normal sleep were compared. Observation showed that, when a person is falling asleep, the alpha waves become gradually less frequent, and finally subside. In deep sleep, a new type of wave train appears: "spindles," so called from the record which they leave—the record or imprint of a spindle-like wave-train tapers at both ends. That is, the spindle is made up of a series of waves, whose height, or amplitude, gradually increases, reaches a maximum, and finally decreases to zero. All of the waves in a single spindle—about 14—arrive within somewhat less than a second. One spindle follows another during deep sleep, and are so characteristic of this state that their appearance is now accepted as a demonstration of the maximum in slumber. Certain random waves also occur during sleep.

A subject in whom the hypnotic state has been induced, however, and who exhibits the typical, sustained cataleptic rigidity, has the wave trains of a person wide awake. No spindles and no random waves appear. Loomis, Harvey, and Hobart conclude that, applied to the hypnotic state, the term "hynotic sleep" is a misnomer.

Subjects thus have learned to fall asleep with electrodes attached to their heads. The wires are led into an adjoining laboratory and there plugged into the amplifier. As the subject slips into deepening slumber, the waves subside gradually. Spindles and random waves



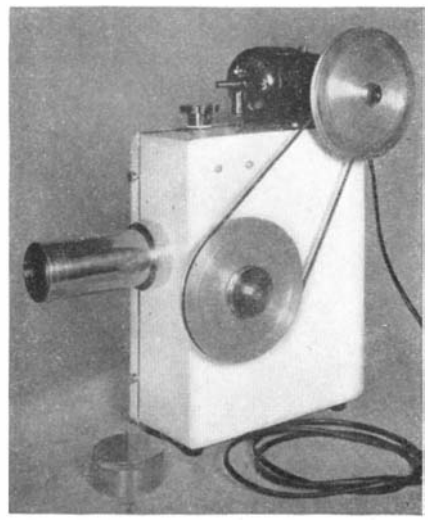
Electro Medical Laboratory, Inc.

A clinical electro-encephalograph of the kind that records waves by means of an ink-writing oscillograph

finally replace the erstwhile rhythm. If the individual is gently awakened, the rhythm returns.

The honking of automobiles has no effect upon the sleeping subject who is accustomed to such noise. Even the slamming of a door may go unrecorded on the tape or film. But let there be a whisper, or a rustling of paper, or stealthy footsteps—less noise, it is true, but somehow more suggestive noise. At once the wave trains come scurrying along. Is this a newly found vestige of our prehistoric existence? The sign of an innate, ancient fear of stealthiness near at hand? Perhaps some secret sentry, quick with primitive emotions, is alert, and nudges the higher command: "Hark! What beast skulks close by?"

One martyr allowed himself to be kept awake for more than 50 hours. Hence, he was able to fall asleep almost instantly. Each time he fell asleep, his alpha waves vanished. Prodded after a minute, he awoke, and his Berger rhythm resumed. By this technique, his alpha waves were forced into a second rhythmic display. His ordinary rhythm—as long as he was alternately awakened and permitted to sleep—came at one-minute intervals. No clearer evidence could there be that the alpha waves depend, at least to a certain extent, upon moderate activity in the conscious brain.



A close-up of the motor-driven, continuous-film camera which photographs cathode-ray oscillographs

Then, too, the alpha waves faint when a person swoons. Deep anesthesia likewise makes an end of the waves. Here it is of interest that where the anesthesia is light, the waves continue, but at a slower rate, perhaps only five or six per second, instead of about ten. Moreover, each anesthetic or drug seems to have its own peculiar effect on the waves, as shown by sharp-spiked or rounded waves, low or high waves (weak or strong), frequency high or low.

Oxygen also has an effect. Take many very deep breaths (with your eyes closed, to give your alpha waves a chance). With every deep breath, your alpha waves arrive more slowly. You could cut the beat in half—bring it down to five waves per second. The cause of this effect? Another mystery.

And so we see that, in the same person, the alpha rhythm differs from time to time, varying in accordance with numerous conditions. As one authority expresses it: "The alpha rhythm appears to be the labile indicator of something, but as yet we do not know what."

(*To be concluded*)

THE QUEST OF HELEN

At the Classical Site of Troy the Final Work of Archeological Excavation Has Now Been Completed ...Nine Superimposed Cities Revealed in New Detail

By JOTHAM JOHNSON, Ph.D.
University of Pittsburgh

Figure 1: A large room in a building in the sixth city level of ancient Troy. Its ceiling was supported by ten columns, arranged in two rows of five each

IT happened a long time ago if it happened at all, but to the ancient Greeks it was very real—one of the latest and freshest episodes in the age-long romance of their footloose, carousing, bronze-age ancestors. Three lovely goddesses took their beauty contest to a royal shepherd named Paris, and as objective decisions were improbable in those days, each goddess offered a persuader: Hera, unlimited power and dominion; Athena, fame and wisdom; Aphrodite, the most beautiful woman in the world.

Naturally, Aphrodite won. Paris presently found himself a guest at the Spartan palace of Menelaos, and violated the rules of hospitality which obtained then as now by seducing Helen and luring her off to his Trojan boudoir. In retaliation, Menelaos and his potent brother Agamemnon, king of Mycenae, led an army to Troy, and after ten years Ulysses' trick of the wooden horse put a squad of Achaeans within the walls and Troy was sacked and burned. Thus Mycenae's dangerous commercial rival at the mouth of the Hellespont was liquidated.

That is the story about which Homer wrote the Iliad and the Odyssey. We won't at this time go into the question of who wrote Homer's poems. One scholar has impatiently observed that if they were not written by Homer they must have been written by somebody else of the same name.

The Greeks accepted poet and poems as mostly true, while squabbling over details. In antiquity there were several solemn estimates of the date of the fall of Troy, based on the number of generations since—each prominent Greek family alleging descent from one or more of the Greek warriors who fought there. Eratosthenes worked out a date equivalent to 1184 B.C. Three other ancient chronologists accepted his figures and three independent calculations landed within a few years of that.

Few Trojans survived the sack. Aeneas escaped with Anchises his father and Ascanius his son. Later on the Romans were to consider him the founder of their nation, as Romulus, his many-times-great grandson, was to be the founder of Rome the City. They established a festival at the traditional site of Troy, though some writers, even in that day, argued that the site could not be reconciled with the Homeric tradition.

Vergil's Aeneid was a conscious borrowing from the Iliad and the Odyssey; Aeneas' flight via Sicily to Carthage, where he loved and left tragic queen Dido, resembles Ulysses' sea-wanderings till he reached his home, and the battle scenes in Latium, Aeneas' first adventures on the site of future Rome, suggest the fighting in the Iliad.

Later criticism was inclined to put the whole story down under the heading of entertainment. Sixty years ago, however, thanks to Heinrich Schliemann, the story was revived as almost-history. I am not going to waste your time or mine repeating his *American Magazine* success-story pattern—if you're interested you can look him up in an encyclopedia. From his boyhood he was a fervent admirer of the classics, reading and re-reading the Iliad. He could not persuade himself that Troy was not founded on fact.

WHEN he had made enough money, Schliemann retired from business and went to northwestern Asia Minor to find Troy and dig it. Several explorers before him had noticed that the smallish mound of Hissarlik fitted roughly the topographical requirements of the siege described in the Iliad, and it had satisfied the Romans. Schliemann excavated a mammoth trench right through its bowels, for which archeologists have been cursing him ever since.

He unquestionably landed in something. He distinguished seven successive strata, levels of occupation. The seventh city he called Greco-Roman, the sixth "Lydian", the rest prehistoric. I have already explained in this magazine (May, 1937, page 310) that "prehistoric" means before the use of written documents, which constitute history; and that prehistoric archeology, which is the harder of the two, is currently more fashionable among archeologists than the other kind.

Down near virgin earth Schliemann found a primitive city, surrounded by strong fortification walls, and evidently wealthy. Furthermore, it had been destroyed by fire. He announced to a frankly skeptical public that he had proved Hissarlik Level III to be the Troy of Homer. One of his staff observed that the burned city was only one remove from bedrock, and was therefore Hissarlik II, and in a later volume Schliemann made the correction. Troy I, a cluster of wretched hovels at the very

bottom, he considered neolithic. He gratefully removed a rich Troy II treasure of copper, silver, and gold cups and jewelry from Turkish jurisdiction, which cost him his permit to dig.

Accordingly, he moved to Greece and pitched his tent at Mycenae. At once he found the royal "circle graves," which have been a sensation ever since, and the palace in which Agamemnon may have—must have—lived. Anybody who is that lucky is bound to rise. Schliemann's digs at Ithaca, Orchomenos, and Tiryns were less successful, but in due course he rose in public estimation from a crackpot to something of a savant, and died believing that in Troy II he had laid bare the Troy of legend.

IN the meantime the school of Aegean archeology which he fathered had been reclassifying and recomparing the primitive potteries from Troy and Mycenae and elsewhere in the lands bordering the Aegean Sea, and began to articulate their suspicions that Troy II was far older than the palace of Mycenae. Mycenae's chieftains came at the very end of the bronze age, and soon after 1100 B.C. were overwhelmed by invading "Dorian" Greeks who brought with them the first iron and therefore can usually be recognized even by very young archeologists. Troy II, on the other hand, was very early bronze-age, and being rapidly pushed back toward 3000 B.C.

Schliemann died in 1890. In 1893, with funds contributed by Mrs. Schliemann, and in 1894, at the expense of the German government, Wilhelm Dörpfeld, a capable young German architect who had been associated with Schliemann, returned to Hissarlik for further exploration. He counted nine cities on the mound instead of seven and paid special attention to the upper levels, especially the sixth which Schliemann had called "Lydian." He found what Schliemann had overlooked—the walls of a fortress enclosing Troy VI, a city larger and much more powerful than Troy II, and likewise destroyed in some fearful catastrophe.

The pottery associated with it, by which it had to be dated if it was going to be dated at all, was not Lydian but *was* directly comparable with late bronze-age pottery from Greece, some of it perhaps made at Mycenae itself. Dörpfeld accordingly gave out that Schliemann's Troy VI was prehistoric, contemporary with Agamemnon's Mycenae, and could be shown to fit the Homeric requirements so beautifully that no dispute could ever arise again.

He carried conviction, too; the Troy II advocates were about ready to change over, the hold-outs who had been objecting to Troy II as too early were delighted, and most of the uncritical followed along. There remained only a small but shrill French school of dissidents who had plumped for an opposition mound somewhere farther back in the hills. In due course the history books, or most of them, were rewritten to acknowledge in Troy VI the rebirth of the Homeric city.

It was inevitable that someone would question again the patient soil of Troy. Sir Arthur Evans' exploration, from 1900 on, of the Palace of Minos at Cnossos in Crete, revealed that a brilliant bronze-age culture centered there had dominated the Aegean area for centuries. Synchronisms with Egypt provided a fairly accurate scale of dating for the whole span of Minoan culture. The British excavations of Phylakopi on Melos had furnished a similar scale for the island culture, and the mainland chronology had been steadily improved—by Wace's re-excavation of Mycenae in 1921-3, the German reëxcavation of Tiryns, American excavations at Korakou and Zygouries near Corinth and at Eutresis in Boeotia, and British exploration of numerous sites in northern Greece. Yet we were still without an accurate yardstick for the coast of Asia Minor, for Schliemann and Dörpfeld between them had raised as many questions as they had solved at Troy, and the Turks, having newly fortified their coastal zone, were at no pains to encourage foreign enterprise among its buried mounds.

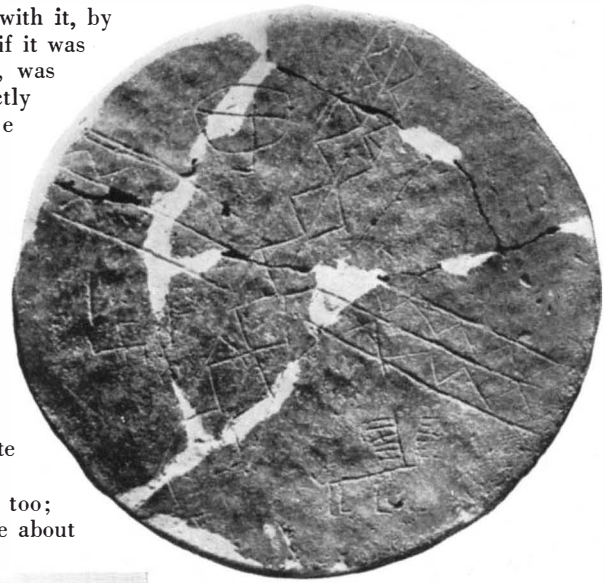


Figure 3: **The lid of a box, found in a destroyed house belonging to Troy IV*a*. Despite the small swastika shown toward its left, the "horizon" is clearly non-Aryan**

Figure 2: **A gate and street of Troy VI. After the earthquake that destroyed the sixth city this gate was repaired and used again in Troy VII*a*, Homer's Troy**

However, they would permit further work at Hissarlik, where, with all the fortune that had been poured into moving it, extensive strata of the original mound still lay undisturbed; and no other site in western Asia had the romantic associations of Troy. The University of Cincinnati, a strong newcomer to the field, qualified for the honor and each spring for seven years Carl Blegen, Professor of Archeology at the University, has returned to dig at Hissarlik.

Results during 1932 were nothing much—limited to new details of the fortification walls of Troys II and VI. In

1933 primitive Troy I, which Schliemann had treated with considerable disdain, was put to an especially thorough examination to learn its true ancestral nature and to see whether beneath it there might lie a city still older. There was none, but the improving classification of pottery and other finds made it necessary to divide level I itself into four periods, *a*, *b*, *c*, and *d*, and later it became necessary to subdivide period I*a* into four sub-periods, I*a*1, I*a*2, I*a*3 and I*a*4.

In that same campaign Troy V was divided into periods *a*, *b*, *c*, *d*, and *e*—I hope I'm not boring you—and Troy VI yielded new quantities of "certified" pottery; that is, lying in undisturbed stratification. Troy VI was architecturally ambitious; one of its imposing buildings is shown in Figure 1—a spacious hall whose roof was supported first by four, later by ten columns, anticipating the plan of the Roman basilica whose name the excavators have temporarily borrowed for it. This city had a long period of steady cultural development reaching from before 1900 B.C. to after 1400 B.C., and it is likely that it was one of the most important commercial cities in the world during that period.

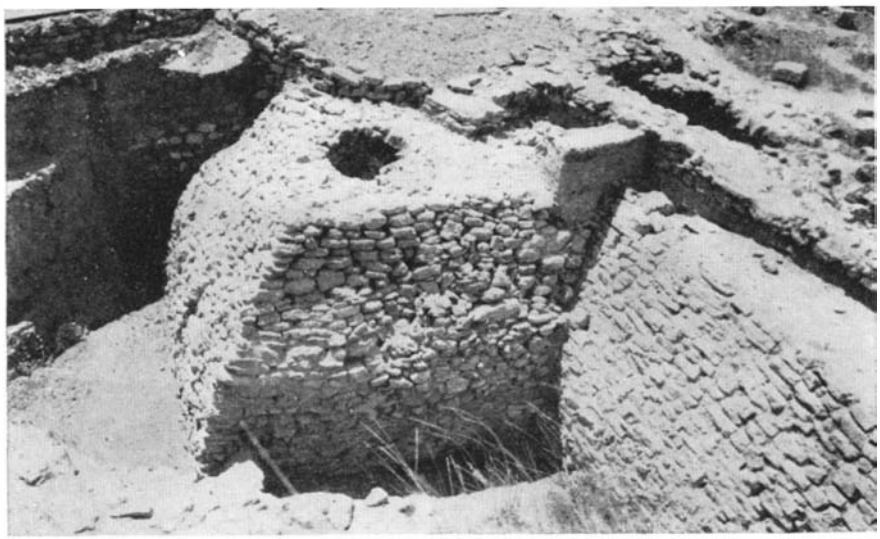


Figure 4: **Remains of a tower flanking the south gate of Troy I, found in 1937**

ALSO, in 1933, it was ascertained that Troy VII, the sub-Mycenean settlement built on the ruins of the sixth city (in Dörpfeld's renumbering of Schliemann's strata) had three periods, VII*a* being still bronze-age, iron making its first appearance at Hissarlik in Troy VII*b*. VII*a* showed ominous signs of destruction.

It had been growing more and more difficult to show any cultural break between Troy VI and VII*a*. It was true that there was a destruction level separating them, but the culture, as indicated by the finds, was continuous, indicating that the same people had gone on living there after the tragedy, not supplanted by alien forces; if Troy VI was Homer's Troy then its beaten, scattered survivors had returned with surprising vigor to mend their broken lives and rebuild their city.

1934 was the year of the big wind. After that campaign Blegen announced that the catastrophe which had destroyed Troy VI shortly after 1300 B.C. could not have been the conqueror's torch, for it was impossible to recognize over the whole site a general layer of ash and carbonized matter which would indicate such a conflagration. Instead, its fortifications and house walls had been shattered by an earthquake.

On its shaken foundations the city had been reconstructed. In some places the fortification walls had to be torn down and rebuilt; in others they were relatively solid and so were returned to use. Figure 2 shows a good example, a gateway which belongs to both Troy VI and VII*a*.

Troy VII*a* was a century old when, soon after 1200 B.C. according to the archeological evidence, it was gutted from one end to the other by fire. It alone, of all the levels of Hissarlik, satisfies the requirements of Homer's Troy. And that is the date indicated by the consensus of the Greek genealogists who worked out dates for the Sack of Troy.

Above the ruins of Homer's Troy was built Troy VII*b*, a mixture of Trojan, sub-Mycenean, and new alien elements—indeed a poor village, but knowing iron. Back before 2000 B.C., Troy III and IV turned out to have been not separate cultures but one city, a sequence in a slowly-developing bronze-age civilization, interrupted, it is true, by a fire, but one not attributed to hostile invasion. From the earliest of Troy IV's five periods comes the cover of an ointment-box, reproduced in Figure 3.

In 1935 and 1936 Troy II was scrutinized again, and divided into periods *a*, *b*, and *c*, and *c* in turn into 1, 2, 3, and 4. Troy II had fairly pretentious buildings, more so than the early excavators realized, and Blegen's discovery in this second city of gold objects duplicating examples in Schliemann's treasure confirms Schliemann's identification of the level in which his treasure was found.

This sort of thing, with ancient wells to open, Greek and Roman buildings and inscriptions to record, cemeteries to search for, is what keeps the archeologist lean but happy. When all the subperiods of all the periods of Troy's nine cities are totaled they now—July, 1938—number more than 40, subject to change without notice.

It remained for 1937 to bring Troy I into true focus. Through all the older excavations and five modern campaigns, even the intensive researches of 1933 and 1936, it had kept its secret, its small but powerful fortification wall built of stone, its great south gate flanked by projecting towers (Figure 4). Instead of a sub-neolithic village it stood revealed as a stout guardian of the Dardanelles, a customs house set to badger Black Sea commerce 'way back in a day so close to the dawn of navigation that we are at a loss to imagine what commerce was worth regulating.

Figure 5: **Oldest known sculpture from the Aegean area, found outside the south gate of Troy I. It represents a heart-shaped human face**

Built into a barrier outside one of its gates stood three stone slabs, re-used from some monument still older, and on one of them was a rude representation of a human face (Figure 5), the oldest piece of monumental stone-carving in the Aegean area and one of the oldest in the world.

The excavation is now complete. Last spring the staff from the University of Cincinnati returned to Troy for a final season of study, and presently the republication of the site will begin.

Floods Give Fair Warning

Lives and Property Can Be Saved if the Warning is Heeded . . . Flood Patrol Co-operates With Amateur Radio . . . The Gulf Stream of the Air

By ALEXANDER MAXWELL

EARTHQUAKES and tornados strike quickly and unexpectedly. Hurricanes give several days notice, while a flood may be a week or more building up to the point where it becomes destructive. Yet more damage is done by flood waters than all other natural disasters put together. Half of it, or more, is preventable.

In the May issue of Scientific American, page 261, is told the story of the mighty TVA and the almost superhuman task of remaking an entire river basin for the purpose of minimizing flood losses, making year 'round navigation possible, providing mosquito control, and impounding water for power purposes. One feature of this project is the forecasting of floods in the Tennessee River and its tributaries. It is a complex procedure; by adjusting the control gates on a series of dams, a flood crest can be ironed out so that no one point gets all the raging torrent at once. This complex system saved Cairo in the flood of January 1937. It saved it by inches. By closing the gates in the face of a cloudburst, an additional crest of six inches was delayed; the hard-pressed levee was not topped. If the TVA never does another good deed, that one demonstration will stand as a monument to man's triumph over flood waters.

FLOOD damage in the Ohio Valley has made a deep impression. Giant dams cannot be used as on the Tennessee River. No other method of flood control seemed practical. Many were suggested, but when figures showed that a storage basin the size of Lake Erie would not hold the flood waters of the Ohio when on a rampage, those who had suffered looked up in despair and said: "What can we do?"

A number of newspapers serving the Valley provided the answer. They saw what had happened and pooled their resources to inaugurate a project unique in dealing with floods. Contrary to most projects which require millions or billions of dollars, this one depends mainly upon the human element. Men, skilfully directed and all working together, can accomplish much, even with meager financing. The project looked almost pathetic, but when tested in the spring of 1938 it proved an unqualified success.

To begin with, what causes a flood? We all know about the ocean current called the Gulf Stream and how it circulates in the Atlantic Ocean. What we were not taught in school was the presence of another Gulf Stream, not in the ocean, but in the air! Meteorologists have long suspected its presence, but only recently, when world-wide weather reports could be assembled with speed and accuracy, has its existence been checked and verified. Visualizing the Northern Hemisphere as a whole, the path of this mysterious river of the air is unmistakably clear. It flows in a well defined channel, but like all rivers, it has the power to alter its path to meet changing conditions. Coming from the tropics, it is heavy with moisture. As it flows along, its path is marked by clouds—the fleecy, billowing type which artists so admire, or again, by the villainous thunderhead, just waiting to ruin a picnic. If you could ascend high enough, the path of the Gulf Stream of the Air would be visible as a great, meandering streak of clouds. A meteorologist compiling his daily chart gets just such a picture on the map before him.

Damage by floods can be materially reduced if adequate warning is received and proper precautions are taken to protect property

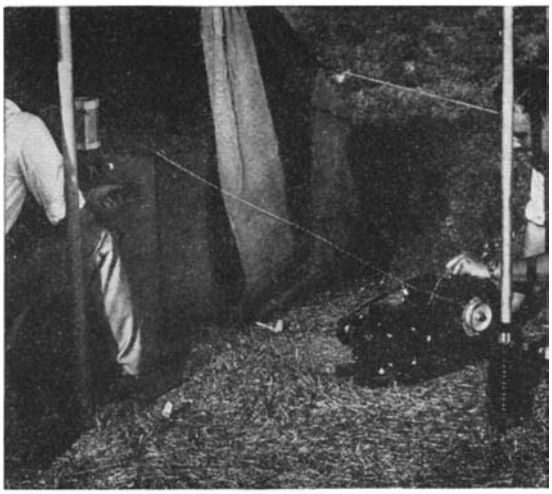
This Gulf Stream of the Air is much more important to our welfare than has been generally supposed. On the whole it is quite agreeable, but every so often it turns with a snarl of wind and thunder; rainfall which should have been distributed evenly over most of North America is concentrated in a restricted area, resulting in a cloudburst, or, if heavy enough, in a flood. When there is a flood there is also a drought—in a place which should have received its share of the rain but did not.

The Gulf Stream of the Air never follows the same course for very long. It snakes and twists like a giant fire hose. One day it will be over the Atlantic Coast; then it heads west until it brushes the towering heights of the Rockies. Later it slithers into the Mississippi Valley and eventually back to the East. Wherever the current goes, there are found rain storms. When the Gulf Stream of the Air is elsewhere, the skies are clear and there is no rain. In short, it is the generator of floods.

Floods do not start in the river channels. The drainage area of the river proper is not sufficient to build up floods. However, should the headwaters of a number of tributaries receive heavy precipitation simultaneously, the hillsides will drain into brooks, the brooks flow into runs, the runs into creeks, the creeks into small rivers, the small rivers into larger rivers, and when all the tributaries pour their muddy torrent into the main river at the same time—the flood is here.

SEVERAL days usually elapse between the time when the Gulf Stream of the Air discharges its liquid burden and the river rises. By watching atmospheric conditions the forecaster can tell when and where to expect heavy rains and be prepared for them. The elaborate system of the TVA does this, and never yet has high water come unexpectedly. The Ohio Valley newspapers are applying the forecasting in a different manner.

Water travels slowly. Last year, when a big Ohio flood was anticipated, an expedition went to the headwaters of the rivers rising in the Virginia-Kentucky-Tennessee triangle to watch developments and take photographs. Rainfall did not seem unusually severe, but shortly



Portable short-wave radio equipment used by the flood patrol to report rising water conditions to areas which will soon be affected

after New Year's Day the creeks began topping their banks. They had already gone down to normal long before the first warning of a flood was sounded at Louisville. The water traveled down each stream in a miniature "tidal wave." It rose rapidly, stayed at crest a certain length of time and then fell just as quickly as it had come up. It was possible to follow the progress of the flood by automobile, taking photographs before, during, and after the crest hit a given spot. Then, by driving rapidly a hundred miles down stream, the whole performance could be seen over again on a larger scale, until at last Cincinnati was reached, where the water soon began to lick the doorsteps of houses.

Ninety percent of those who lost life and portable property in last year's Ohio flood did so needlessly. There was a full week in which to prepare—had coördinated information been available. But there were no clearing houses for flood reports.

PREVENTING floods in the Ohio River is still far in the future. It may never be entirely successful. On the other hand, getting out of the way of a flood is something which can be done right now. That is exactly where the newspapers decided to help. The weak link in the chain was the absence of reliable advance information on the movements of flood waters. The water was coming—but, how much? How fast? When will it get here? Which homes should be evacuated? How high should sand bags be piled? Every city along the river has ample facilities for handling its inhabitants and their belongings, if ample and accurate warning is available. To provide such warnings the newspapers have established their own advance information bureau. This "flood patrol" at first glance appears to be a cross between the pony express and Paul Revere. Not having money to establish measuring stations at the headwaters and at strategic junctions of streams, a survey party laid out routes along surfaced highways, connecting the tributaries of the rivers which fed the Ohio. Speeding rapidly by auto from stream to stream a single observer can measure the level and flow of many isolated watercourses in a short time.

The system of patrol routes does not hug the river; it reaches far into the hinterlands. Parts of the states of Ohio, Indiana, Illinois, Pennsylvania, Maryland, New York, West Virginia, Virginia, Tennessee, and Kentucky are included. Observation posts within 50 miles of the Ohio are worthless. It seems odd to think of looking for floods on a mountain top, but that is where the trouble starts. The patrol functions only during flood season. If the observations of the meteorologists show no trouble in the offing, four men can patrol the entire Ohio Valley, making the circuit twice a week. Should the position of the Gulf Stream of the Air indicate undue rainfall, the patrol can be increased, sending daily or even hourly reports by telephone, telegraph, or short-wave radio to the central clearing house. With all the water levels of the numerous tributaries clocked and measured, it becomes a simple matter to calculate the quantity of water which will pour into the Ohio at any time within the next week.

That such information will be valuable is proved by the experience of the inhabitants of Portsmouth, Ohio, during the flood of 1937. Portsmouth, a low-lying city, had been flooded before. The people knew better than to argue with the river. Acting upon such meager information as was available, coupled with hard-earned experience with past rampages of the river, Portsmouth was completely evacuated. Stock was moved from stores, plate-glass windows were boarded over, homes were deserted, all before the river arrived.

But this case was the exception. In other cities on higher ground there was a mad last-minute scramble to escape through water that was already knee deep and rapidly rising.

A major flood is usually accompanied by numerous minor accidents such as washouts and breakdowns where communication is interrupted. Short-wave radio can bridge that gap, or, in fact, any gap. There has been no disaster, major or minor, during the past 12 years, from war to explosion, from earthquake to flood, anywhere in the civilized world, where short-wave radio has not stepped in and filled the breach in shattered communications systems.

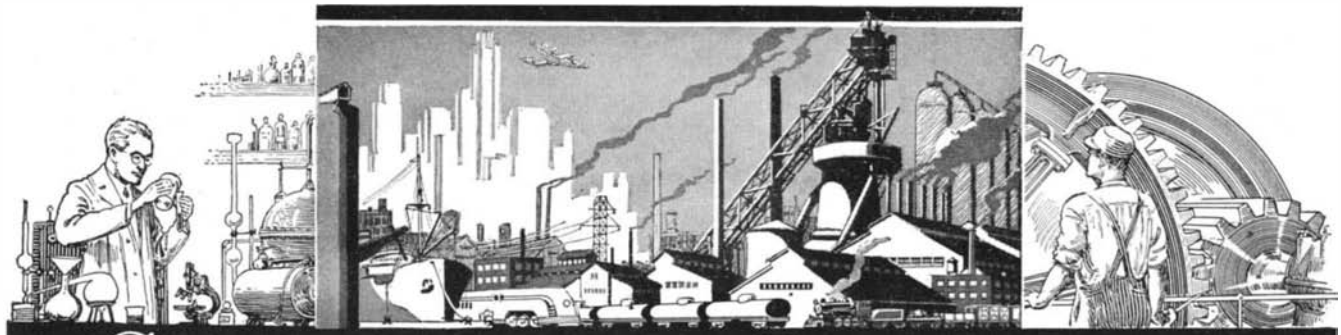
That is a record to cherish, and more so because almost all of those who participated did so voluntarily. Amateur radio. The American Radio Relay League. Men who follow radio as a hobby. Thousands of amateur listeners are continually combing the air waves. Hardly a thing escapes them. Many a message of distress which was not heard by government or commercial operators, paid to listen, has been picked up by amateurs and relayed to the proper authorities, usually at the expense of the amateur. A large number of amateurs risked pneumonia and braved severe hardships during the last Ohio flood, handling messages, directing relief and ordering supplies—voluntarily, using their own equipment and being paid by nobody. They have been on hand whenever needed, so it is not strange that the flood patrol includes them in the program. They would be there anyway.

To test the system of flood reporting by radio under field conditions, one of the patrol cars took an RCA 40-watt phone and C. W. transmitter up into the wilds of the Cumberland Mountains. With power furnished by a half horsepower gasoline engine, no trouble was encountered in putting signals into civilization. Such a radio unit, transported on the back seat of a car, can be set up in a house, barn, or tent, and be on the air in ten minutes. A 40-foot gas pipe is all the antenna needed, and a length of chicken wire serves as a ground. Lower power sets mounted permanently in cars can communicate while on the run, though their range is not as great. So far there has been no need for such split-second communication.

The antenna pipe screws together and rests on a porcelain insulator. One man can push it up and hold it while another drives the stakes on the ends of the three guy wires. Dismantled, it is lashed to the running board while the ground is rolled up and placed behind the spare tire. All equipment is standard and of the type used by many amateurs.

THE flood patrol functioned for the first time in the spring of 1938. No floods threatened, but it was inaugurated as an experiment to prove the feasibility of the plan, and see just how rapidly all the desired information could be assembled when an emergency did arise. Now, when a flood threatens, each of the cooperating newspapers can keep its readers informed, and when a notice to move is given it will be issued with assurance. No longer need the population of a threatened area rely upon pure guesswork; there will be no false alarms to upset those already on the verge of panic.

Huge sums do not need to be spent to accomplish things worth while if men are willing. The Ohio Valley flood patrol is ready; it is there to give exact information to those needing it most, but it is hoped the emergency will be a long time coming.



SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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

D. H. KILLEFFER
Chemical Engineer

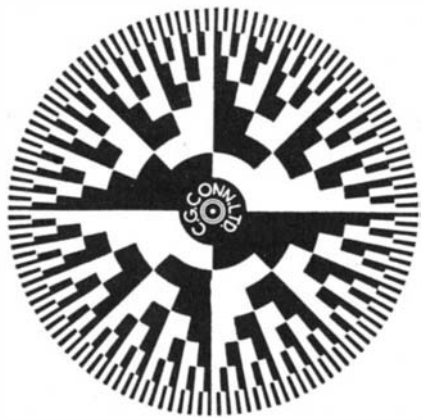
Instrument Measures Musical Frequencies

A NEW device called the Conn Chromatic Stroboscope has been developed for the precise and rapid measurement of sound frequencies in the range represented by the piano keyboard. By an entirely visual method, the deviation of a given tone from the equally tempered scale based on the standard A of 440 cycles per second, may be read directly, without further computation or reduction. The instrument may be used in the testing of musical performance; in making measurements of intonation, both vocal and instrumental; in piano and organ tuning; and in musical instruction and demonstration.

Testing intonation of a clarinet

Two units and a microphone comprise the complete stroboscope outfit. One unit, called the "stroboscope unit," has 12 windows having the relative positions of the white and black keys of the piano keyboard. The 12 notes of a chromatic octave starting with C are thus represented. Behind each window is a rotating disk imprinted with a pattern consisting of seven rings of alternating light and dark segments. Each ring, progressing radially, has twice as many segments as the preceding one. These disks are illuminated from behind by a gaseous discharge tube which is made to flash in accordance with the pulsations of sound reaching the microphone. When the number of light pulses per second is the same as the number of dark segments passing per second on some ring of one of the disks, that disk will appear to stand still. When the same note is sounded an octave higher, a similar pattern appears in the same window with twice the number of bars, since the frequency is doubled. The position of the pattern is also shifted to the next ring of the figure. Space is provided for seven octaves on each disk and, with the 12 windows, a total of 84 notes may be checked.

When the pattern remains stationary the tone sounded is correct in intonation. However, if the tone is sharp, the pattern will move toward the right. If flat, the pattern will move toward the left. To find out just how sharp or flat the tone is, the operator simply turns a knob on the "fork unit" to the right or left (in the same direction as the motion of the pattern) until the pattern appears stationary. The reading on the dial gives the exact degree of deviation from the correct tuning expressed in hundredths of a semitone (cents).



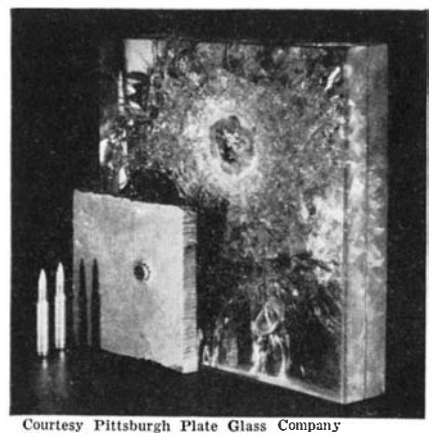
One of the stroboscope disks used in measuring musical frequencies

While the stroboscope was developed primarily for testing the intonation of most wind instruments, it has been found adaptable to a wide variety of uses where accurate measure of frequency is involved. For example, piano manufacturers and tuners saw in it an accurate device for measuring the tuning of the piano. Teachers of music, bandmasters, and orchestra directors see in the Chromatic Stroboscope a means of ear training. Limited experience with the stroboscope in this connection has revealed some remarkable progress by students who formerly played with faulty intonation.

Bonnet Protects Giant Bearing

THE world's largest telescope bearing practically crawled to a new world's marathon record recently, wearing a sunbonnet and chalking up a seven-mile-long grind in 131 working days. Literally, it was a hard grind too, because the 317,000-pound horseshoe-shaped bearing lost approximately one and a half tons of steel in the undertaking.

This race for perfection—and not speed—was run on a 144-foot track in the generator works of the Westinghouse Electric & Manufacturing Company. A specially constructed



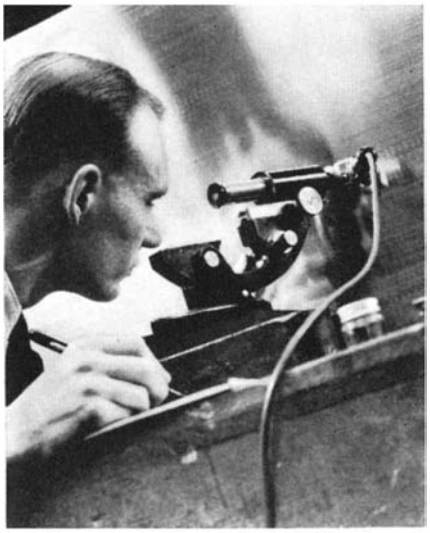
Courtesy Pittsburgh Plate Glass Company

A bullet shot from a Springfield army rifle at a distance of 60 feet penetrated the ⅝-inch-thick boiler plate shown in the foreground. Under the same test conditions a bullet penetrated only ½ inch into the plate of laminated safety glass shown behind the boiler plate

boring mill machined, ground, and polished the bearing to within five thousandths of an inch of a perfect circle.

Hard but sensitive is this titan of steel, and that accounts for the sun-bonnet. Westinghouse research engineers prescribed the bonnet, a composition roof, to reduce the expansion effect of the sun's rays on the steel. The bearing had to be smoothed to perfection in order to carry the million-pound weight of the 200-inch telescope which will be erected atop Mt. Palomar, California. The few thousandths of an inch expansion caused by the sun's rays streaming through the skylight in the generator aisle became a mountainous problem for the engineers.

Shortly after starting the machining process they discovered that every afternoon around 4 o'clock, the telescope bearing began to swell as it revolved slowly on the

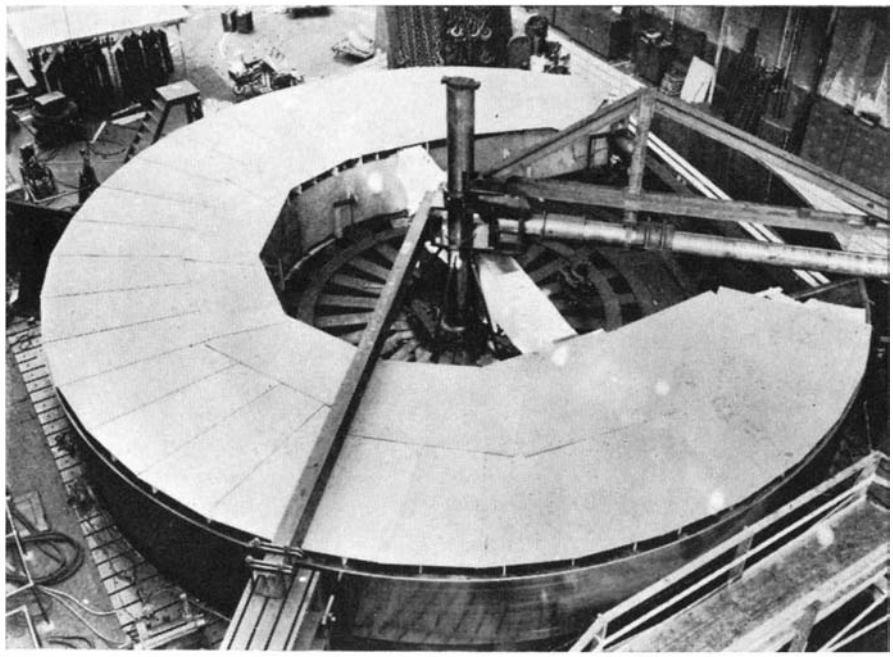


Checking surface of giant bearing

circular track of the boring mill. While the temperature increased approximately 10 degrees during the late afternoon sun bath, the steel expanded as much as 13 thousandths of an inch. At night it contracted.

What's more, the stubborn bearing did not expand evenly. At the bottom of the horseshoe, farthest from the sun's rays, the expansion was only seven thousandths of an inch. For two weeks an engineer filled reams of paper with calculations until he had charted the complete course of the expansion for every revolution of the bearing and was able to adjust the grinding wheels in the proper ratio.

Expansion continued to be a handicap, however, and the engineers next covered the skylight of the plant with blue paint. This reduced the expansion some. Next they built the bonnet a few inches above the revolving bearing. Immediately they reported a 50 percent reduction in temperature fluctuation



Looking down on the sun-bonnet that protects the huge telescope bearing

and a corresponding cut in the expansion.

With the sun out of the way, craftsmen worked the huge bulk of steel into a perfect circle with a face almost as smooth as glass and bright as nickel. They didn't trust their eyes to tell them when they had attained smoothness, but Dr. Stewart Way, a research engineer, spent many hours exploring the surface through a surface finish microscope, plotting a profile map of the bearing. Through the microscope, ridges a few thousandths of an inch deep appeared like craters.

Relentlessly the polishing wheels buzzed and the microscopic hills and valleys on the steel surface grew smaller, to less than five ten-thousandths of an inch in depth. Engineers had won the battle with sun and steel.

Rubber Bands Snap at High Speed

TWO hundred and four miles an hour is the speed at which a stretched rubber band snaps, as measured by ultra-high-speed motion pictures recently taken in the laboratory of Gustavus J. Esselen, Inc., chemical consultants.

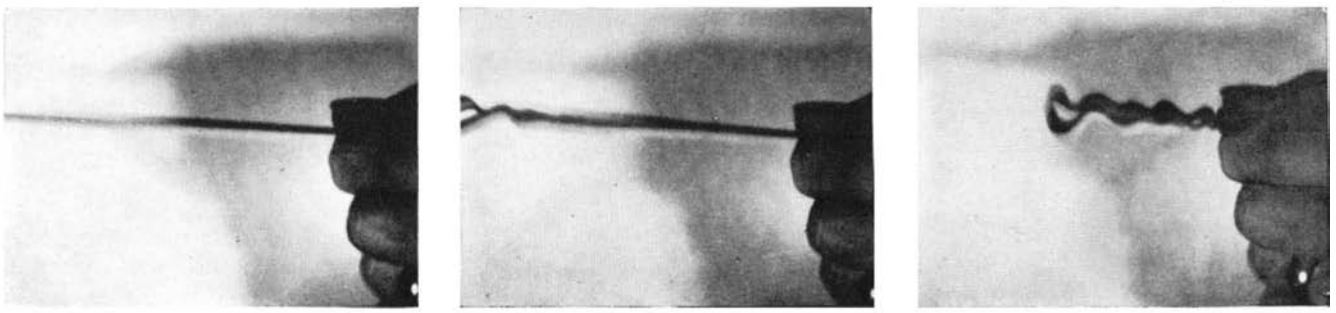
"An ordinary rubber band, about four inches long, was stretched nearly to its limit with the fingers, and as it was released photographs were taken of it at intervals of a twelve-hundredth of a second," Dr. Esselen explained. "When these pictures were studied, the mechanism of the recoil of the rubber could be easily observed and measured. The free end of the band relaxed first and gradually more and more of the band lost its tension, the end held in the fingers last of all. During the snapping, the free end of the band attained a measured speed of 204 miles per hour.

"This technique of taking ultra-high-speed motion pictures has been used with great success in solving industrial problems involving motion too fast to be followed by the eye alone," Dr. Esselen said. "In effect, action can be slowed down as much as 125 times. An object moving at a rate of 125 miles an hour, or 183 feet per second, which is much too fast for the eye to see, can be photographed and shown traveling at a rate of only one mile an hour, or about one and one half feet per second. At this speed it is easily watched and the nature of the motion analyzed in detail. In measuring the speed of the snapping rubber band, motion was slowed down only 75 times."—*D. H. K.*

Hogs Lose a Job

"EXTON," a new bristling filament for use in toilet brushes, has just been announced by the Plastics Department of E. I. du Pont de Nemours & Company as the result of several years of research and experimentation. The present production is limited and the entire output is being used in du Pont's own tooth brush manufacture.

The new bristling filament is ultimately expected to replace the natural hog bristle which has heretofore been used in the best grades of toilet brushes. Made from a plastic dough-like batch, it is extruded through holes of the required size and can be made



Three high-speed photographs of the snapping of a rubber band

into strands of virtually any desired length. It is not softened by water or saliva. Its stiffness can be controlled accurately in the making through variation of the diameter of the hole.

Experiments have shown that the new synthetic product is superior in appearance and has much longer life than the natural bristle.

A Thrill for the World's Fair

WE have had occasion to describe in these columns the system of training in parachute jumping with the aid of "Parachute Towers." Now we are privileged to describe the parachuting tower which will

be erected by International Parachuting at the World's Fair. The hazards of the jumps have of course been reduced to a minimum, and there will be no such thing as instructing the public to pull the rip cord, or even an attempt to have automatic opening of the 'chute. On the contrary, the 32-foot 'chutes will be held permanently open by big metal spreaders. The passengers will be held securely and comfortably fastened in a double seat suspended from the 'chute. An automatic release will start the drop and the 'chute will be guided by vertical wires to prevent swaying during the descent. Shock absorbers will eliminate any effect of impact on alighting. Then the 'chute will be hauled back to the top of the tower.

Eleven of these devices will be in constant operation. Both ascent and descent will take about one and a half minutes each. Even though the World's Fair jumpers will not experience the thrills of a man bailing out of a ship, they will enjoy quite a novel experience, and a splendid view of the fair from a height of 250 feet. The whole structure will weigh 170 tons, but is so constructed that it can be readily dismantled and assembled elsewhere. Perhaps the parachute tower will in time become a familiar feature of the really modern traveling circus.—*A. K.*

An Aerodynamic Novelty

AS one of our photographs indicates, The Willoughby Delta Company of London, England, has produced an entirely

Above: **An artist's drawing of the parachute tower as it will appear at the World's Fair.** *Left:* **One of the parachutes at the end of its descent, showing size in comparison with the couple in the seat**

new and interesting aerodynamic form in their "Delta" wing. The Delta airfoil includes a normal wing of moderate aspect ratio, and two "side wings" which are cambered sideways as well as fore-and-aft. In combination with the tail surfaces there is formed an "annular wing" of rectilinear formation.

Much original thought and careful wind tunnel investigation have gone into the development of this twin-engined Menasco-powered Delta type airplane now approaching completion. Some of the striking results claimed by the designer, P. Nesbit Willoughby, are:

1—The side wings act as booms to carry the tail surfaces, but provide lift (at all but the smallest angle of incidence) so that they are *not* purely parasitic elements as ordinary tail booms would be.

2—In a very large machine the thick booms of long chord permit complete housing of passenger cabins on either side without the addition of parasite drag, while the central nacelle can be given a relatively small frontal area and small drag.

3—In the ordinary wing there are "vortex" losses at the tips and all along the trailing edge. In the Delta there is an annular lifting line closed on itself so that "vortex" losses are reduced. This explains the high lift/drag ratios attained with a relatively small aspect ratio.

4—The aircraft maintains its lift well beyond the stall of the conventional airfoil, because after the front wing has reached its maximum lifting capacity, the side wings still continue to increase in lift. This means that sudden stall or loss of lift will be avoided.

5—As raising or depressing the elevator affects the whole aircraft, the longitudinal control is very powerful in spite of the small size of the elevator.

6—With the conventional airplane of large size the bending moments at the root of the wing become very large and the structural weight goes up accordingly. With the Delta design, weight and lift distribution are more nearly coördinated; this tends to increase strength and decrease structural weight.

Of course the above is a highly condensed statement of reasoning which would require a lengthy, technical paper for adequate presentation. Also, technicians may find arguments *contra* as well as *pro*. Nevertheless, it is quite clear that serious consideration must be given to these novel principles; the disclosure of wind-tunnel tests and the results of flight tests will be awaited with interest in Europe and the United States.—*A. K.*

PLANE TIRES

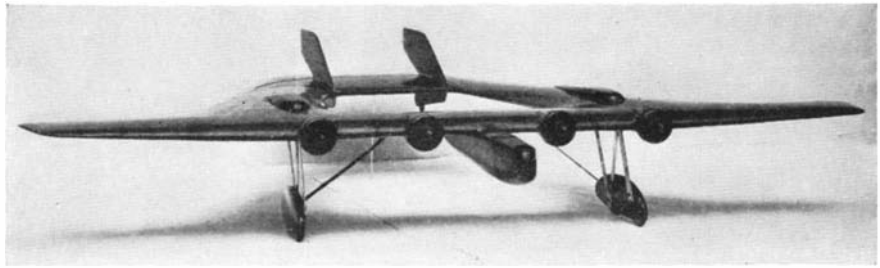
THE largest tires so far used in American aviation—those built for the new DC-4, 42-passenger airliner under construction by Douglas Aircraft Company—contain 45 miles of tire cord and four miles of bead wire each, and weigh 360 pounds.

Engines for Various Types of Aircraft

THE United States took an early lead in the development of the air-cooled engine, with Charles L. Lawrance as the outstanding pioneer, and it has kept this lead ever since. The progress in air-cooled engines has been truly remarkable, and their power for a given weight and over-all diameter is now surprisingly high. However remarkable the success of this type may be, some authorities are of the opinion that we have been remiss in the development of other categories of aircraft motors. The Germans, so these authorities tell us, have taken a broader view, and while making the fullest use of the air-cooled type have also pushed ahead with liquid-cooled gasoline engines, and with aircraft Diesels.

Broadly speaking, the Germans have classified their prime movers under the following headings:

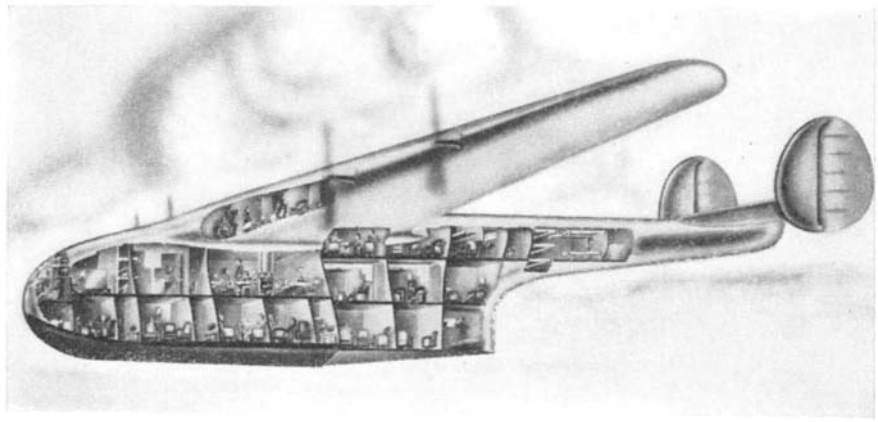
1—Liquid or chemically cooled engines of small frontal area, fitting admirably into the nose of a fuselage and allowing the designer to build single- or two-seater fighters of the highest speed.



A model plane built with the Delta annular wing

2—Large air-cooled gasoline engines for machines of intermediate size—observation, light bombers, and so on.
3—Powerful Diesels with low fuel consumption for very large airplanes with long range endurance, in which the weight of fuel is a highly important item.

Of course we now have the Allison engine to represent the liquid-cooled category, but we have no large aircraft Diesels in service. We might do well to follow the German example, and without being carried away by the success of one category, seek a more comprehensive coverage of the aircraft engine field.—*A. K.*



A portent of the future—passengers housed within the wing

Sleeve Valves for Aircraft Engines

IN 1905, Charles Y. Knight of Chicago began his work on the subsequently famous double-sleeve-valve engine, and there is no doubt that the honor of originating the sleeve-valve internal-combustion engine rests with the United States. Yet it is the Bristol Company of England that has done the most creditable work in developing the sleeve valve for use in the aircraft engine. Now that an intense effort is being made to develop two-cycle Diesel engines for aircraft use, the sleeve valve is sure to come into its own, and we predict confidently that American engineers will no longer neglect this device. Space considerations will not allow us to discuss the sleeve valve and its possibilities in full, but the following résumé of the advantages claimed for it in A. H. R. Fedden's recent paper presented before the Society of Automotive Engineers is of real interest:

There is a total absence of valve maintenance and of any hot spot in the combustion chamber. Since pre-ignition and detonation are often traceable to the red-hot exhaust poppet valve, this latter item appears quite important. There are greater effective valve areas and reduction of restrictions to the gas flow. The poppet valve, however skilfully designed, and even if four valves are placed in the head, suffers from definite limitations as to valve area. In the sleeve valve, almost the whole wall of the cylinder may be used for gas inlet or exhaust. Large valve area is particularly valuable in achieving rapid scavenging in the two-cycle engine. Sleeve-valve engines are relatively silent in operation.

It is possible to achieve any desired control of cylinder turbulence in sleeve-valve engines. Fuel injection is one of the secrets of the aircraft Diesel, and successful injection must be accompanied by proper swirl and stratification of the incoming air. The sleeve valve gives the designer a chance to secure these ends.

In all probability the best combustion chamber should have a perfect hemispherical shape. It is clear that this cannot be achieved with a poppet valve system, but is perfectly possible with the sleeve valve. It is further claimed that there is a decrease in the number of parts.

Perhaps Mr. Fedden has glossed over some of the difficulties, such as cooling through a double wall; namely, valve sleeve and cylinder proper. Also, actuating the sleeve valve through cams from the crankshaft is a nice mechanical problem. Probably an experienced poppet-valve man would have other "contrary" arguments to offer. Nevertheless, we will go along with Mr. Fedden in saying that the sleeve valve deserves full study on the part of American designers.—*A. K.*

Design Trends in Giant Flying Boats

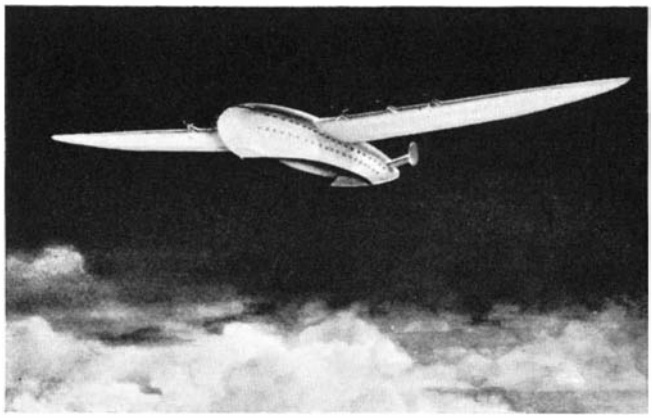
WHILE American, English, French, and German airlines are making their transatlantic survey flights with existing equipment, it is interesting to consider what transatlantic flying boats may be like in a very few years. According to a paper by I. M. Laddon and T. P. Faulkner in the *Consolidator*, even the latest Boeing Clipper is but a forerunner of greater things to come. These authors predict:

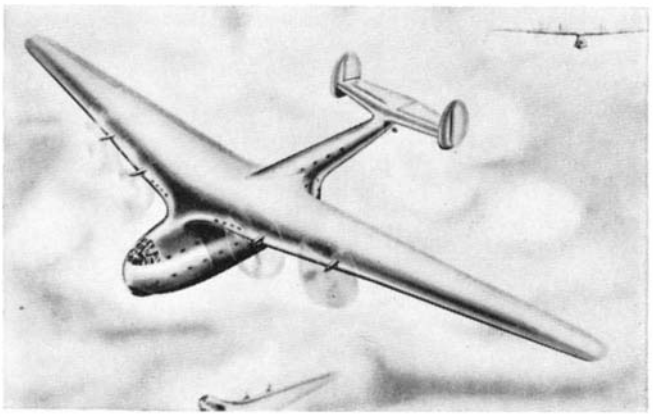
1—Increase in size to a gross weight of 400,000 pounds and more. 2—Three hundred passengers, with baggage, mail, and express, and a range sufficient to cross any ocean non-stop. 3—Speeds of over 300 miles an hour in the stratosphere. 4—Comfort and equipment fully equal to that of an ocean liner. 5—A means of "assisted take-off" (such as a catapult) so that schedules will not be affected by water conditions. 6—Increase in size of wings, allowing all passengers and operators to be accommodated within the wing; thus the hull will assume much smaller proportions and project far less below the wing. 7—Higher wing loadings and the use of stainless steel instead of aluminum alloys, particularly in places of great stress concentration. 8—Large, dependable, liquid-cooled engines completely housed. At the beginning of a voyage, all six engines might be brought into play, and then as fuel load is lightened, two engines might be taken out of commission with "hydromatic feathering" propellers set edgewise into the air stream.

Announcements of the bids recently submitted to Pan American Airways substantiate these trends. Five important companies—Boeing, Consolidated, Douglas, Seversky, and Sikorsky—have submitted designs which are being examined by a Technical Committee of which Colonel Lindbergh is a member.

The design presented by Consolidated Aircraft is to weigh 168,000 pounds and develop a minimum average cruising speed of 240 miles an hour for a 5000-mile range. Four liquid-cooled engines of 2150 horsepower each are to be located between spars in the wing, with an extension shaft driving the tractor propellers. Access to these engines will be available during flight for servicing and minor repairs. Auxiliary tip floats disappear into the wing in flight. It is proposed to house 36 passengers in the

Sikorsky's conception of the future Super Clipper





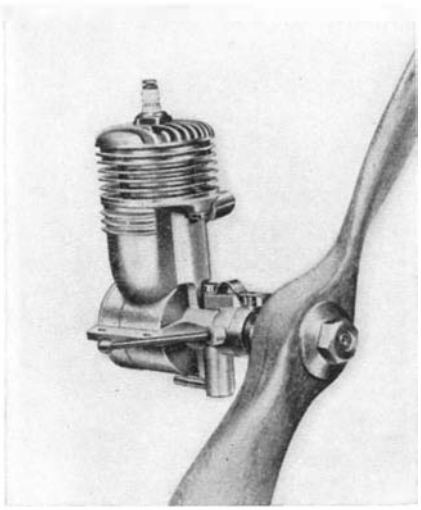
A projected 168,000-pound Consolidated flying boat

wing. The main problem encountered in putting the passengers within the wing was the interference with the cabin by the wing bulkheads or ribs. This was overcome by putting main bulkheads at the sides of each compartment and using arched auxiliary ribs which did not impair the effective head room of the compartment.

In the design submitted by Igor Sikorsky, the hemispherical nose of the beautifully streamlined hull is necessary for stratosphere use, with a supercharged cabin. The payload of the proposed Sikorsky flying boat will be 25,000 pounds and cruising speeds may reach 300 miles an hour.—*A. K.*

Speaking of Airplane Sizes!

THE mammoth and the midget, two extremes of airplane construction built in plants only a short distance apart, were both recently tested for the first time. The giant is the new Douglas luxury transport, largest



Height of this tiny engine is 3½ inches; it develops 1/7 horsepower

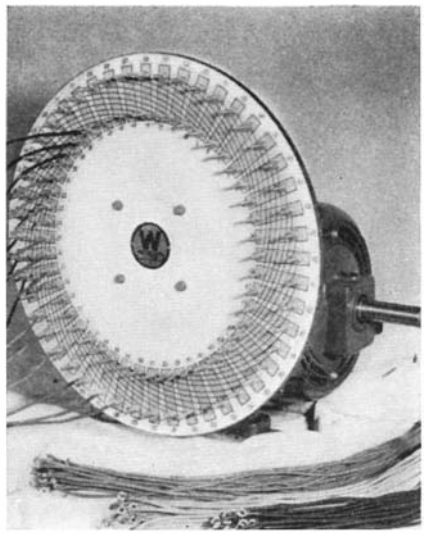
and most powerful airplane yet built. Its 65,000 pounds of streamlined metal, powered with four super-charged motors, will carry 42 passengers more than 2000 miles without refueling.

In relation to weight, the Phantom model plane, the midget mentioned, develops a flight range never remotely approached by the big Douglas or any other commercial airplane. The engine develops one seventh of one horsepower and will carry the 20-ounce plane five miles on its normal gasoline supply. If the Douglas transport could fly as far in proportion to its weight as can the Phantom, it could circle the globe ten times before landing to refuel.

The Phantom engine could be passed through an exhaust valve of the larger craft's power plant; its total height is less than 3½ inches.

Induction Motor for Educational Institutions

A PRACTICAL laboratory unit for demonstrating fundamental operation of alternating-current motors has been developed by the Westinghouse Electric & Manufacturing Company.



Front and rear views of the laboratory unit for demonstrating alternating-current motor fundamentals

This unit has the unique arrangement of a standard squirrel cage motor with a special circular terminal board. Inlaid under the top surface of the board is a representation of the 48 slots in the primary of the motor, together with numbered lines to show the actual location of the coils in the slots. The ends of these 48 stator coils are connected on the rear of the board to the studs shown as the ends of the coils when looking at the front of the board. This makes it possible to interconnect the coils in any desired manner by the use of leads or jumpers on the face of the board. The use of the numbers 1 and 101, 2 and 102, and so on, for the respective terminals at the end of each coil makes it easy to follow through when making connections. Three sets of colored leads are supplied so that groupings and phases can be identified by using different colors. This entire arrangement makes it possible to connect the motor for either two, four, six, eight, or ten poles and for either two-phase or three-phase power supply. Single-phase operation can be secured by connecting for two phase and using a capacitor (static condenser) in one phase.

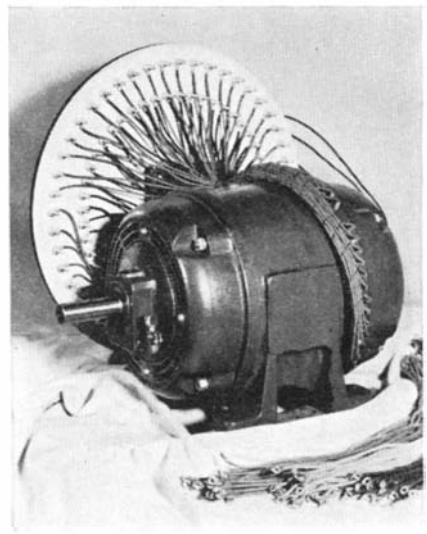
Glass Cloth in Electroplating

A BAG of glass cloth has been developed to put around the anode in an electroplating bath to catch any insoluble particles that might otherwise form holes in the electroplate. Recent improvements in glass cloth permit the construction of a bag from seamless tubing woven of glass which easily resists the chemical action of the electroplating bath. The lower end of the tube is sealed by a special process so that nothing but glass is in contact with the solution. The pores of the glass cloth give sufficient electrical conductivity so that the electroplating process is not changed.—*D. H. K.*

Government Seizes Poisonous Eyelash Dye

THE first seizure under the new Federal Food, Drug, and Cosmetic Act of June 25, 1938 has been made. The United States Department of Agriculture announced recently that on the recommendation of the Food and Drug Administration, the Federal District Attorney at Milwaukee, Wisconsin, caused seizure of a consignment of "Lash Lure, The New and Improved Eyebrow and Lash Dye." The Government alleges that this product is adulterated in that it contains a poisonous or deleterious substance—a coal-tar preparation, paraphenylene diamine—which may make it injurious to users.

The product against which the Govern-



ment has proceeded has an unenviable history, say Department officials. Numerous instances of severe eye injury to women who have used the product are on record, including a number of cases of total blindness. Until the passage of the new Food, Drug, and Cosmetic Act, the Government has been powerless to prevent continued traffic in this article.

Under the new Food, Drug, and Cosmetic Act the interstate shipment of dangerous cosmetics is immediately prohibited. The act, in most of its provisions, does not become effective until June 25, 1939.

New Process for Tin Plating

A NEW process for applying tin to fabricated articles of other metals consists in suspending the articles for a few minutes at 500 to 600 degrees, Centigrade, in an atmosphere consisting of a mixture of hydrogen and stannous chloride vapor. The process, called "Stannising," depends upon the reduction of stannous chloride to metallic tin by hydrogen on the surface of the metal to be coated. The thickness and other characteristics of the coating can be controlled by regulating the temperature and time of exposure.—*D. H. K.*

Adhesive Fastens Cuts When Stereotyping

A FEW months ago, after extensive research, Van Cleef Brothers, of Chicago, announced Plate-Tak as a new and economical means of attaching cuts to metal or wood bases in the process of making stereotypes. Plate-Tak, made with a special long fiber base, is an ultra-thin double adhesive tape having a very efficient adhesive coating on each of its surfaces. The successive

layers of Plate-Tak are kept from adhering to each other in the roll by means of a protective Holland cloth backing such as the manufacturer of this product has used on its rubber insulating tapes for years.

Much of the printing in the newspaper field is done from stereotypes which are the result of molding type metal in papier-mâché forms or matrices which are first given reverse impressions from original type faces and cuts or electrotypes. It has long been the practice to use small brads or tacks to hold the cuts in place during the impression process. Plate-Tak, however, is replacing this method which took considerable time and exposed the cuts to damage in the mounting operation.

When mounted with Plate-Tak, cuts or electrotypes are so securely anchored in place that the pressure roller will have absolutely no effect upon them, and because of the extreme thinness of the product, Plate-Tak will cause no bumping-up effect when the impression is made.

When it is desired to release a cut from its base, it is only necessary to pry the cut upward and roll off the Plate-Tak which always removes cleanly and with ease. Cuts, however, will not slip laterally or longitudinally while on their base.

Jungle Mosquitoes Transmit Yellow Fever

JUNGLE-BRED mosquitoes can harbor and transmit yellow fever, a Rockefeller Foundation research team at Rio de Janeiro reports in a communication to the journal, *Science*. Until recent years yellow fever was regarded as a house disease, but when in 1932 it broke out under rural and jungle conditions the existence of a jungle type of the disease became evident.

During the epidemic of this year, jungle mosquitoes were caught and allowed to bite monkeys in order to determine whether they carried and transmitted the disease. The research workers were Drs. R. A. Shannon, Loring Whitman, and Mario Franca of the Co-operative Yellow Fever Service of Brazil and the International Health Board.—*Science Service.*

FLEECE

A CENTURY ago the average annual fleece weight of sheep was only about two pounds and wool production was concentrated in the North Atlantic States. Today the annual fleece averages about eight pounds and wool growing is most important in Texas, the far West, and Ohio.

Better Use of Anti-Freeze

LOSS of anti-freeze from modern automobile engines equipped with thermostats occurs principally through leakage and overflow, according to a recent investigation made by the Ammonia Department of the Du Pont company. It was found in this investigation that the amount of methanol anti-freeze which boiled out of the radiators was only a very small fraction of the total loss and that the total loss of so volatile a material as methanol was very little different from the loss of anti-freeze materials which did not boil away. Comparison between methanol, which boils at 149 degrees, Fahrenheit, and ethylene glycol, the boiling point of which is 387 degrees, Fahrenheit, shows the losses to be very nearly the same. This similarity of behavior is accounted for by the fact that when methanol boils out of the solution some of the water boils away at the same time and also that the overflow and leakage from the system take out both methanol and water. The recommendation is that in replacing anti-freeze in cars equipped with thermostatic radiators the anti-freeze be added in solution instead of straight. Thus a radiator protected by methanol to 0 degrees, Fahrenheit, should contain originally about 27 percent methanol, and 27 percent methanol solution should be used to make up losses.—*D. H. K.*

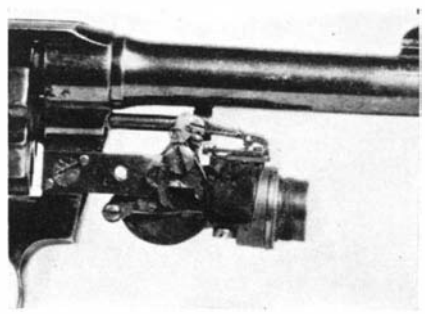
Wooden Stamp Pad

A NEW stamp pad is made of a block of wood with the grain surface exposed. Developed by the Phillips Process Company, Inc., this pad is always flat, firm, and free from lint; samples that have been tested indicate that it does not become sticky. A special ink is used that is not affected by moisture or humidity and always gives a clean, sharp, uniform impression.

Prevention of Stream Pollution

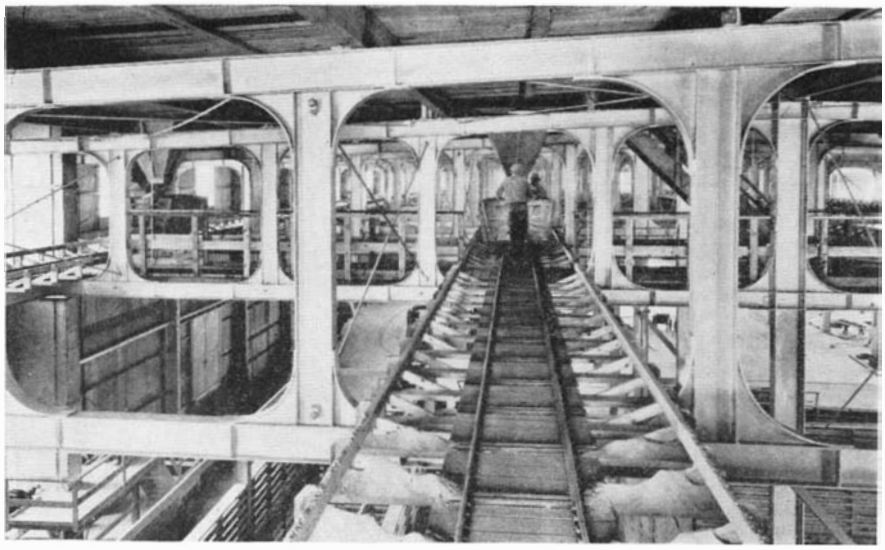
IN the iron and steel industry an outstanding problem is to prevent stream pollution by waste liquors from such operations as pickling, in which metal is commonly acid-treated. This industry, after many years of heavy expense in endeavoring to solve this problem, has recently founded, through the American Iron and Steel Institute, a fellowship at Mellon Institute of Industrial Research, in Pittsburgh, with the aim of acquiring novel ideas and attempting a definite solution just as soon as possible.

According to word from Mellon Institute, this investigation will be carried on thoroughly until concluded to the satisfaction of



Photographs from Mirzaoff

This combination of a revolver and a miniature camera, devised by A. Kurnick, should get its man either with a bullet or on sensitive film. When, as above, left, the gun is fired at an intruder, there is always recorded on the film a photograph of the law-breaker. In the top center illustration the inset shows the actual size of a contact print from the negative, the larger picture being an enlargement that gives sufficient detail to be of value to the police in tracing the criminal. Details of the camera mechanism are shown in the other three illustrations. The film, sufficient for six exposures, is carried on a hexagonal spool which is rotated every time the trigger is pulled, in order to bring a new frame into position. The trigger also operates the shutter mechanism. A single screw holds the six-ounce camera to the revolver



Industrial cars operate within the roof trusses of this new building

health and industrial authorities. It will be the objective to treat or process the waste liquor of pickling plants so as to render it entirely safe for discharging into streams, recovering from it chemicals from which useful products can be made economically.

Thousands of tons of iron and sulfuric acid are now wasted annually in various districts of this country by the lack of a suitable method of treatment, especially a procedure that can be employed on the large scale necessary in big mills; through the fellowship at Mellon Institute a concerted effort will be made to take out the chemicals in solution in the liquor and to discover uses for them.

Cars Ride Through Trusses

FARMERS throughout the rich agricultural areas which spread out like a fan at the foot of Lake Michigan will soon be driving up to the world's most completely mechanized fertilizer plant in Chicago Heights, Illinois, for scientifically blended chemicals to meet their soil conditioning needs.

Inside the International Agricultural Corporation's new plant, located a block from the Lincoln Highway, a crew of 30 men are establishing new highs in efficient operation for this industry. The plant represents the first commercial application of the portal truss designed by engineers of The Austin Company to simplify the installation of conveyors, ducts, walkways, or other facilities in otherwise useless roof areas. By eliminating all diagonals from the trusses in this all-welded structure, they have opened up 12 seven-foot passageways just below the building's roof, so that industrial cars could ride right through on tramways which are supported on and extend between the trusses.

From a structural standpoint the plant suggests many interesting future uses for the portal truss. According to Austin Company's engineers, these welded trusses open up three entirely new conveyor levels, which will be of particular value in the bulk handling of materials for chemical, paint, rubber, and food industries, not to mention many metal working fields. Tram rails can be suspended from the upper chord of the truss and stretched between trusses to carry materials through the upper portion of the portals, while tram cars operate below but still inside the portal. In addition, monorails can be installed directly on the bottom chord of the roof trusses, to operate below the truss, the lower flange of which can be adapted to serve as a rail.

Kaufmann-Fabry photographs

Realistic outdoor effects are obtained in a skyscraper room through the use of photomurals set within frames and properly lighted, as shown above and below. In this case, the murals are part of a memorial room

LEMONS

LEMON imports have dwindled during the past 20 or 30 years to insignificant proportions, while California's production has steadily increased. During the five-year period, 1927-31, that state's average production was 6,800,000 boxes, while in the following five-year period production had stepped up to 8,100,000 boxes.

Photomurals Recapture Outdoors for Memorial Room

FOURTEEN stories above the streets, in the midst of Chicago's crowded west side, a quiet room has been set apart as an unusual memorial to an unusual man.

There are no plaques, no busts, no commonplace mementoes. On a sturdy workbench is a small lathe. On the wall is its motor. Over there, on another bench, are interesting looking tools, neatly arranged. Evidently, the man who used these things was something of a philosopher and an artist, too, for clippings and maxims are tacked to the walls and window frames; from the windows one looks, not down upon a smoke-scarred city, but into what appears to be an actual shaded yard, a massive tree and at the right, a cluster of shimmering bamboos! All this 150 feet up in the air!

This skyscraper sanctuary, on one of the top floors of the University of Illinois Medical and Dental Building, is, in effect, a restoration of the California laboratory of the late Edward Hartley Angle, the father

of one of humanity's most beneficial services—orthodontia—the science of straightening teeth.

The window frames and sash are set in a false wall. The scenes observed through the panes are not real, but strikingly natural illusions produced by means of large photomurals. The views are taken from actual photographs snapped from the windows of Dr. Angle's original laboratory in Pasadena. They have been enlarged to proper scale, colored, and lighted to give an unusually realistic effect.

ARTHRITIS

THE scope of the economic problem of arthritis, one authority states, is seen by the fact that in the United States alone it causes a loss of over 7,000,000 work-weeks at an approximate cost of $200,000,000 a year.

Leakless Fountain Pen

FOR many years attempts have been made to perfect the fountain pen so that there will be no leakage at any time. The first friction cap was a notorious offender, often soiling fingers or opening in the pocket so that clothes were badly stained. Some of its shortcomings were corrected by the development of the screw cap, in which a shoulder fits tightly against the flat rim at the base of the pen point. Changes also have been made in the feed in the endeavor to prevent pumping of the liquid and flooding of the point.

Mr. Julius L. Schnell, an inventor long associated with the development of some of the most famous pens on the market today, tackled this problem and has solved it by an ingenious yet simple invention. Mr. Schnell reasoned that when the pen is carried in the pocket, the heat of the body expands and compresses the air in both the cap and in the barrel above the level of the ink. When the pen is removed from the pocket and the cap is unscrewed, the compressed air in the barrel expands through the feed, carrying with it a certain amount of ink. Thus the pen is often flooded around the feed and point.

The invention which Mr. Schnell has made to correct this fault and on which he has received a patent consists in the insertion of a tiny perforated bushing in the side of the cap to give a free outlet for the air imprisoned within. By means of this air outlet, air escapes as fast as it expands so that there is no built-up pressure within the barrel of the pen. Tests show that this invention keeps both the point and its feed dry at all times, and it remains only for the point to be so designed that proper feeding is always assured.

Dry Cleaning Solvents Clean Coal

BY using the difference in specific gravity between coal and slate, more accurate separation and cleaner coal are being produced by a new method employing heavy synthetic liquids similar to the solvents used in dry cleaning. The liquids used are mixtures of the so-called halogenated hydrocarbons, which are several times as heavy

as water. Mixtures are made which have a specific gravity just between that of coal and of the refuse to be separated. Cracked coal as it comes from the mine is wetted with water and passed through a bath of the heavy liquid. As a result the coal separated by floating has less ash and a higher heating value. After the treatment the liquids used are easily recovered. A typical mixture could be made of pentachlorethane and tetrabromoethane.—*D. H. K.*

Passengers on the Pennsylvania Railroad's Broadway Limited have at their command a secretary with a fully equipped private office. Although the secretary will work anywhere in the train that a passenger may request, most patrons prefer the quiet of the office where letters and messages may be taken directly on a noiseless typewriter

Artificial Emeralds

IN case you plan to give your wife or fiancee an emerald necklace, you need not worry about being swindled with a man-made imitation.

It is true that chemists can make real emeralds which resemble, in many respects, those dug from the ground. But it costs far more to make them than to dig them and there are differences which can be detected by almost any jeweler or mineralogist.

A Dash of Bitters

EXCEPT for milk, most popular beverages are conspicuously bitter; some people drink only chocolate-flavored milk, which is bitter. Coffee and coffee substitutes are bitter and "burnt"; tea, maté, and cassina are bitter and astringent; cocoa is bitter and aromatic; tomato juice, citrus juices, and many manufactured soft drinks are conspicuously bitter and sour. Beer is outstandingly bitter.

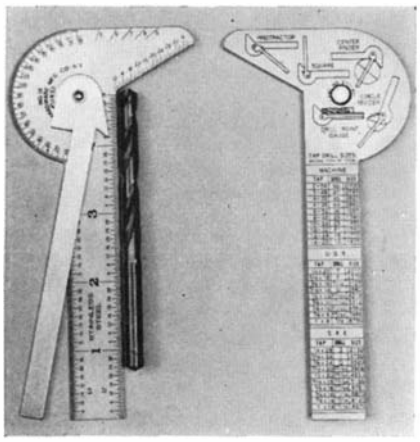
There is an old belief, perhaps in part true, that bitter things stimulate appetite. Based on this theory were the "stomach bitters" of a generation ago, and possibly some of the current vogue of *hors d'œuvres* and *smörgåsbord.* Bitters are being incorporated into the flavor of some brands of sausages. A breakfast starting with bitter grapefruit, followed by bitter coffee, and perhaps with

marmalade, is satisfactory to many, although sweetness is often used to tone down the bitterness.

Perhaps the broadest interpretation of the use of bitterness is that, as one of the four fundamental tastes, it has to be included in all highly-flavored dishes or drinks. Its presence in large amounts allows increase of the other taste factors so that a strong-tasting article is possible without the taste unbalance that would be so obvious in its absence. There is a sound physiological basis for table condiments including sugar for sweetness, salt for saltiness, vinegar or lemon juice for the sour tang, and meat sauces, pepper, and mustard competing for use in imparting bitterness.—*The Industrial Bulletin* of Arthur D. Little, Inc.

A Versatile Rule and Gauge

THE simple device shown in our illustration can be used for many purposes by mechanics, toolmakers, draftsmen, experimenters, and all tool users. Its principal arm is graduated on one side with a 1/64-inch



rule and with a 1/32-inch rule, while the curved end piece is graduated in degrees so that with the auxiliary arm swung out the tool becomes a protractor. The angular end serves as a drill point gauge.

On the reverse side are a number of designs showing the manner of using this tool; also given are three tables of tap drill sizes—machine, U.S.S., and S.A.E.

This tool is made of stainless steel for long use and comes in a leather case.

School Books Not Likely to Carry Disease Germs

EVERY so often in some community comes up the question of disease germs being spread by school books. This is only natural since books handled by patients having tuberculosis, scarlet fever, diphtheria, meningitis, infantile paralysis, and kindred diseases are more than likely to get some of the germs on them either from the patient's breath in sneezing or coughing or from his hands.

A pretty clean bill for ordinary school books, however, and some recommendations on books in general, are now presented by Arthur H. Bryan of the science department of Baltimore City College. He collected pages from very old and from newer school

books, most of which had been recently used by students, cut up the pages, soaked them and shook them in sterile water for from 15 minutes to one hour, and then transferred some of the water to germ-growth media to get some idea of how many germs actually had been on the pages of the books.

Ordinary school books, surprisingly enough, showed very few germs and those mostly of a harmless variety. Books that are not too old or dilapidated, he concluded, are not serious carriers of infectious diseases. School books that are kept for some time before being redistributed do not seem to have many living disease germs on their pages. Old books with visible dirt and grime smeared over their pages are capable of harboring many more disease germs than clean or new school books.

Mr. Bryan recommends that old school books which are frequently exchanged should be opened up and sunned for several hours. Books used by sick children should not be handed out to other students immediately (most germs die or lose their virulence if kept away from body tissues for a while). Books which are dilapidated, out of date, and filthy with grime should be destroyed. Books coming back from quarantined homes should be destroyed or held for several months before redistribution.—*Science Service.*

DIESEL OIL TAX

THIRTY-SIX states now tax Diesel fuel when it is used in the propulsion of motor vehicles on the highways.

CARRIERS OF RADIOACTIVITY

THE high cost of radium and the intensity of its radiation have encouraged research workers to seek material on which radium or radium emanations can be spread in such a way as to dilute them without interfering with their valuable qualities. Investigators in Prague, Czechoslovakia, have recently found that silica gel combined with heavy metals and alkaline earth hydroxides yield compounds having high absorbing ability for radioactive salts and yielding stable emanations. Good results have been obtained with the hydroxides of magnesium, manganese, cobalt, aluminum, and nickel combined with iron and mixed with silica gel to form an absorbing base for radioactive salts. The effect of this is to give a more accurate control of the application of radiations of radium for medical use.—*D. H. K.*

U. S. FOURTH IN NUMBER OF NOBEL PRIZE WINNERS

THE United States ranks fourth in the number of Nobel Prize winners, it is shown in a survey completed by Prof. Harrison Hale of the University of Arkansas for the American Chemical Society. Eighteen Americans have been honored with the prize since it was first inaugurated in 1901 under the will of Alfred Nobel, discoverer of dynamite.

Germany leads the list of nations with 37

winners, England comes second with 23.5 winners, and France is third with 20.5. The half winners merely mean that some years the prize has been split between two men.

The Nobel Prize, granted for outstanding achievement in physics, chemistry, medicine, literature, and on behalf of international peace, has changed in its award pattern in the last decade, says Prof. Hale.

In prizes awarded in the last 10 years England and the United States lead with 10 each. Germany comes next with 9.5, and France has dropped behind with only four winners. During this time the relative position of the United States has improved 63 percent, a change mainly due to the improving caliber of American scientific achievements. A similar improvement in the next decade would raise the United States to second place.—*Science Service.*

Controlling Volatility of Perfume Oils

MANUFACTURERS of the odorous oils of cedar wood and cedar leaf have borrowed from the technique of the formulators of lacquer solvents to increase the useful life of their oils. The oils of cedar wood and cedar leaf are used in polishes, coatings, insecticides, and disinfectants, but on exposure to air they soon evaporate and lose their usefulness. Mixtures of the two have a longer life than either alone, but by the addition of certain resins and other materials, the rate of evaporation of either of the oils or a mixture of them can be made materially slower. In this way the life of cedar-treated moth-proof containers can be materially lengthened.—*D. H. K.*

Blueprint Kit is Portable

OFTEN the engineer or architect wishes to make numbers of reproductions from small drawings or specification sheets. Lacking a machine for making them, he must wait until they can be turned out for him by some professional blueprint organization. To solve this problem the Vandenwood Company has developed what they call the Baby Blue Personal Blueprint Kit. The maximum size prints made with this machine measure 9 by 18 inches.


For office blueprinting jobs

This outfit consists of the blueprinting unit proper, which is a glass cylinder mounted on a cast aluminum base and carrying two conventional light bulbs. Operation is on a 110-volt lighting circuit. The tracing and sensitized paper are wrapped around the outside of the cylinder and held in place by a Fabrikoid shade, one end of which is fixed and the other rolled on a roller of a special design. Operation is by means of fixed cables at top and bottom.

This machine is not continuous. When tracing and paper are in place, a conveniently located switch in the extension cord is manually operated and exposure is timed in accordance with instructions. After exposure the blueprint is washed and fixed in pans which are supplied with the kit. Fixing solution and a rubber roller are also provided.

Traveling Oven Temperature Recorder

A NEW portable recording thermometer for use in traveling baking ovens, finishing ovens, enameling ovens, and so on, has been developed by The Bristol Company.

The instrument passes through the oven on the conveyor with the "work" and gives a continuous record of the temperatures to which the heated product is subjected as it passes through the oven. The record is made on an eight-inch round chart arranged for 24-hour or seven-day clock rotation. These thermometers are especially useful in large enameling ovens in plants where electric and gas heaters and ice refrigerators are manufactured. They are also extensively used in ovens for treating the finish on automobile bodies. In this type of work they are valuable in maintaining the proper temperature for the color of the finish desired.

Fire Hazard From Oil on Water

FIRE hazard from oil or gasoline spilled on water over which it can spread freely is much less serious than has been ordinarily supposed. A recent thorough investigation of the flammability characteristics of gasoline and oils under such circumstances, as reported in *Oil and Gas Journal*, led to the following conclusions:

1. Only gasoline and some light naphthas will ignite or burn.

2. Tremendous quantities of gasoline are required to cover even a few acres of water.

3. Gasoline weathers rapidly when exposed in thin films and will not ignite after a short exposure.

4. Gasoline will not ignite other oils such as kerosene either when mixed with them or lying adjacent to them on the surface of the water.

Apparently the effect of the water in keeping the oil layer cool, the action of moving

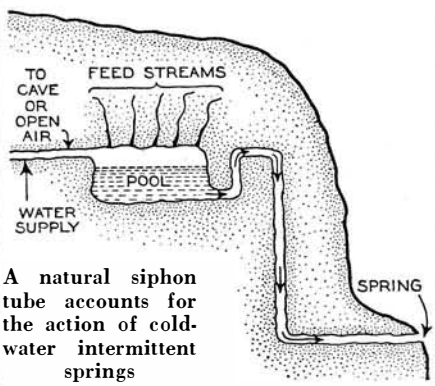
air in diluting and removing the more flammable constituents of the oil, and the thinness of the oil layer when it is free to spread over the water surface are important factors in the change of its properties and behavior.

The extreme thinness of films of oil on water is seldom realized. Gasoline, for example, may yield a film from 7 to 15 thousandths of an inch in maximum thickness. To form such a film over a square mile of water surface would require between 122 and 261 thousand gallons of gasoline! Heavier oils form thicker films (up to 50 thousandths of an inch thick) and one hundred tank car loads of them are required to form such a film over a square mile of water.

All of which explains why oil fires are not more destructive in times and areas of high floods.—*D. H. K.*

Intermittent Springs

HERE and there occurs a spring that flows a while and stops a while, flows a while and stops a while, day in and day out, year in and year out, to the mental confusion of those who, not knowing their cause, invent explanations of them as fanciful as a medieval gnome or hobgoblin. There are two kinds of these intermittent springs, as explained by the meteorological physicist,



A natural siphon tube accounts for the action of cold-water intermittent springs

Prof. W. J. Humphreys, of the United States Weather Bureau at Washington, D. C., in the *Monthly Weather Review*, namely, the cold-water kind which every physicist understands, and the hot-water kind that not even the chemist fully understands in every particular.

The flow of the cold intermittent spring is just the emptying of an underground, air-connected (essential for rapid outflow), water cavity by a natural siphon tube, as shown in the diagram. Obviously, when the reservoir is emptied to the level of the siphon intake the flow ceases—the spring goes dry and stays dry until the reservoir fills again to the level of the highest bend in the tube, whereupon the flow and the stop occur again as before, over and over without end.

The hot-water type, confined to volcanic regions, commonly is called a geyser, Professor Humphreys continues, even when it just mildly overflows. Its intermittent spurts appear to be the repeated blowing out by steam of an underground reservoir that as often fills up again. Where all this water comes from and how it gets into the steam chamber are not known to the complete satisfaction of everyone. It is easy enough to make a laboratory geyser that works perfectly, but that does not prove that Nature made hers on the same plan—she is very resourceful.

Conducted by JACOB DESCHIN

A Record of Growth

THIS is the story of a yam and how it sprouted—and *how*. After we had nursed two along in this way and found them worth their care, it occurred to the photographer of the family to make a step-by-step (or nearly so) record. The series of five pictures here reproduced is a partial result. It is obvious that all were taken by daylight.

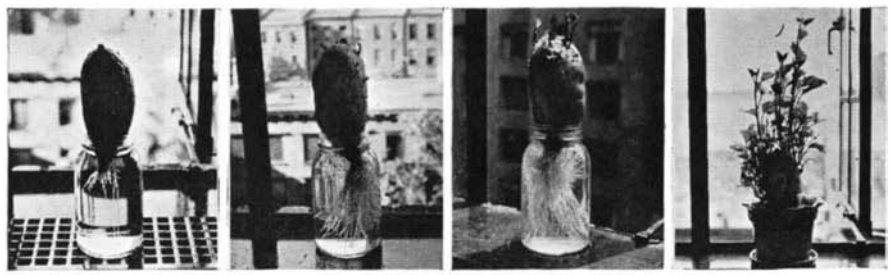
The first three photographs were made chiefly to display the roots to the best advantage, although in the third case a cardboard reflector was employed to show some detail on the camera side of the potato. The best effect was obtained with the camera tilted downward in order that relatively dark areas rather than the sky itself might serve for backgrounds. The fourth shows the "transplanted" potato and the last picture in the series gives some idea of the possibilities of this "poor man's fernery." But you should see it now as the runners extend the length of a six-foot window sill!

For those of our readers who may not be familiar with this type of plant, it must be stated that the feat is accomplished with an ordinary yam purchased at the grocer's. The yam is inserted root-end first in a preserve jar full of water and the water changed daily. After a few days the roots start "coming out" and some time afterward little growths push out of the upper end of the potato. The next step is to transplant the potato to a pot full of top soil, water daily and watch it grow, carefully arranging the vines in the way you want them to grow.

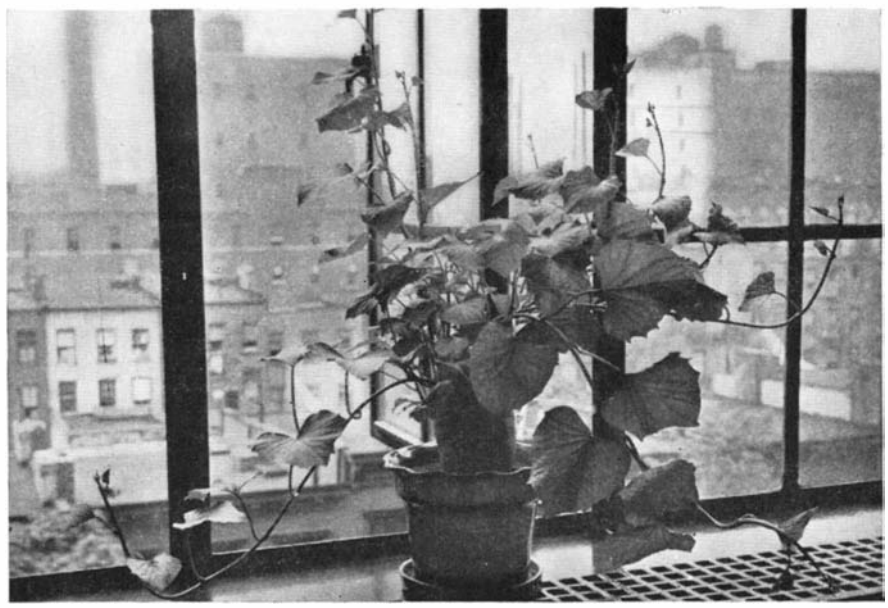
In making such a photographic series as this, or a similar one, the temptation arises to make too many pictures, some of which are for practical visual purposes little more than duplicates of each other. While it is both instructive and interesting to have as complete a pictorial record of the development of the plant as possible, the individual pictures should be limited to those which show real differences.

In the lighting of the illustrations repro-

(*Please turn to page* 210)



A brief photographic record of plant growth



The full-grown plant

Third Annual

SCIENTIFIC AMERICAN

Amateur Photography Contest

$225 IN PRIZES

TO present more opportunity to a greater number of amateur photographers, Scientific American's Third Annual Photography Contest has been planned on an entirely different basis from former contests. Contestants may enter prints in any or all of three separate divisions, thereby being assured that their work will be in competition only with similar efforts submitted by others.

Three Divisions To Enter

Division 1. **Human**—including portraits and other camera studies of people.
Division 2. **Landscapes**—including all scenic views, close-ups of parts of landscapes, seascapes, and so on.
Division 3. **Science and Industry**—including laboratory and factory scenes, technical aviation and natural history photography, and so on.

In each division the prizes awarded will be:

First Prize $50
Second Prize $25

Five Honorable Mentions, Each to Receive a One-Year Subscription to Scientific American

The scope of each one of the divisions has been purposely generalized to a certain extent in order to permit the individual amateur to apply his own ingenuity to the interpretation which he will achieve with his photographic study.

The rules are few and simple, but please read and abide by them to insure against disqualification.

RULES OF THE CONTEST

1. The groups will be judged independently on the basis of pictorial appeal and technical excellence. The decision of the judges will be final. In case of a tie for any prize, duplicate prizes will be awarded to the tying contestants.

2. Prints must not be smaller than 5 by 7 or larger than 11 by 14. Prints need not be mounted, but may be at the contestant's option.

3. Photographs must be submitted by first class mail, packed properly to protect the prints.

4. Each entry must have the following data written on the back of the print or mount: Name and address of contestant, type of camera, and film used.

5. Contestants may submit only one print in each group, but may enter any or all groups.

6. Prints must be in black and white. Color photographs are not eligible.

7. Prize-winning photographs will become the property of Scientific American, to be used in any manner at the discretion of the publisher.

8. Scientific American reserves the right to purchase, at regular rates, any non-winning entry.

9. Non-winning entries will be returned only if sufficient postage is included when the prints are submitted.

10. No entries will be considered from professional photographers.

11. All entries in this contest must be in the hands of the judges by January 2, 1939. Results will be announced in our issue dated March 1939.

12. This contest is open to all amateur photographers who are not in the employ of Scientific American.

The judges:

McClelland Barclay, artist
Robert Yarnall Richie, commercial photographer
Ivan Dmitri, artist and photographer

Address All Entries to

PHOTOGRAPH CONTEST EDITOR

SCIENTIFIC AMERICAN

24 West 40th Street, New York, N. Y.

duced, it must be confessed that had the photographer not been quite so lazy (at the time), he might have improved the job to some extent by using some kind of lighting from the inside of the room as well as daylight. This lighting, when used, is sometimes effectively furnished with a white reflector properly angled. If artificial lighting is used this should be carefully done—just enough to do the job yet soft enough not to overbalance the daylighting. In the case of such pictures as the first three of the series presented, it is better to use only daylight and thus obtain the full effect of the desired translucence. Many subjects, too, may be photographed outdoors and in that case, because of the tremendous diffusion of the lighting afforded by the great dome of the sky, lighting difficulties such as these will not arise. Incidentally, it must not be overlooked that the employment of a reflector with outdoor subjects has its uses just as effectively as indoors, although the contrast between the highlights and the shadows may not be as great as those obtaining with indoor window-sill photography.

Shoot the Troubadours

THE troubadours of the city streets may sometimes prove annoying to one's musical sensibilities, but they frequently offer picture possibilities exciting enough

"Pied Piper"

to offer ample compensation. This department found such a subject in the "Pied Piper." The children trailing after him furnished the idea and completed the subject. The diagonal composition provided the effect of forward movement as well as a generally pleasing arrangement.

Rolleiflex Salon on Tour

FOLLOWING its exhibition in New York City this year, the Third Rolleiflex-Rolleicord Salon is now on tour throughout the country. The show has been seen in San Francisco, Los Angeles, Hollywood, Omaha, and Denver, and is scheduled to be shown during September in Boston, Buffalo, and Cleveland; in October in Detroit, Chicago, St. Louis, and Louisville; and in November in Indianapolis, Cincinnati, Pittsburgh, Washington, Baltimore, and Philadelphia. Herbert Peerscke, of Francke & Heidecke, is in charge of the traveling salon of 250 selected prints.

Bargain Counters

TAKE a tip from the housewife and look for the specials and the bargains in cameras and accessories. With many items it

really makes little difference whether the equipment or photographic supply is purchased new or used or shopworn; just so long as it will give satisfactory service it is practically "as good as new." And the difference in the price is often considerable. The advertisements of the various photographic dealers and distributors are worth scanning periodically, but a better plan, because many items are too small to warrant the cost of inclusion in an advertisement, is to visit your dealer at frequent intervals, if only for "just looking around." It is on such occasions that sometimes you will run across some long-wanted item that you felt you could not afford at the regular price but which now, at the greatly reduced price, brings it well within reach of even a lean pocketbook.

WHAT'S NEW

In Photographic Equipment

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

New Films

THREE films designed for greater light sensitivity and finer grain are now on the market under the names Kodak Plus X Panchromatic, Panatomic X, and Kodak Super-XX Panchromatic films. They are made in 35-mm and 828 sizes. Recommended for general use in miniature cameras, Kodak Plus-X Panchromatic is declared to have about twice the speed of, and as fine grain as, Kodak Panatomic and about 50 percent greater speed than Kodak 35-mm Supersensitive Panchromatic. For Panatomic X, said to possess even finer grain than the fine grain of the original Panatomic film, though without any increase in speed over the latter, the manufacturers claim the possibility of making enlargements "of a size which will exhaust the sharpness of images before graininess is visible."

Kodak Super-XX Panchromatic is reported to have about four times the speed of Kodak Panatomic and more than twice the speed of Kodak Super-X Panchromatic, both in sunlight and artificial light, with a finer grain than that possessed by "any other film anywhere near this speed." For maximum emulsion speed the manufacturers recommend full development in Kodak Developer D-76.

The manufacturers further make the statement that "it is possible to overexpose these new films to the extent of 100 times the minimum exposure necessary to provide a reasonably good print."

Agfa Isopan New Type film, available in all standard sizes on safety and nitrate base, replaces Isopan film, which it doubles in speed. The new film possesses extremely fine grain, according to the manufacturers, as well as brilliant gradation and full color sensitivity.

Bearing a similarity to Agfa Superpan Portrait in gradation and color sensitivity, a new cut film, Triple S Pan, is available in standard cut-film sizes of 3¼ by 4¼ inches, 9 by 12 cm, 4 by 5 and 8 by 10 inches. The Triple S Pan, say the makers, "provides a speed advantage of one full lens stop over

Superpan Portrait and Supersensitive Panchromatic cut films." The price of this new Agfa film is approximately 10 percent higher than Superpan Portrait cut film.

Formula X33

DECLARED to embody "entirely new developing agents and chemicals" and possessing "qualifications and chemical performance hitherto never attained in any other product," Formula X33 ($1.85 a quart) is the newest fine-grain developer to appear with claims of proved performance at temperatures as high as 85 degrees. The following synopsis of the laboratory report tells the complete story: Temperature range—may be used for developing negatives at temperatures ranging from 65 degrees to 85 degrees, Fahrenheit, with perfect safety. Stability—stable in all climates; not affected by repeated temperature changes; does not oxidize readily through constant use or exposure to air. Non-staining—does not stain the hands, the reducing agents in the developer being comparatively non-toxic. Development—at normal temperature and in cool weather, rinse of a minute or two between development and fixation is sufficient; when temperature of developer and room is above 78 degrees, good short-stop bath required. Fixation—temperature of the fixing bath has no effect on the results if it does not exceed 80 degrees. Exposure—films should be exposed at their maximum rated speeds. Fine grain—negatives developed in Formula X33 are brilliant and free of fog; there is a wealth of detail in the shadows; negatives reproduce a well balanced photographic scale; the size of the grain of the developed image is very fine, the clumping together of silver particles being entirely eliminated due to the very even distribution of the silver grains. Economy—32 ounces of stock solution will develop 20 rolls of 36-exposure, 35-mm film or its equivalent of surface area in other sizes. Character of negatives—clear and of a neutral grey-black in color. Storage of developer—may be kept any place irrespective of prevailing temperatures or climates for indefinite periods in its original stoppered bottle; does not need chilling before use unless its temperature exceeds 85 degrees.

New Speedgun Release

DESIGNED for use with cameras that focus from the front bed, a new release mechanism for the Mendelsohn Speedgun (release, $2.50) has been introduced to speed the transfer of the fingers from focusing knob to flash release. The plunger of a standard cable release attaches to the bed of the camera in such a manner that one hand operates both the focusing knob and the cable release button. The other end of the release screws into a small socket in the body of the gun. In use, the camera is focused in the regular way, and the shutter and flash are set off by touching the button of the conveniently placed cable release.

Photometer

THE M.C.M. Photometer ($4.85) was designed primarily to eliminate guesswork, and the nuisance of test strips, from the enlarging process. It can also be used to determine the density scale of any negative and

thus gives a definite indication of the proper grade of paper to use in each case.

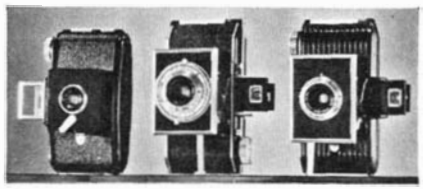
It makes use of the well known "grease spot" laboratory method of light measurement. Operating directly from any 110 volt A.C. or D.C. power source, it is simple and easy to use as it reads directly in seconds of exposure.

Zephyr Camera

A 35-mm camera in the low price field, the Zephyr Candid Camera is offered in two models, each equipped with a two-inch Wollensak lens, one *f*/2.9 ($29.50), the other *f*/3.5 ($22.50). An ever-ready leather carrying case ($4.95) is available. The Zephyr includes the following specifications: Balanced focal plane shutter; speeds from 1/25th to 1/500th, as well as time and bulb; diaphragm stops ranging from *f*/3.5 (or *f*/2.9) to *f*/16, hard aluminum alloy case, leather covered, with brushed aluminum trimmings; automatic film counter; accommodates standard 36-exposure 35-mm film spools; Wollensak telescopic view finder; winder lock, built-in range finder attachment; tripod screw bush in base; finger and cable release.

Three Kodak Bantams

KODAK Bantams *f*/8 ($4.75), *f*/5.6 ($16.50) and *f*/4.5 ($27.50) are announced as the latest members in the Bantam line. The *f*/4.5 has a body and back of die-cast aluminum covered with black morocco-grain Kodadur, a self-erecting front, revolving lens mount focusing from 4 feet to



infinity, and lens openings down to *f*/16, with shutter speeds from 1/25th to 1/200th, including time and bulb. The *f*/5.6, with lens openings to *f*/16, has shutter speeds to 1/100th, with focusing from 4 feet to infinity, self-erecting front, folding eye-level optical view finder, and automatic film centering. The *f*/8 supersedes the Kodak Bantam with doublet lens. The front comes into position at the touch of a button; a folding open-frame eye-level view finder is provided and film frames are automatically centered. The *f*/8 is a fixed-focus camera giving sharp negatives from five feet to infinity. With an 8A Portrait Attachment snapshots may be made at 2½ feet.

Each of the three cameras loads with 8-exposure rolls in the 828 sizes and produces negatives 28 by 40-mm.

Projection Apparatus

THE Diafant Model 1 ($69) and the Diafant Model O ($49) projectors are now available in this country. The former has a projection system based on a 250-watt bulb and is equipped with a polished glass reflector, three 60-mm fixed condensers, and a heat absorption filter. The lens is an Omar *f*/3.5, 100-mm focus and the front assembly re-

volves to permit the projection of either vertical or horizontal pictures. Accommodating either film strips or 2 by 2 inch slides, the Diafant Model 1 is provided with a shielded reading window for identification of slides during projection.

The Diafant Model O uses a 100-watt bulb and is somewhat smaller than the Model 1. All other details correspond with those of the larger model, with the exception that the lens is a 90-mm Parastigmat *f*/4.5.

Saymon-Brown Range Finder

THE Saymon-Brown Range Finder ($4.75), designed for use with cameras not equipped with a built-in range-finder focusing device, is declared by its makers to be of "fool-proof, shock-proof construction." The range finder is provided with a distance disk on which the numbers are clean-cut. Finished in black and chrome, the device has an extension foot for attaching to a camera and is provided with a leather case. The distances range from 2 feet 6 inches to infinity.

Pic-Sharp

DESIGNED for facilitating ground-glass focusing, Pic-Sharp is the latest aid to photographers who find difficulty in focusing. The new device is made of soft pliable rubber, in the center of which is a magnifier lens that triples the size of the image. The manufacturers claim for the Pic-Sharp that because of its design it fits easily into the pocket or kit, cannot scratch ground glass or other equipment, and may be accidentally dropped or stepped on without breaking.

Federal Fixed Focus Enlarger

A LOW-PRICED enlarger of the fixed focus type is offered in the Federal Model No. 835 Automatic Fixed Focus Enlarger ($12.50). A double frame 35-mm negative strip is placed in the open view negative carrier, the switch pressed and a 3½ by 5 inch enlarged image is visible on the ground-glass plate. A sheet of 3½ by 5 or 2½ by 3½ inch bromide paper is inserted into the holder under the ground-glass plate. The switch is held down from five to ten seconds, depending on the density of the negative and the paper contrast used, and the enlargement is ready for development. Any bromide paper may be used with the Federal, the manufacturers recommending the purchase of paper in 5 by 7 inch sizes. For cutting the paper, a paper slitter is supplied with the enlarger.

The Federal enlarger is operated on either A.C. or D.C., and may be used as a viewer for colored transparencies if desired. The enlarger includes a corrected achromatic lens system and a parabolic reflector for even distribution of light.

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. In a recent issue (July, 1938) you answered a query as to finding the depth of focus for various distances and stops. In your reply you said that to find the hyperfocal point one must "Multiply the focal length by itself; multiply the result by the circle of confusion (in your case 1/250. . . .); divide the result by the *f* value of the lens . . . multiplied by 12 to obtain a result in feet instead of inches." First, in what units is the focal length given, cm or inches? And *what* of the circle of confusion is 1/250—the radius, diameter, or circumference—and in what units is it given? And why, in the example worked, was the focal length $(7.25)^2$ multiplied by 250 instead of 1/250? The *f* value of a lens, as I understand it, is the ratio of its focal length to its diameter, and since this is dimensionless, how can multiplying it by 12 turn it into feet? Will you please set me straight on this matter?—*C. J. LaF.*

A. Perhaps we took too much for granted, but we wrote on the assumption that in this country the focal length of a lens, when not otherwise stated, is generally understood to be expressed in inches. The same applies to the circle of confusion measurement, which is 1/250th of an inch, the diameter of the circle or disk of light known as the circle of confusion, employed in calculating the hyperfocal distance in this particular case. The figure 250 was used because, since all the measurements were expressed in inches, the reciprocal of the circle of confusion (1/250) is 250. The multiplication of the *f* value by 12 was used merely as a convenience in arriving at the measurement in feet. The same result may be obtained by ignoring this part of the calculation, getting a result in inches and then dividing the latter by 12.

Q. Is the range finder on a Leica camera adjusted to show the focal distance from the object to the film plane or is it adjusted to show the distance to some other point on the camera? The majority of larger cameras figure the distance to the lens, do they not?—C. B. S.

A. If the distance indicated were to "some other point on the camera," the whole purpose of the range finder would be defeated. This purpose is to focus an object sharply on the plane where the film surface lies. When the subject is sharp in the range finder, in your case when the "two images" coincide and are one, the subject will be rendered sharp on the film emulsion when the latter is exposed to the light reflected from the subject.

Q. Would you please tell me if it is possible to make full color movies by using Kodachrome film in a Univex 8-mm movie camera equipped with an *f*/5.6 lens?—K. B.

A. Kodachrome film is not at present available in loadings for the 8-mm Univex. If it were, however, there would be nothing to prevent your using it in the Univex equipped with the *f*/5.6 lens, provided there is sufficient light intensity to permit taking motion pictures at the normal movie-taking speed.

Q. What is meant by the term "local intensification?"—A. L.

A. This refers to the use of a chemical solution for building up density in a selected part or parts of an under-developed negative so that these portions may print satisfactorily.

Q. I have a 1200-rpm synchronous motor which, I believe, is just the thing with which to measure shutter speeds of cameras. My idea is to fasten a piece of wood at right angles to the shaft (balanced, of course), with a flashlight bulb on the end of it. I would then take pictures of the light revolving and from these calculate the speed of the shutter very simply. What accuracy could be expected?—G. B.

A. Shutter speed testers devised by amateur workers are usually based on the use of a device that revolves at a known speed and employs some luminous point to record the results of the test for each shutter speed. The length of the arc formed by the revolving light is related to the number of revolutions made by the rotating device in one second. The measurement of the arc, therefore, provides the answer to the shutter's efficiency with regard to any of the marked speeds. The condition of continuous movement at a known speed that will not vary is fulfilled by the motor you mention and the use of a revolving bulb provides the luminous point or light source. Your prob-

lem is to select a tiny bulb and an extremely light-weight support for the bulb in order to keep drag down to a minimum. If you can effect such an arrangement, the resulting tests should prove fairly accurate.

***Q.* Enclosed are 14 prints from negatives I have taken in different parts of the world, which if suitable I wish to offer for publication along with the necessary notes. They are submitted for comment as to their merits for reproduction only; I would like to know what type of negative and print is most desirable for that purpose.—J. D. M.**

A. It is difficult to tell from the obviously rushed prints you have submitted just what type of negative they were printed from. As for the subject-matter, it will stand the best chance if accompanied by an article and submitted to a magazine or newspaper feature section which is in the market for this type of material; that is, travel. A negative with good detail in the shadows and enlarged to at least 5 by 7 or preferably 8 by 10 inches on glossy paper with the general tone on the light side will please the editor no end, provided, of course, that the subject is something he can use.

***Q.* Can you give me a simple formula for cleaning trays?—F. X. R.**

A. For cleaning all ordinary photographic stains from trays and graduates, the following solution has been found successful: one ounce of sulfuric acid added to ten ounces of a saturated solution of potassium bichromate.

***Q.* Several weeks ago I bought a set of color filters for my camera. I have been discouraged with the results, being unable to determine the correct exposure for the different filters. I have always been very careful in calculating exposure times, using a meter and considering the factors indicated in the filter set instructions. But this seems to be of no avail as some of the filters cause over-exposure and some under. My set consists of a holder and five optical glass filters.—S. A.**

A. We are not familiar with the filter set you mention and would suggest that if you do not find the given factors to be accurate you write to the manufacturers or distributors of the filter set, state your experience with their factors when using certain films and ask for a revised table. Filters do have different effects on different makes of films and the best way to find the proper factors for given films is to write to the service department of the manufacturers of the film. Another way, although more laborious, is to make tests on your own and determine the proper factors for yourself.

***Q.* I have a 16-mm motion picture camera which is an old timer. On the film formerly used the perforation track ran down the middle. Can you tell me where I may purchase 16-mm film with the track in the middle?—W. A. H.**

A. This film is no longer available. While it may be had perforated in the middle on special order from film manufacturers, the minimum quantity which the makers would be willing to supply would probably be much more than you would want for amateur purposes.

Books

SELECTED BY THE EDITORS

EXPERIMENTAL TELEPATHY

By René Warcollier

A TRANSLATION from published accounts of the experimental work of the author over a 15-year period, published in this country by the Boston Society for Psychic Research with which he had close relations. The numerous illustrations include many which are presented in pairs, of which the first in each instance shows the drawing transmitted and the second the image perceived. Many of these show striking correspondence. The author attempts an explanation of the nature of telepathy and discusses the subject in other respects, in addition to giving the accounts of the actual experiments. (290 pages, 5¾ by 8½ inches, illustrated.)—$3.70 postpaid.—*A. G. I.*

GUINEA PIGS AND BUGBEARS

By G. L. Eskew

AN open attack on Consumers' Research and on Kallett and Schlink, the authors of the widely-read book "100,000,000 Guinea Pigs." While many cooler heads thought that book greatly overdid a job that needed doing, it being as sensational and exaggerated a book as your typical crusader can usually be depended on to produce, there isn't much more to be said for the present counterblast to it. Even so, "Guinea Pigs and Bugbears" makes interesting reading and may lead the previous reader of "100,000,000 Guinea Pigs" to strike an average between two extremes. (269 pages, 6 by 8½ inches, illustrated.)—$1.65 postpaid.—*A. G. I.*

BOTH SIDES OF THE MICROPHONE, TRAINING FOR THE RADIO

By John S. Hayes and Horace J. Gardner

AVERAGE radio listeners are familiar only with the receiving end of radio broadcasting. Here, however, they can find a compact story of the other side of the microphone—the program department, the musical division, sound effects, the announcer, and so on. Those who are interested in broadcasting from a vocational angle will appreciate the succinct information which the authors present. (180 pages, 5¼ by 7¾ inches, unillustrated.)—$1.40 postpaid.—*A. P. P.*

THE CONQUEST OF CIVILIZATION

By James Henry Breasted, Ph.D., LL.D., D.Litt.

A NEW edition, fully revised, of an account of the earliest civilization in Egypt, Western Asia, Greece and Rome. To call this a history would be to mislead the reader and do the book an injustice. If only books like this had been used in the schools of a generation ago, the word history would not make most middle-aged people of today shy off the subject but like it instead. The smooth flow and charm of Breasted's style, his own dislike of the old-fashioned boredom of dates, lists of kings and battles, and the vividness and humanness of his account, taken with his own pre-eminence, make this a book capable of wiping off the history hater's hate. It doesn't even look like a text book. This reviewer has read it (in the earlier edition) three times. (669 pages, 5½ by 8½ inches, 215 illustrations.)—$4.20 postpaid.—*A. G. I.*

TRANE AIR-CONDITIONING MANUAL

ASSEMBLED and presented in this one large volume is a complete course in air conditioning, beginning with a study of heat fundamentals and continuing through more technical and mathematical aspects of a conditioned air supply. The facts are based upon the experience of one large company which is one of the pioneers in this new science of comfort. This volume is rather on the technical side including, as it does, more mathematics than the layman would ordinarily like to work with, and numerous tables. It is recommended especially for air-conditioning engineers. (333 pages, 8½ by 11¼.)—$5.00 postpaid.—*F. D. M.*

DUODECIMAL ARITHMETIC

By George S. Terry

A LARGE volume containing full instructions for using the duodecimal system of arithmetic, with extensive duodecimal tables (accompanied by examples of their use) of square and cube roots, reciprocals, logarithms and trigonometric functions in terms of the duodecimal circle; together with shorter tables of some of the higher mathematical functions. To duodecimal devotees this work will long be a landmark. (407 pages, 9¼ by 11½ inches.)—$7.75 postpaid. —*A. G. I.*

MASTER BUILDERS OF SIXTY CENTURIES

By John Anderson Miller

"WHEN Moung Tien started work on the Great Wall he had at his disposal a force of about three hundred thousand men. It soon became evident that a force of this size would not be able to build a wall of the desired type and length in less than about a hundred years. So the system was changed. Moung Tien laid out the whole course of the wall across North China and work was then begun at numerous places along this course instead of proceeding step by step from the original starting point."

This paragraph, taken almost at random from the book, serves to indicate the manner in which the author has brought to life the details of construction of many great monuments of man's genius. In this volume he sets the reader down at the scene of the job and almost allows him to see with his own eyes the essential details of the construction work. The result is a fascinating study of the construction of the Pyramids, the Great Wall of China, Roman aqueducts, Roman roads, cities of the Mayas, Crusaders' castles, dykes of the Netherlands, subways, bridges, the Panama Canal, and other great projects. Midnight oil will be burned by many who expect to read this book in sections but wind up by reading it all at once. (315 pages, 5½ by 8½.)—$3.15 postpaid. —*F. D. M.*

LIGHT

By Vivian T. Saunders, M. A.

A COMPACT treatise on elementary optics, not for entertainment but for study, dealing in respective chapters with reflection, refraction, lenses, reflection at spherical surfaces, optical instruments, refractometry, color, photometry, light velocity, interference, diffraction, and polarization. It is intended for use in the English schools, is thorough as far as it goes (a good, solid elementary grounding) and employs high-school geometry and algebra throughout. (328 pages, 4½ by 7 inches, 196 illustrations.)—$2.65 postpaid.—*A. G. I.*

HEREDITY AND POLITICS

By J. B. S. Haldane, Professor of Biometry, University of London

A NOTED biologist discusses some of the central dogmas of eugenics (using the term largely as it is conceived by politicians and by a part of the public) and shows the fallacies on which some of them are premised. The futility of the sterilization laws of this country and Germany, with their intention beneficial but their scientific basis faulty; the fallacy that all men are created equal, and the causes of human inequality; the fallacy of racial superiority; the questions of race mixture and of other race problems—these and cognate subjects are discussed directly and clearly and their truly scientific aspects are explained. Just such questions are daily debated at social gatherings and in Pullman car smoking rooms, usually with more heat than light and often with perfect logic based, however, on faulty premises. This book states the premises according to science and not according to politicians, self-admiring nationalities, dictators, and other well meaning, wishful, or end-seeking thinkers. (202 pages, 5 by 8 inches, 14 illustrations.)—$2.65 postpaid.—*A. G. I.*

FOR OTHER BOOKS YOU WANT, SEE PAGE 204

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

THREE telescopes constructed by our readers, which win deserved applause for excellence, are shown in Figures 1, 2, and 3.

Finished is the word for the 6″ portable 'scope shown in Figure 1, made by Emir Kelley, of South Brownsville in the southwestern corner of Pennsylvania. All its parts are of instrument-maker grade of workmanship, as the photograph shows. A Hindle "crocodile-type" grinding machine ("ATM," 4th ed., p. 235), also made by Kelley, is equally finished in appearance and its description will be published at some later date. Kelley's telescope has an eyepiece adapter that rotates 90° over the top of the tube in a transverse slot. It also has a weight-driven clock that will run 3½ hours with one setting.

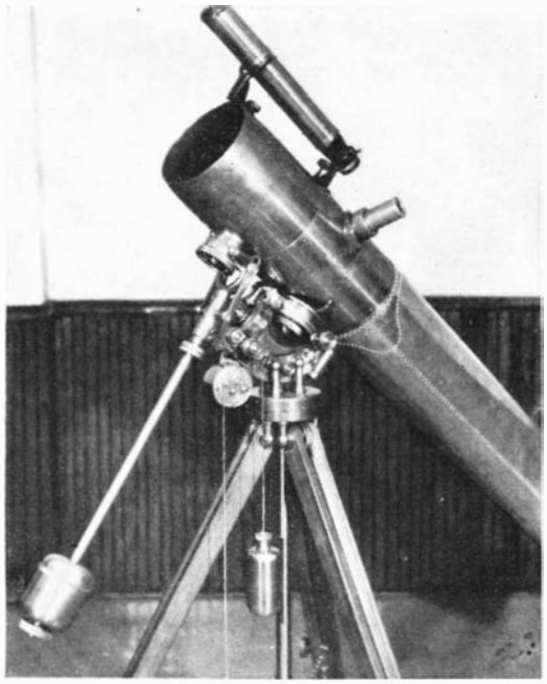


Figure 1: Kelley's attractive portable

We detailed one of our supersleuths to dig up more data about Kelley, as we suspected him of being something of an inventive genius, and this secret operative reports that he is the senior partner of Kelley and Stewart, makers of auto jacks and cranes; also that he owns a famous grandfather clock of his own design and make, which not only tells the time and the moon's phases, but is a true Gentleman's Annual Best Friend and Life Preserver. Almost any married man will recall the awful feeling experienced when, one day of the year and generally along toward bedtime, his wife hands him a calendar and stands waiting before him with lips tight drawn; whereupon he is at first puzzled, then leaps suddenly from his chair, passes a trembling hand across a flushed brow and begins thinking fast for alibis. Once more, dog*gone* it, he has forgotten his wife's *wedding anniversary!* And now it is too late—too late! To Kelley, however, nothing like this ever happens, for on that date, once each year, the good old grandfather clock he devised raises a small flag on a miniature flagpole and blows a whistle (*Esquire* please copy). Kelley then dashes downtown and buys flowers.

The design in Figure 2 seems almost ideal. It is a 6″ Cassegrainian-Gregorian combination made by Roy E. McAdams, a designer and builder of miniature gasoline engines, according to his letterhead, and situated at 2155 S. Limestone St., Springfield, Ohio. "Time consumed for making patterns, machining castings (which are of aluminum alloy) and grinding and polishing optical surfaces was approximately 8 months' spare time work," he writes.

"The main mirror is 30″ in *f.l.* and the Gregorian combination has an amplifying ratio of 6. Despite the fact that its accuracy is excellent, it is used but little." [The present year is the 300th anniversary of James Gregory's birth.—*Ed.*]

"The clock drive consists of synchronous motors and a train of gears which give sidereal time to a minute fraction of a second for a run of 24 hours."

The axes of the McAdams telescope have the cross-section urged by R. W. Porter in "ATM," and the plate attaching the declination axis to the tube is also a thick, heavy one. When mounted on a fixed base this 'scope should be rock-solid. The tube is a piece of engineering design, and the whole is also "easy to look at"—a factor not always combined with good engineering design, just as good engineering design is not always ideally combined with "easy to look at."

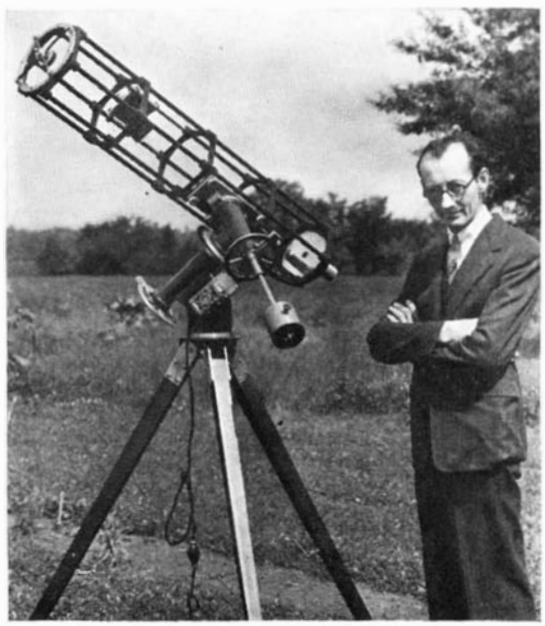


Figure 2: McAdams and his solid portable

The third well-designed telescope is shown in Figure 3 and is commendable for great rigidity. The maker of the mounting, William W. Maxwell, 1018 S. Franklin St., Mt. Pleasant, Mich., whose letterhead indicates that he runs an electric and ox-acetylene welding establishment, has really gone as far as Porter urges in "ATM" (4th ed.) in the direction of that desirable quality—something that few of the telescopes made by amateurs (and professionals) exhibit. This telescope was built as a memorial to the late William Tyler Olcott, for the Daytona Beach Star Gazers' Club, and is to be set up at Daytona Beach, Fla. The piers shown in Figure 3 are merely temporary rough ones of wood. Concrete piers are to be built.

Most of the details are best explained in Figure 4, which is well worth stopping to study at this point. The bearing of the tube is of the full three-point type with really wide spread, and the mounting is as stiff as a mountain.

The counterweight tube, shown in Figure 3, is a piece of galvanized steel bent to form a 20-sided figure.

At the lower end of the polar axis shaft is a 120-tooth starter ring-gear (Figure 5) welded to the edge of the brake drum. The drive is a large hand-cranked phonograph motor and will run for 35 minutes. There are setting circles on both axes and the slow motions operate from the eyepiece neighborhood by way of flexible shafts.

The mirror was made by R. E. Stevens, 500 S. Ridgewood Ave., Daytona Beach, Fla., and is of Pyrex.

"Yours for bigger and better bottlenecks," Maxwell signs his data letter. Proportionately this mounting has the biggest bottleneck we recall seeing, outside of Porter's mounting for the 18″ Schmidt at Palomar ("ATMA," p. 398).

PEOPLE, themselves, are fully as interesting as telescopes. The following notes attempt to snoop a bit into the private lives of some of the authors of "ATMA," also some amateur telescope makers who seem to have burst right into professional optics.

It has turned out that among the authors of "ATMA" there was an unsuspected moving picture actor. "I presume you know," Capt. M. A. Ainslie of England (himself a capable mirror maker—"ATM," p. 100) tells us, "that the W. T. Hay, F.R.A.S., who writes on a 'Simple Chronograph' in 'ATMA' is better known as Will Hay, the comedian film star." Later, H. E. Dall sent us an English newspaper from which the advertisement shown in Figure 6 is reproduced. He states that a few years ago Hay "was in all the newspapers as discoverer of a

Figure 3: Maxwell's rigid 'scope

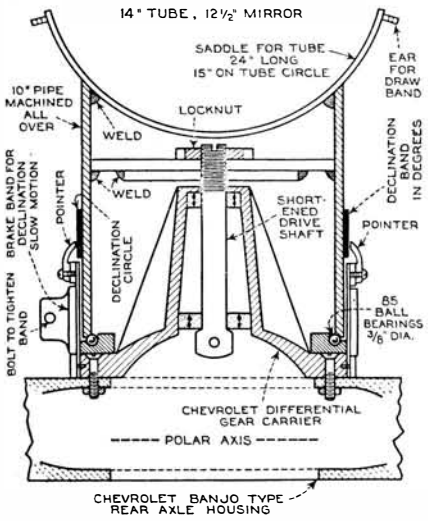


Figure 4: Declination axis detail

new big white spot on Saturn, soon afterward was elected a fellow of the Royal Astronomical Society and then published a book called 'Through My Telescope.'" We find that this same book was reviewed in our June 1936 issue, before we knew Hay's identity. Hay lives at Hendon and owns a 6" refractor.

D. Everett Taylor, author of the chapter on "The Refractor—Metal Parts and Mounting," in "ATMA," before his recent retirement was one of the leading dentists in New York, also an outstanding tenor singer.

H. E. Dall of Luton, Bedfordshire, England, mentioned above (see "ATMA" chap-

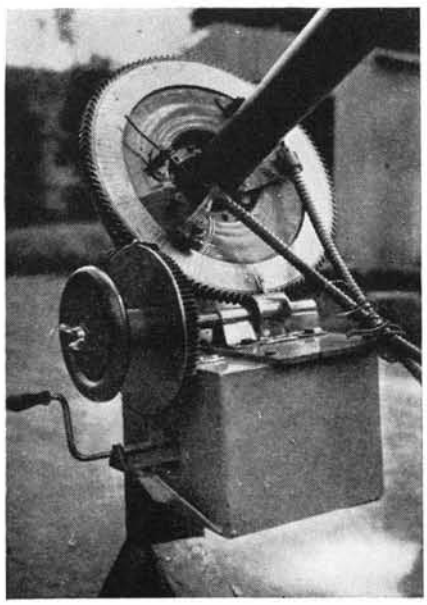


Figure 5: Clock and R. A. circle

Figure 6: Astronomical cinemactor

ter on the "Camera Obscura") is an engineer who works on design for the 100-year-old firm of George Kent, Ltd., makers of industrial measuring and controlling instruments such as meters for the accurate flow of water, steam, gas, air, oil, and other fluids. The photograph of Dall, Figure 7, was taken by F. W. Epley of the Amateur Telescope Makers of San Francisco, when visiting him in England.

Figure 7: Dall

A. W. Everest (opening chapter, "ATMA," on mirror making) is assistant to the superintendent of the distribution transformer factory of the Pittsfield, Mass., works of the General Electric Company.

Harold (telescope drives) Lower of San Diego, California, with chapters in "ATM" and "ATMA," during the World War was a Leatherneck and instructor on the rifle range and machine-gun school. His hobbies are archery and photography.

Franklin B. Wright, similarly with chapters in both "ATM" and "ATMA," is a telephone engineer with the Pacific Telephone Company.

Cyril G. Wates, "ATMA" page 274, is a maintenance engineer with the Edmonton Municipal Automatic Telephone System, at Edmonton, Alberta, Canada. His hobbies are mountaineering and photography.

John Bunyan ("ATMA," page 425, sidereal clock) is president of the Berthoud National Bank, Berthoud, Colorado.

PERSONALITY items about other prominent telescopticians: No American "opposite" to the English moving-picture actor Hay, named above, is known to us. The closest we can come to this is Rod LaRocque of Hollywood, an amateur telescope maker who now and then does a turn in pictures. Byron, Lord Graves, of Los Angeles, who knows numerous cinemactors and actresses, in reply to your scribe's urging, writes as follows about LaRocque: "Used to be popular in the silent film days. Married Vilma Banky and is a very happy family man. Fine mechanic and has a complete metalworking and woodworking shop (Figure 8) back of his home. Makes ship models, furniture. Built a camera complete, except lenses, which he sold for $250. Built the 6″ *f*/8 shown."

Another American movie actor who rates as a sort of "friend's friend" of telescoptics is Franchot Tone, whose father is president of the Carborundum Company. We doubt whether Franchot actually abrades glass with the paternal Carbo.

In "ATM," on page 402, there is a picture of Winston Juengst, with a telescope. When this was inserted, quite a number of years ago, Juengst was only a young lad; but time marches on and the lad Juengst finally grew to manhood, entered the University of Rochester, took that University's stiff, four-year course in optometry (Columbia also gives a superior course in optometry), and today is teaching in the School of Mechanical Optics, Montague and Henry Streets, Brooklyn, New York, where training is given in the mechanical work of filling oculists' and optometrists' prescriptions.

How many others may have been steered into optics as a life career through the awful effects of "ATM" we know not, but one is W. J. Kiefer, who now has a job in the Bausch and Lomb Precision Optics Depart-

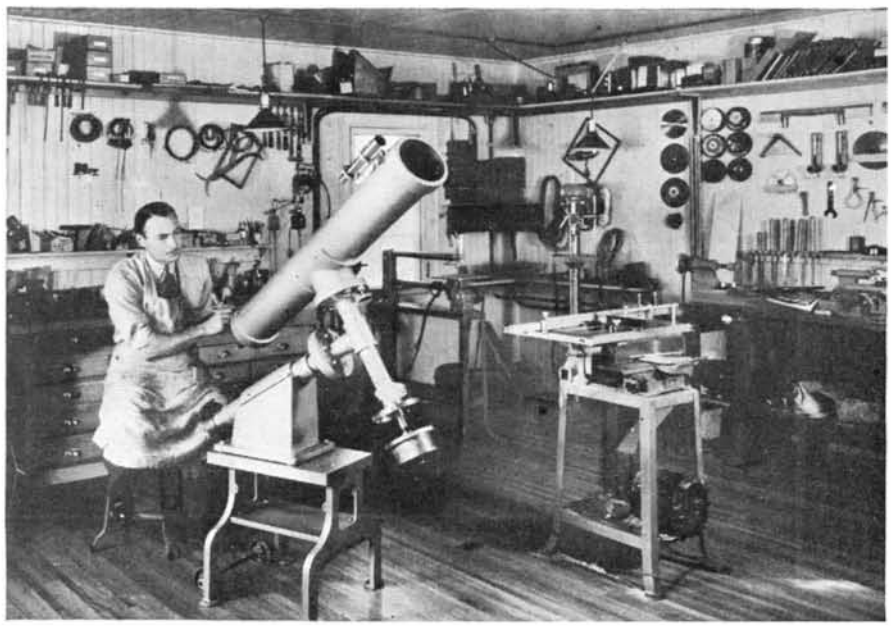


Figure 8: LaRocque and the kind of shop every man hopes to have

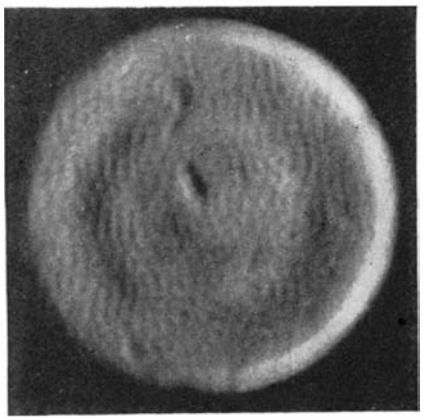


Figure 9: The virgin effort

ment and at present is surfacing various types of precision prisms. R. E. Clark, author of the chapter on eyepiece making in "ATMA," recently told us about Kiefer. "About five years ago," he writes, "we had a young fellow as instructor in our local high school—that is, Kiefer. He made a 6", shown in the focogram (Figure 9) and brought it to me for test and correction. I allowed him the facilities of my basement shop, and during three years I do not think he missed a single night. He then took an A.M. degree in optics at the University of Rochester and went with B. and L."

Urged to give some of the harrowing details about himself, Kiefer first states that the kindness, generosity, and patience Clark exercised in attempting to teach him practical optics are indelibly written on his mind. Regarding his first mirror (Figure 9), he thought at the time that it really was finished, but adds that Clark "evidently didn't." Clark "took one look at it and I guess that was plenty!" He started Kiefer on eyepiece lens making and gave him a course of sprouts all along until he went to Rochester and studied mechanical design of optical instruments, physiological, physical, and geometrical optics. There he also earned part of his tuition by working in the university optical shop assisting H. E. Wilder, optics shop instructor and president of the Amateur Telescope Makers of Rochester who use facilities at Rochester University.

So, if you are just a raw, rank beginner, and are afraid you will never amount to much in the mirror figuring line, look at Figure 9, a first mirror which only a mother could love, and have faith that, in time, and with work, you too will eventually arrive.

Still another average telescope maker was R. W. Dietz, 2187 W. 25 St., Los Angeles, Calif., who is working on a group of Schmidt cameras for the Foundation for Astrophysical Research—that is, as a professional.

Ten years from now, what percentage of U. S. A. optical personnel will be from TNs?

FOR the benefit of new readers of Scientific American, perhaps partly puzzled by some of the more advanced discussions of telescope making and telescoptics which have appeared in this department, a new approach, more elementary, will be made in future numbers by means of special space set aside for the description of simple telescopes such as the tyro can build as his maiden effort, also for discussions having the beginner's point of view. Readers who are already familiar with the amateur telescope making hobby are invited to offer suggestions for interesting the potential tyro.

LEGAL HIGH-LIGHTS

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

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

LINGUISTS

IT is sometimes stated that patent attorneys have a language of their own. Undoubtedly, the basis for this contention can be found in the fact that in describing new inventions existing words are frequently inadequate and it is necessary to create new words. However, even though the language used in a patent application is strange or unusual it does not affect the validity of the patent as long as the meaning is clear. The patentee may arbitrarily select his nomenclature as long as the meaning of the words is clearly defined. Thus, in a recent patent infringement suit the patent described a part of a sewing machine in the shape of a segment of a circle, as a disk. The Court took the position that while the word "disk" was not aptly definitive of the particular mechanism the meaning was nevertheless clear and on this basis it sustained the patent. In reaching this conclusion the Court stated:

"Of course, I am quite aware that the word 'disk' is a somewhat unusual word to use for referring to a segment of a circle, but anyone can adopt his own nomenclature. Why the patentee adopted the name 'disk' for his ridge-former, shown in the drawing as a segment of a circle, I cannot see, for I think some better descriptive word might have been used."

LIQUOR TRADE MARKS

WE have commented from time to time on the growing importance of trade marks. The United States Supreme Court has again emphasized this importance in a recent decision sustaining the constitutionality of a Minnesota statute prohibiting the importation into the State of Minnesota of intoxicating liquors, unless the brand or trade mark was duly registered in the United States Patent Office.

Shortly after the repeal of prohibition the Minnesota legislature passed the statute referred to above. Prior to that time a corporation engaged in the business of selling intoxicating liquors had obtained a license from the State of Minnesota to sell such liquors. Several of the brands of liquors sold by the corporation were not registered in the United States Patent Office, and the corporation brought suit against the Liquor Control Commission of Minnesota to restrain it from interfering with its business, contending that the statute in question violated the 14th Amendment of the United States Constitution.

The United States Supreme Court held that the statute clearly discriminated in favor of liquor produced within the state in that the requirement for federal registration only applied to liquor imported into the state. The Court pointed out that normally such discrimination would be prohibited by the 14th Amendment of the Constitution, but that the 21st Amendment to the Constitution, which repealed prohibition, permitted the state to prohibit or to place any restriction whatsoever on the importation of intoxicating beverages. The 21st Amendment reads in part as follows:

"The transportation or importation into any state, territory, or possession of the United States for delivery or use therein of intoxicating liquors, in violation of the laws thereof, is hereby prohibited."

With regard to this amendment the Supreme Court stated that it confers "upon the state the power to forbid all importations which do not comply with the conditions which it prescribes."

It was accordingly concluded by the Court that the State of Minnesota had the right to prohibit the importation of intoxicating liquors unless the name or brand of the liquor was duly registered in the United States Patent Office.

LOTTERIES

THE Federal Trade Commission has been active in attempting to restrain the use of lotteries in connection with the sale of merchandise.

In a recent case the Commission found that a manufacturer was supplying retailers with candy assortments designed and intended to be sold by lottery and the manufacturer was ordered to cease and desist from selling candy assortments in which the sales "may be made by means of a lottery."

The proceedings before the Commission were reviewed by a Federal Circuit Court of Appeals and the Court held that the order was too broad since any candy assortment could be sold by lottery. The order was modified so as to restrain the sale of candy assortments in which the sales "were designed to be made by means of a lottery."

PURITY

A PATENT cannot be obtained on the purity of a product. This principle is exemplified by a recent case decided by the Court of Customs and Patent Appeals.

An inventor had developed a new process for purifying artificial or synthetic ultramarine. He filed a patent application setting forth his new process and obtained the allowance of claims based upon his process. He also sought to obtain claims for purified ultramarine, contending that it was a new article since prior to the development of his process ultramarine was only obtainable in an impure form. The Patent Office tribunals rejected the claims on the purified ultramarine and the inventor appealed to the Court of Customs and Patent Appeals. The Court sustained the Patent Office tribunals, pointing out that normally it does not amount to invention to provide an article in a purified form when it had previously been available in an impure form. The Court summed up its conclusions as follows:

"We are in agreement with the tribunals below in their holdings that while appellant may be entitled to a patent on a method for purifying an ultramarine either artificial or natural, he is not entitled to a patent on the article which after being produced has a greater degree of purity than the product produced by former methods."

Normally the purification of an article is regarded as a mere change in degree rather than in kind. The Court pointed out that in the rare cases where the purification of an article results in a product having entirely new and unexpected characteristics a patent may be obtained on the purified article. As an example the Court referred to the famous aspirin case involving a patent on the pure form of acetyl salicylic acid. In the aspirin case the pure form of the product was found to have medicinal uses not available from the impure form and the patent was sustained.

DIXIE

IN a recent suit for trade-mark infringement the word "Dixie" was held not to be geographical when used in combination with other words as a trade mark for gin. A prominent distiller using the trade marks Dixie-Belle and Dixie Beaux on gin sought an injunction against a competitor who used the trade marks Dixiana and Dixie Dew on gin and whiskey. The competitor contended that the trade marks Dixie-Belle and Dixie Beaux were invalid for the reason that the word "Dixie" is geographical.

The Court rejected this contention and held that the trade-mark registrations were valid and infringed. With reference to the word "Dixie" the Court stated:

"It is not intended to signify that the product is manufactured in the South or intended to be sold or used there nor does it indicate the quality or characteristics of the product."

TITLE PAGE

A COPYRIGHT on a book or pamphlet is not valid unless the proper copyright notice is affixed to the title page or to the page following the title page.

In a recent suit for copyright infringement the plaintiff claimed to be the owner of copyrights on two pamphlets. The notice of copyright was affixed to the back cover of both pamphlets. It was contended by the defendant that the notice used on the pamphlets did not comply with the statute and that the copyrights were invalid.

The Court sustained this contention, stating:

"By explicit provision of the statute the place for copyright notice in the case of a book or printed pamphlet is on the title page or the page immediately following. It follows that a notice on any other page, no matter how prominent, is ineffective."

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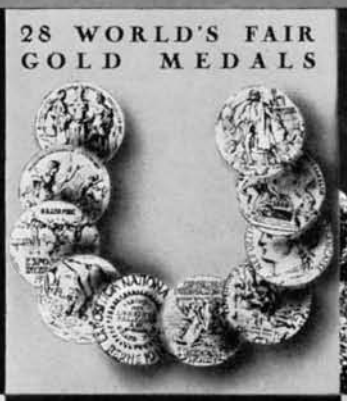

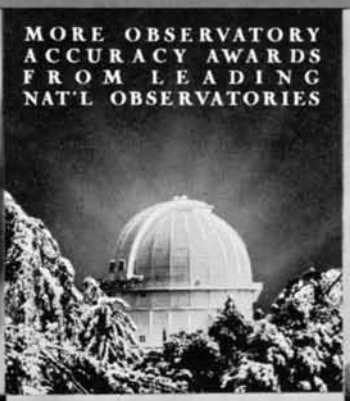

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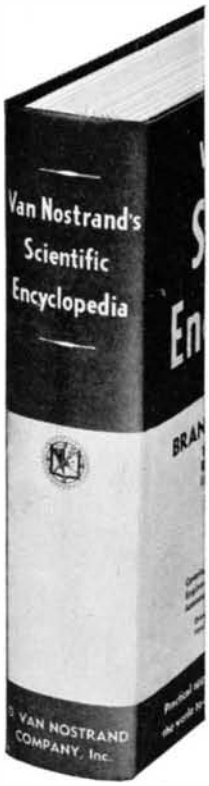

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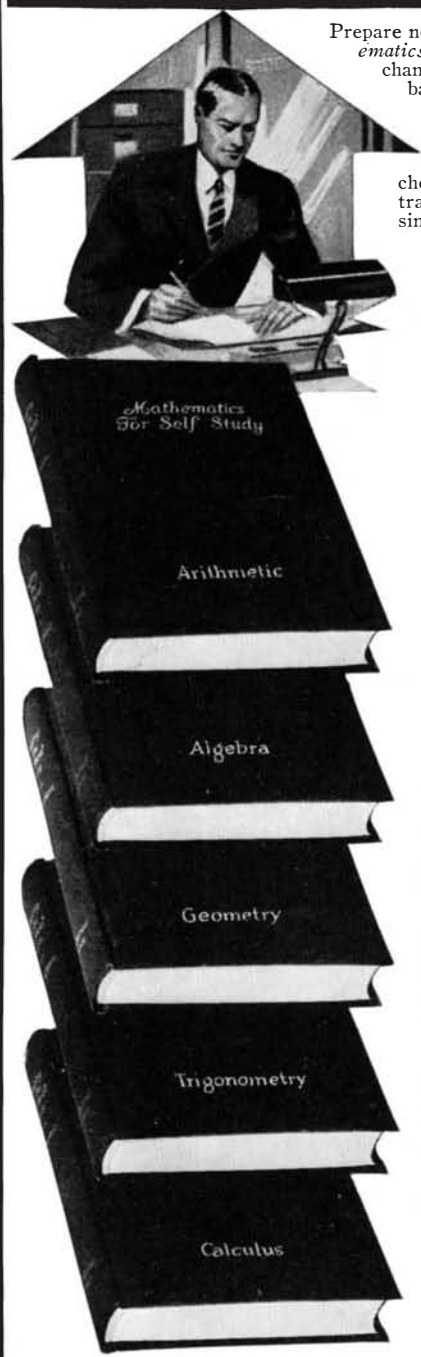

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