FLOOD FORECASTING

# SCIENTIFIC AMERICAN

MAY
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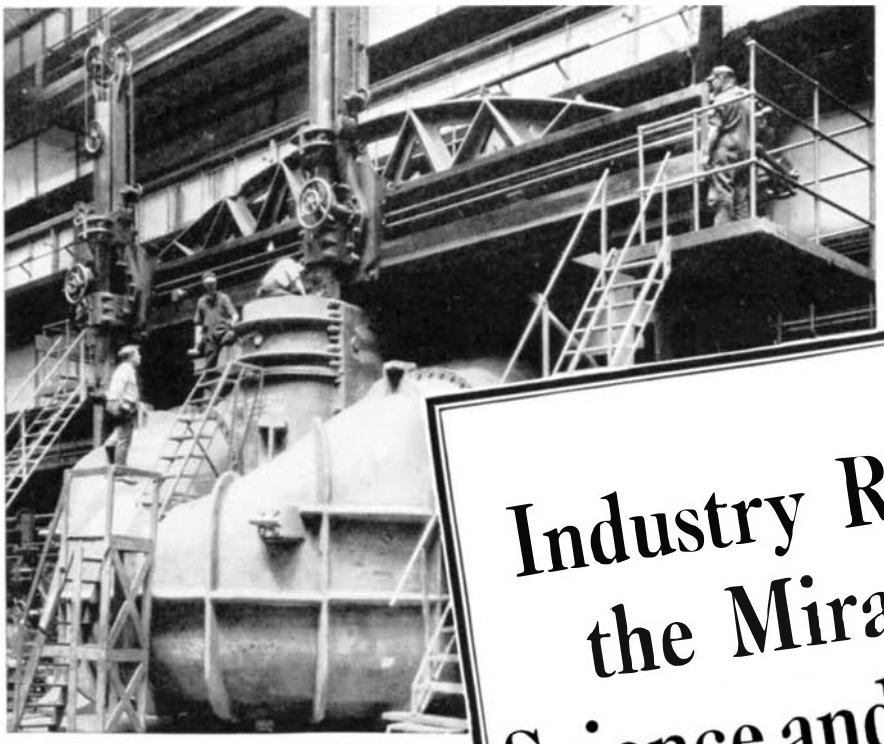

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# SCIENTIFIC AMERICAN

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**NINETY-FOURTH YEAR** • **ORSON D. MUNN, Editor**


## CONTENTS · MAY · 1938



**THE Bell XFM-1 fighting plane, illustrated on our front cover through the co-operation of the U. S. Army Air Corps, has been designed to fill the need created by the introduction in military air forces of the large high-speed four-engined bomber. A multi-place, all-metal, twin-engined pusher-type monoplane, the XFM-1 has a top speed with full load of better than 300 miles per hour. Equipped with the most powerful armament ever before carried on a fighter, it can handle in addition a load of light bombs.**


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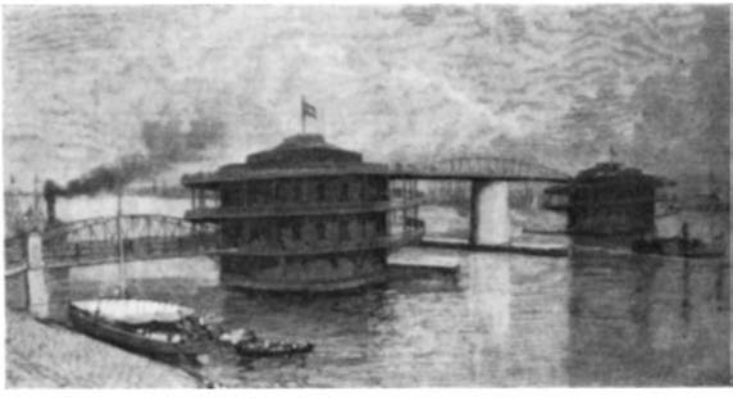
# 50 YEARS AGO IN . . .

## SCIENTIFIC AMERICAN

*(Condensed From Issues of May, 1888)*

COAL IN THE MAKING—"During the late violent storms in the Channel the sea washed through a high and hard sand bank near the Isle of St. Malo, France, nearly four meters thick, laying bare a portion of an ancient forest which was already passing into the condition of coal."

BRIDGE—"Owing to the enormous expense of acquiring real estate for the construction of the approaches and termini of bridges in populous districts, a most interesting engineering problem is presented in the designing of bridges in which this difficulty is to be avoided. The bridge illustrated in the accompanying engraving is of this type, the shores being little above the water level, the stream



being a navigable one, and the necessary condition being that the span should be sufficient to allow several ships to pass under simultaneously, and of sufficient height to permit vessels of ordinary size to pass under without the necessity of opening the draw."

GUM—"The high price of gum acacia has led Trojanowsky to seek for a substitute. This he believes may be found in the mucilage of flax seed. By boiling the seed with water and precipitating the strained decoction with twice its volume of alcohol, he obtained a substance which, after drying, consisted of opaque, yellowish-brown irregular fragments, somewhat brittle, but not easily reduced to powder, dissolving in water to a turbid mucilaginous solution."

LACKING—"The King of the Belgians recently sent to the Sultan of Morocco a present of a locomotive and a Pullman car. The difficulty is that there is no railway in Morocco!"

TELEGRAPHY—"It is a matter of considerable pride to the operators of the Western Union Telegraph Company in San Francisco . . . that the feat of transmitting clock signals through 7,200 miles of line and communicating directly through that same line has never been equaled."

CANNON—"The ordnance department of the army has received from Mr. Hiram Maxim, of England, the description of a new dynamite gun which he has projected. . . . He mixes with compressed air a quantity of volatile hydrocarbon, such as the vapor of gasoline. This compressed mixture is introduced behind the projectile and the pressure is applied to start it forward in the chamber of the gun. After it has moved a certain distance the projectile itself uncovers a detonating fuse and an explosion then occurs, the air furnishing the oxygen for the explosion and the pressure being increased about eight times. . . . By this means he hopes to render the use of dynamite in projectiles practicable in big guns."

MICA—"The peculiar physical characteristics of mica, its resistance to heat, transparency, capacity of flexure, and high electric resistance, adapt it . . . to applications for which there does not appear to be any perfect substitute. Its use in windows, in the peep holes on the furnaces used in metallurgical processes, as well as the ordinary use in stoves for domestic purposes, are examples of its adaptability to specific purposes which it does not seem to share with any other material."

PLANT GROWTH—"Prof. Sachs, the celebrated German botanist, has discovered that the ultra-violet and invisible rays of the solar spectrum especially promote the development of flowers, the growth of which is exceedingly feeble when the rays are suppressed, although that of the other parts of the plant is very luxuriant."

ANCIENT—"The oldest arm chair in the world is the throne of Queen Hatafu, who flourished in Egypt 1,600 years B.C. It is of ebony, beautifully carved. It is now one of the treasures of the British Museum."

OYSTER FARMING—"The method of farming most successful in America consists in depositing oyster shells upon the bottom, just before the spawning season, to which the young attach themselves, and then placing among the shells a few mature oysters to furnish eggs and young. As soon as the young oysters caught in this manner are large enough to handle, they are distributed over the bottom."

BISON—"Mr. Clinton A. Snowden of the Chicago *Times* is the originator of a scheme to save bison that still remain on the plains. It has been ascertained that of the millions which once roamed on the prairies of the West only seventy-five or a hundred remain. . . . It is to be hoped this laudable expedition will succeed. It would seem as if Congress might do something to promote and encourage the preservation of this wonderful breed of animals."

PHONOGRAPHS—"The improvements in the phonograph have now been carried to such a degree of perfection that the instrument is practically ready for general introduction. Undoubtedly means will be hit upon from time to time to enhance the value and efficiency of the phonograph, but it stands today, in our opinion, far more practical and complete than was the typewriter when first brought out and placed on the market. Back of all the tall talk and exaggeration on the subject . . . is a machine of admirable performance, whose utility is so wide and various that it is hard to determine just which work will give it the largest field of employment. . . . And then, too, is the wonder . . . that not only can the human voice be registered, but it can be duplicated in countless electrotypes."

### AND NOW FOR THE FUTURE

**¶Ultra-violet light put to work as a practical germ killer, by F. D. McHugh.**

**¶How plant "wizards" develop important new fruits, vegetables, and flowers, by Keith C. Barrons.**

**¶Transatlantic telephony—a story in photographs, by A. P. Peck.**

**¶Personalities of the elements, and how they affect metal structures, by Sidney J. French, Ph. D.**

**¶How do you know you can't eat onions?, by T. Swann Harding.**

# *Personalities in Industry*

**VINCENT BENDIX**

TRAVELING eastward on The Twentieth Century Limited, you are surprised when it comes to a grinding halt at South Bend; ordinarily this crack train does not stop at the Indiana city. Suddenly there appears in your car a broad-shouldered, brown-haired man, surrounded by several companions. The group at once plunges into earnest conversation and you are struck by the incisive tones of the central figure, the sweep of his hand, his bright eyes, his almost boyish enthusiasm. If at Elkhart several more persons climb aboard and join the conference, you may be sure that the broad-shouldered man is Vincent Bendix.

Vincent Bendix leads a busy, active life, consistent with his position as one of America's leading manufacturing and inventive figures; wasted moments are few. Decisions are frequently made between his South Bend factory offices and his New York headquarters, from where he can look across the Hudson and see his newest factory rising at Bendix, New Jersey, or while he travels across the Atlantic, to the South, or to California.

Vincent Bendix as a boy left his Illinois home filled with the ambition of youth, and now actively heads 32 corporations. He who once operated an elevator in New York today sees airplanes equipped with his products rise into the sun all over the globe. And the young man who started his actual business life in a motorcycle shop is now internationally known as the inventor of the Bendix Drive of which more than 60 million have been used on the automobiles of the world.

On land or sea or in the air, some Bendix product will be found—carbureters in automobiles and airplanes; radio direction finders on ships at sea; starters, generators, magnetos, landing gear, brakes, and many other devices on great transport planes; even outboard motors for recreational purposes.

While still in his early teens, Vincent Bendix worked on plans for a chainless bicycle, and when nothing came of a long correspondence with a manufacturer, he left his clergyman father's home and came to New York. At 17, Bendix was a stenographer in a law office, meanwhile picking up the fundamentals of mechanics from a building superintendent and a knowledge of electricity from an Edison official.

The first definite step toward his chosen field was made by the youthful Bendix when he bought a second-hand motorcycle. True to form, he soon worked out improvements on the machine he rode. He engineered the design and supervised the building of the experimental machine in a bicycle shop in New York City. He filed application for patents on this spring frame motorcycle and then took it to Hammondsport, New York, and showed it to Glenn H. Curtiss. Curtiss wanted his new friend to become a partner; "V.B." likes to reflect that, at 19, and for only 1000 dollars, he might have taken a half interest in what was to become a great business. But even broader fields were in store for the boy from Illinois.

Today the Bendix realm includes, among others, the Bendix Aviation Corporation, Bendix Products, Eclipse, Bendix Radio, Scintilla Magnetos, Hydraulic Brakes, Jaeger Watch, Friez weather equipment, Pioneer Instruments, and, more recently, Bendix Home Appliances, manufacturers of an automatic home laundry.

Business is the dominating passion of his life, but he has many side interests. His 25,000 dollar prize, annually awarded for the National Air Races transcontinental classic, is known throughout the world of aviation, as is the Bendix Glider Trophy in the world of motorless flight. His was the moving spirit that brought the Golden Lama Temple to the World's Fair in Chicago, and he also aided the trust that gave the museum at Stockholm, Sweden, its magnificent collection of Asiatic ecclesiastical art. He has been decorated with the Legion of Honor of France; he is a Knight Commander of the Order of the North Star, an honor from King Gustave of Sweden.

## HIGH FINISH ON A DISK AT HIGH SPEED

AT some stage in the manufacture of almost all metal products, they must go under treatment with an abrasive—sometimes once, often several times. It may be that a disk is polished with a grinding wheel, as in this photograph which was supplied by The Norton Company, or it may be that abrasives cut steel tubing to make modern furniture, grind telescope mirrors, or cut and polish gem stones. Abrasives (see page 266) made and operated under rigid control now play a major part in the steady march toward greater precision in mass production.

**Wheeler Dam, near Muscle Shoals in Alabama, which was recently dedicated by the TVA. In this photograph, this important dam has just been drawn down for malaria control, as indicated by the exposed shore**

# FLOOD FORECASTING

## Daily Gaging of Tennessee Valley Stream Levels and Rainfall . . . Dams Store or Release Water Accordingly . . . For Flood Control, Navigation

By HERBERT F. GOUGH

KEEPING tab on an annual cycle of 145,000,000,000 tons of water—recording its movements, anticipating its whims, and manipulating the proper mechanical checks and restraints, —furnishes a sizable demonstration in modern water control methods. Such a demonstration, definitely needed in America today, is now in progress in the Tennessee Valley. In fact, for the first time in history, man is in the driver's seat and holds the reins of control on a river of major proportions.

Four years ago the nation massed its technological forces under the Tennessee Valley Authority and began its program aiming at the orderly development of the water resources of the Tennessee basin.

The Tennessee basin problem may be stated numerically—52 inches of rain a year, distributed over 41,000 square miles of territory that varies from mile-high mountains to low flood plains only a few hundred feet above sea level. This is twice as much rainfall as occurs in the Missouri Valley, and approximately one and one-half times that of the Ohio Valley.

The storms that contribute most of this rainfall come from the Gulf and occur during the months of December to April inclusive. Thunder-storms, coming from the west, occur during the West Indian hurricane season from July through November. An equally serious menace during these summer months comes in the form of tropical storms from the Atlantic coast. Without warning, moisture-laden winds swing in from the coast and have to travel but a short distance before striking the high southern Appalachians. There they release torrential downpours into the drainage areas of the Watauga, French Broad, Pigeon, Little Tennessee, Hiwassee, and Ocoee Rivers, all of which flow westward into the Tennessee.

THE fluctuations in the Tennessee River correspond to these wet and dry seasons. During summer, the flow at Knoxville often drops to a flow of 3000 cubic feet per second. Several months later, following the winter and spring rains, the river has increased its depth by 23 feet and the volume of flow is over 100,000 cubic feet per second. On the lower river beyond Muscle Shoals, the seasonal discrepancy is even more alarming. At Pickwick Landing, when there is no regulation, the flow drops to as little as 7000 second-feet. Under flood conditions, however, the river will increase 44 feet in depth and, bursting over its banks, attain a flow of 318,000 second-feet. The highest stage on record occurred in March, 1867, when the discharge was 428,000 second-feet at Chattanooga.

This annual flood menace is aggravated by the peculiar break in the natural direction of flow of the Tennessee itself. In early geologic times the Tennessee River flowed from its present upper basin in eastern Tennessee through a channel which extended southwesterly from a point somewhat downstream from Chattanooga to the vast embayment which has since receded to form the Gulf of Mexico. A subsequent uplift of the

earth's crust blocked this old outlet, thus diverting the upper river into its present lower basin, which extends westward and then north.

The danger in this situation lies in the fact that it prevents a co-ordinated flow of flood waters down the river. The topography of the lower basin is low and rolling, and the run-off is much slower than in the eastern end of the Valley. The rains in the lower basin cause flood crests that recede slowly, retarded not only by low gradient but by backwater from the Ohio at the mouth of the Tennessee River. It is not uncommon for a swiftly moving crest from the upper basin to reach and further augment one that has not yet drained out of the lower river.

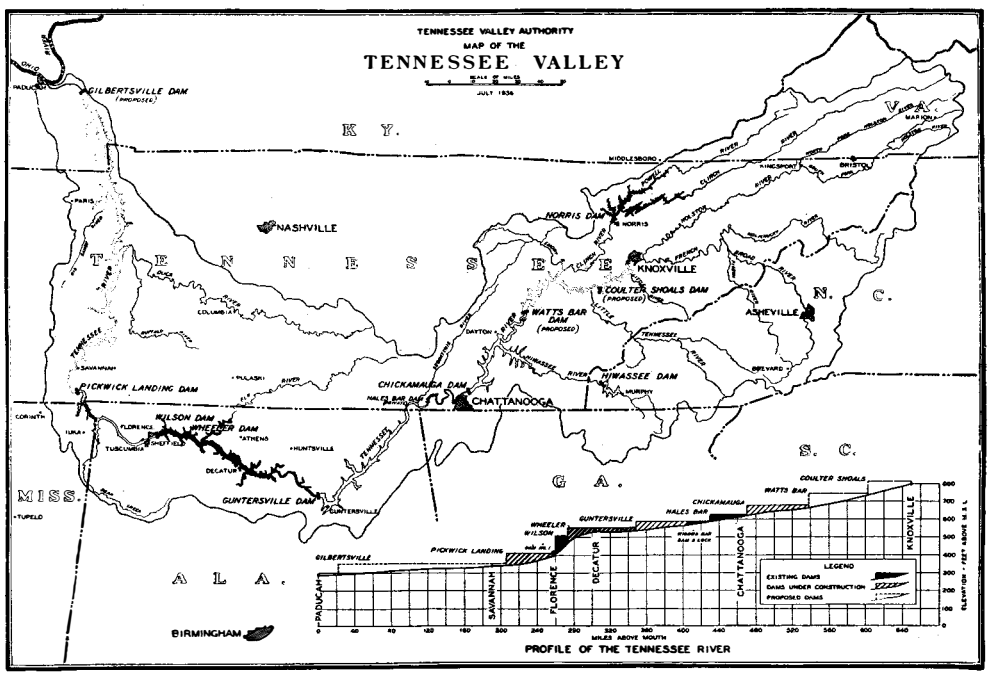
It is estimated by engineers that the maximum run-off that may be expected in the upper Tennessee Basin is about 34 cubic feet per second per square mile of territory. The upper basin is 21,400 square miles in area. This means that, barring regulation, it would not be unreasonable to expect a flow of approximately 730,000 cubic feet per second in the Tennessee at Chattanooga.

Such is the volume of water that must be controlled as a public enemy or put to work in the service of mankind. The Tennessee Valley Authority is using every reasonable method toward this end. The approach is twofold. On the one hand, improved farm management practices aiming at increased ground-water storage by means of cover crops, terracing, and reforestation are encouraged. On the other hand, a construction program is now under way for the erection and integrated operation of a series of storage dams on the principal tributaries, and high navigation dams on the Tennessee itself.

The Authority's agricultural experts estimate that a general shift toward improved farming practices throughout the entire valley area would facilitate absorption of an additional four inches of rainfall, a further ground-water storage equivalent to about twice the capacity of the Norris Dam reservoir. This amounts to approximately 6,500,000 acre-feet.

Such storage in the soil is a valuable supplement to the dams, the main instruments of control. On the Tennessee itself, nine high dams and one low-lift navigation lock are contemplated. Of these, three are now in existence—the privately owned Hales Bar Dam located 40 miles downstream from Chattanooga, the war-built Wilson Dam at Muscle Shoals, and Wheeler Dam, at the upper end of Lake Wilson, completed in 1936 by TVA. Four more are under development or actual construction—Gilbertsville Dam at Gilbertsville, Kentucky; Pickwick Landing Dam, 53 miles downstream from Wilson Dam; Guntersville Dam, near Guntersville, Alabama; and Chickamauga Dam, near Chattanooga, Tennessee. Two more dams have been recommended to complete the transformation of the Tennessee from Paducah to Knoxville into a navigable waterway with auxiliary flood control and hydro-electric power values. These are the Watts Bar project near Peakland, Tennessee, and the Coulter Shoals project near Lenoir City, Tennessee—both between Chattanooga and Knoxville.

IN the uplands, to control the flow into the Tennessee, the Authority has built one storage dam, is constructing another, and has proposed a third. Norris Dam, on the Clinch River in northeastern Tennessee, was completed and put into operation during 1936. Hiwassee Dam, on the Hiwassee River in southwestern North Carolina, is in the initial stages of construction. A third high storage dam has been proposed on the Little Tennessee River at Fontana, North Carolina.




Co-ordinated functioning of these monolithic concrete giants will step the waters of the region down through a chain of reservoirs, making them "walk" instead of "run." Integrated operation will make possible 652 miles of year-'round navigable channel, skim the crests off flood waters, produce about 2,000,000 horsepower of electric energy.

Yet all this would be impossible without the work of a small staff of engineers whose duty it is to record with consistent accuracy, the year 'round, how much rain is falling, where it is falling, and how much of it is coming down the rivers of the region.

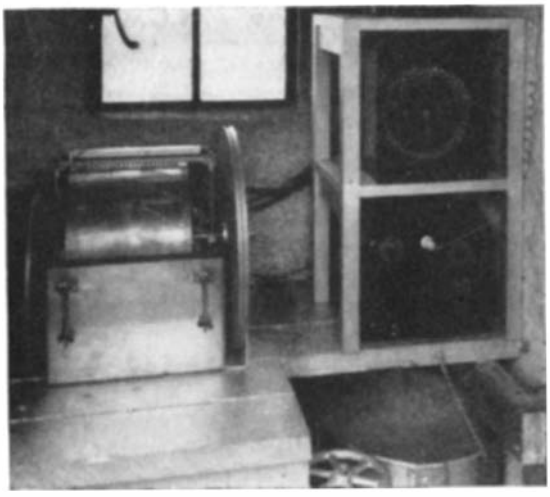
Using as a basis the amount, duration, and intensity of the rainfall, the season of the year, the immediate flow of the river, the average period of surface run-off in the particular area, and the corresponding average period of ground-water run-off, the forecasters are able to calculate the volume of flow in the river as many as 72 hours in advance. They not only determine how much of the rainfall will run off into the river but, if it is an extreme flood crest, when the high stage will arrive at given points along the stream below.

For this purpose, the Authority has located at strategic points throughout the Valley 156 daily gages and 42 recording gages for measuring precipitation. In addition, reports are received from 147 gages owned and operated by other governmental agencies or private corporations. Through the co-operation of the Water Resources Branch of the United States Geological Survey, the Authority receives stream-flow data from about 120 stream-gaging stations located along the Tennessee and its tributaries. By correlation of these data, a continuous record of the total amount of run-off on the land, or in the streams, is made available at all times. To complete the information, stations have been established for measuring the amount of loss through evaporation.

In other words, the question is no longer what effect a heavy rain will have along the Clinch River only, but what effect storms along the Clinch, Holston, French Broad, Little Tennessee, Hiwassee, Elk, and Duck will have on the Tennessee River, and, further, what the combined effect will be on the principal cities and the Authority's construction

projects along the way and in the Mississippi Valley beyond.

"The business is now getting complicated," remarks Albert S. Fry, head engineer in charge of the service, "because we have to estimate the run-off in the drainage basin of each of these tributaries and project our calculations on each flood crest, large or small, as it progresses down to the Tennessee and beyond, determining four or five days in advance just when and where each minor crest will meet others and when the augmented flow will reach cities or points that are not protected against floods."



**Above is shown one of the stream gaging stations on the French Broad River. *At the left:* This special radio device announces automatically every two hours whether the river is rising or falling. A similar one broadcasts a record of rainfall**

Thus, it is like trying to figure out a time table with many variable quantities, yet that time table is turned out daily. A mimeographed report on river stages, rainfall, and a three-day forecast is sent out daily from Knoxville to about 150 interested parties. The same information is telephoned every morning to the TVA dams and a number of towns on the Tennessee.

Since time is the essence of the system's value, the forecasters are constantly experimenting. Experiments are now under way requiring the keepers at certain isolated gaging stations to report twice daily directly from the stations by short-wave radio. The outstanding developments thus far are two automatic radio reporting devices particularly applicable to river gaging stations too remote for telephone connection. These two, inventions of the TVA, resulted from study of a device used in California by the State Engineering Department for transmitting the fluctuating stages of irrigation canals.

One of these is an automatic stream-gage radio transmitter. Because of the unusually rapid run-off from the Elk River drainage area and its almost immediate effect upon the Wheeler reservoir, the first of these automatic devices was set up at the stream-gaging station at Prospect, Tennessee. The principal feature of this equipment is the keying device which takes the gage reading and automatically broadcasts every two hours over a short-wave radio set. The messages, in dot and dash code, are picked up at Wilson Dam and relayed by telephone to the Knoxville office.

The metal float in the gaging station which rises or falls with the fluctuation of the stream is suspended by a small wire cable which passes over a wheel attached to a small drum in the gaging house. The rise and fall of the float, with variations of water level, turn the drum. Around the periphery of the drum are copper electrical contacts corresponding to the water level at any time. These contacts close an electrical circuit and a timing device sends dots and dashes in combinations determined by the position of the drum.

An observer at some distant point listens in and counts the dots and dashes and from these knows how high the water is at that time. The broadcasting is done at any intervals of time desired. Several of these automatic reporting mechanisms have been installed at strategically important stations in tributary drainage areas.

The second device is a radio rain-recording station which operates somewhat similarly to the automatic river gaging station. There are four of these in operation.

Control was sufficient to justify the issuance on April 30, 1937, of a schedule governing operation of Norris, Wheeler, and Wilson reservoirs for the summer in the interests of navigation and malaria control. For navigation purposes, water would be released from all three reservoirs so as to maintain an average discharge of 17,000 second-feet in the Tennessee at Florence, Alabama. For malaria control—that is, the business of leaving mosquito larvæ high and dry instead of permitting them to thrive in breeding pools along the shores—a definite drawdown schedule was worked out for both Wheeler and Wilson reservoirs. This schedule, of course, would be subject to temporary interruption when necessary by regulation for floods, navigation, or TVA construction operations.

It sounds as though this manipulating of two reservoirs, the combined capacity of which amounts to 1,980,000 acre-feet, were as simple as filling and emptying a water bucket. Yet in July one of those expected interruptions occurred to demonstrate what it takes to control a river.

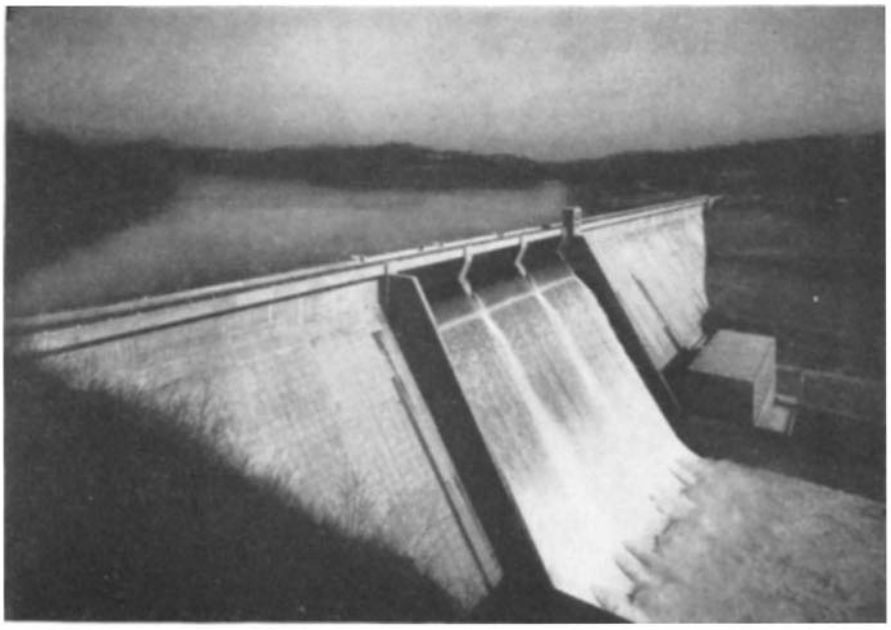
The word came that the engineers were ready to drive the steel for the third cofferdam at Pickwick Landing. This would necessitate reduction of the flow to 8000 second-feet. Then the Eagle Packet Company wrote in from St. Louis that their excursion boat *Golden Eagle* would be coming up the lower Tennessee about the third week of July. Carl A. Bock, assistant chief engineer of the Authority, wrote the packet company as follows:

"Our present plan contemplates discharging 7000 cubic feet per second at Wilson Dam from July 18 to July 22 inclusive. Our records indicate that this discharge will produce a minimum depth of about six feet in the lower part of the Tennessee River.

"At midnight July 22 we plan to increase the discharge at Wilson Dam to 17,000 cubic feet per second. This will produce a minimum depth of about 5.7 feet in the Sheffield Cut and about seven feet at Big Shoals. This increased flow should reach Johnsonville, Tennessee, sometime during Sunday, July 25.

"Six hours before your boat reaches the Sheffield Cut we will increase the discharge to 20,000 second-feet, which will give a depth of about six feet at this point. We will maintain this release until your boat starts down the river on the return trip."

That was the plan, and it left TVA



**Norris Dam, on the Clinch River, as floodwaters were being released**

keeping three balls in the air at one time —malaria control, flowage control, and navigation. And on top of that it rained.

The forecasters calculated their volumes, nonetheless. Wheeler Lake was drawn down enough to make room for the storage that would occur during the period of restricted flow. This left the mosquito larvæ high and dry. Then the gates were closed, and the engineers drove their steel piling in low water. In final fulfillment, the *Golden Eagle* advanced up the Tennessee and met the increased flows exactly at Johnsonville and the rocky Sheffield Cut as predicted.

In February, 1936, storms in the upper Tennessee basin jiggled stream gage floats up and down like fishing bobs. On March 4, Norris Dam was finished and its gates were closed. The heavy rains continued. Yellow water began to lick about Chattanooga's waterfront. By March 30, the high water reached a 37.1-foot stage, 4.1 feet above flood stage. It is estimated that without the regulation afforded by Norris Dam, the river at Chattanooga would have reached a stage of about 41 feet, with consequent flooding of 1000 acres of urban property and flood damages to a total of approximately three quarters of a million dollars.

A FEW days later the crest, a flow of 318,000 second-feet, reached the Pickwick Landing damsite. But, warned in advance exactly when the crest would arrive, the engineers had had ample time to remove equipment and materials to points of safety.

The most effective example thus far of regulation for flood control occurred during the storms that created the great flood in the Ohio Valley in January, 1937. Rainfall records indicate the following precipitation between December 27, 1936 and January 28, 1937: Memphis, on the Mississippi, 20.49 inches; Johnsonville, on the lower Tennessee, 25.06 inches; Nashville, on the Cumberland, 15.81 inches; Louisville, on the Ohio, 19.94 inches; Cincinnati, on the Ohio, 14.81 inches; Columbus, on the Scioto, 11.66 inches; and Marietta, on the Ohio, 11.52 inches.

Rainfall records for Knoxville and Chattanooga during this period were 12.51 inches and 12.87 inches, respectively. Rainfall in the Clinch River basin during January amounted to 10.83 inches, two and one-half times normal for that month, which is 4.11 inches.

All through this period, Norris Dam stored water, withholding from the Tennessee an average flow of about 32,000 cubic feet per second. The effect was to reduce the flow at Chattanooga by about five feet during the two periods of high water. The first high stage was such as to put TVA construction operations at both Chickamauga and Guntersville dams under water. The second was not quite enough to overtop the Chicamauga cofferdam again, but it kept the Guntersville cofferdam submerged. The forecasting system gave adequate flood warnings on each occasion, so that on each job all equipment was protected and no workmen endangered.

Farther down the river, Wheeler Dam reservoir was being operated in conjunction with that of Norris Dam. Wheeler Lake has a flood storage capacity of 500,000 acre-feet. On the occasion of both high stages, Wheeler reservoir was able to withhold enough from the flow of the Tennessee to permit the cofferdam at Pickwick Landing Dam to escape flooding by inches. Release of water at the dam was allowed to rise to a peak flow of 230,000 second-feet, but no higher, during these crises. This gave the lower Tennessee basin a much needed chance to drain out, as it and the Duck were in the path of the heaviest rains.

The effect of the combined storage afforded by Norris and Wheeler reservoirs on the Ohio River, which during all this time was raging in one of the worst floods in history, was to skim approximately six inches off the crest. The town which perhaps benefited most from this was Cairo. With its levees overtopped by nine inches, Cairo had found it necessary to throw up temporary mud boxes atop its permanent protective structure. The occurrence of sand boils throughout the town gave evidence of the tremendous pressure being exerted upon the city's defenses. It may well be that an added head of six inches against the temporary mud boxes plus the increase in the river's pressure would have constituted the last straw needed to undermine the whole protective structure and inundate the city.

Many persons do not understand how a dam can have more than one use, the general impression in the past being that a dam is usually designed for but one purpose and is located at the site particularly expedient for such purpose. There is a growing recognition, however, that the many uses of water and land are inter-related.

THE greatest total public benefit is not attained through piecemeal development. It is come by through treatment of a drainage basin as a whole, through co-ordinated operation of strategically placed plants. And it is entirely possible that comprehensive development requires fewer structures than piecemeal development. For example, in addition to the existing Wilson Dam and Hales Bar Dam, it would have required 32 low-lift dams to create a navigable channel between Paducah and Knoxville similar to that of the Ohio River. The Tennessee Valley Authority is building seven high navigation dams instead of the 32, with resultant benefits of flood control and water power in addition.

The most economical development of water resources for multi-purpose usage comes only after all pertinent factors are taken into consideration. Temperature, winds, rainfall, topography—these are only a few, yet are indicative of the complexity of the problem. And when one looks at the problem as the development of an entire drainage basin rather than of a single stream, the wisdom of integrated development becomes apparent at once. Interlocking and year-'round navigation are not achieved by a dam here and a dam there. Flood protection is not rendered by low-lift navigation dams or by an occasional storage reservoir in the mountains, which under private operation might release water when storage would be to the public interest. Nor is the maximum of power extracted from a basin's flowage if only the largest power sites are developed and the remaining stream flow left unused.

# OUR POINT OF VIEW

## Don't Overtax Fuel Oil

AS pointed out in the article "The Diesel Broadens Its Field," published in our April issue, one of the factors that may militate against the inherent advantages of the Diesel for many purposes is the cost of fuel. Designed to operate on any ordinary fuel oil such as is readily available throughout this country, the Diesel can supply efficient power at low cost. But, remove the low-cost advantage of the engine, by increasing the cost of fuel, and the recent technological advances in design and construction hold little advantage to the ultimate consumer.

It has frequently been stated that there is small reason to fear that the producers of fuel oil will raise their retail prices merely because of increased demand. The insidious and insatiable monster of unfair taxation is the hidden receptacle into which will pour the added costs of fuel oil, unless consumers are wary, keep in constant touch with developments, and nip efforts at increased taxation in the bud.

A case in point is the recently defeated Boland fuel-oil bill, aimed to levy a tax of 42 cents per barrel on all fuel oil used in the United States for the generation of heat or power—a *one cent per gallon* tax over and above present taxes. It is estimated that fuel oil retails at an average of a little more than seven cents a gallon, of which, at the present time, an estimated two thirds of a cent per gallon go for indirect and hidden taxes. In addition, three states levy sales taxes ranging from one quarter to one cent per gallon. Thus, the Boland bill, if passed, would have increased taxation over 100 percent on a commodity that is vital to the prosperity and comfort of millions.

Just because this bill has been defeated is no reason for its opponents to rest on the oars. Similar measures will come up in the future—the very near future, if the avariciousness of the tax grabbers has not changed overnight. In fact, just prior to going to press, one congressman (from a *coal* producing section of the country, and before a convention of *coal* merchants!) has pledged a steady fight for a federal law to tax fuel oil one cent a gallon.

Fuel oil is not a luxury, and therefore should not be subjected to discriminatory taxation, striking largely and directly at home owners who, in one year, use approximately 100,000,000 barrels of fuel oil for home heating. Furthermore, only upon such a low-cost product can be based many future developments in heating and power, as well as in the field of chemical research. Remove the advantage of low cost and immediately there is removed much of the incentive for development. Aside from any questions of discrimination and class taxation, the money-mad tax grabbers must not be permitted to strangle, for their own selfish ends, the progress of scientific research and its benefits to the world at large.

## We Can Laugh—Now

HOW simple hindsight is, and how accurate, but how precarious is any attempt to predict the future! Recently this fact was brought home to one of the editors of this magazine when he repaired to a roentgenologist to have his alimentary canal studied by X ray. As he lay comfortably under a fluoroscope with a seated physician calmly watching his "innards" perform for a while, his thoughts reverted to a statement which he had recently blundered across, written just after Prof. Roentgen's discovery of the X rays. "When the details reach us," it read, "the process will probably prove to be of a scientific rather than of practical interest."

Not of practical interest! Some long-gone writer "stuck his neck out" that time, did he not?

## New Minds For Old

THE "good old days" may constitute the substance for considerable romancing on paper and in the mind; but thinking of them too much very definitely is not conducive to progress. You may, according to Charles F. Kettering, vice president of General Motors in charge of research, have either an old or a young mind, one that looks backward too much —"our whole education is based on looking back on what has been done"—or one that has "got the essentials of optimism" and looks forward with consuming curiosity toward what is yet to be done and will be done.

Mr. Kettering rightly says that there always has been too much of the brand of pessimism which is dubious of the future, and he believes that such thinking of "old" minds retards progress. When the Rosetta stone made possible translation of Egyptian hieroglyphics, he says, the first tablet read bewailed the high cost of living and wished for the good old days. He cites the first issue of Scientific American as arguing the question whether the telegraph would ever be a success (but, unfortunately, did not add that *that* was in 1845). When we got the telephone so that we could talk 100 miles, and again when we could talk 1000 miles, people asked: "Why should you wish to talk farther?" Old minds they had—old minds afraid of the future, Mr. Kettering says.

To these examples and others he gives, we might contribute two from a lecture by Dr. Royal N. Chapman, director of pineapple research in Hawaii, which was recently quoted by Joseph T. Mackey, president of the Mergenthaler Linotype Company. About 1880, a Belgian banker, M. Piermez, said: "It is not likely that there will be again an economic progress comparable with that by which this century has changed the world." The prize came in 1886 when United States Commissioner of Labor C. D. Wright decided in his first report that the world had enough railroads, canals, international communications, and merchant shipping, and added that all that was left for society to do was to settle down and enjoy the fruits of its labors because the next 50 years would see no advance equal to the previous 50 years. Dr. Chapman chuckled when he had quoted this, and then imagined an assemblage of youngsters in 1886 listening to the above-mentioned oldsters.

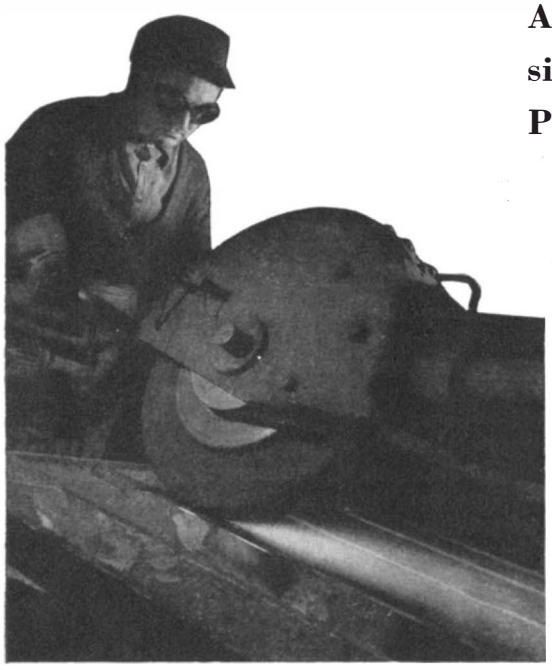
In that audience would have been Edison, aged 39; Albert Michelson, 34; Ford, 23; Steinmetz, 21; Thomas Morgan, 20; Madame Curie, 19; Millikan, 18; Orville Wright, 15; Marconi, 12; Kettering, 10; Einstein, 7; Irving Langmuir, 5. The two Compton brothers had not yet been born.

"Nowadays even the man in the street knows better than to say 'It can't be done,' for he believes science can work any miracle," we said in a recent editorial. The statement is quoted here, not to imply that people are more hopeful of the future than Mr. Kettering believes, but to emphasize our belief that they are generally open-minded because they have listened to a few leaders such as he, and are willing to be shown. They, however, are the spectators, not the doers. It is those who make progress of one kind or another who are most to be chided for living and doing so close to one restricted channel that they lose perspective on the whole picture. It is those in high places who have their pet theories concerning the "social implications of science," "science holidays," and the like who tangle the threads of progress and cause bewilderment. The young ones with the young minds are too busy to listen to such talk and haven't so much to unlearn.

# GRITS FOR GRINDING

## Abrasives Important to Industry . . . Make Possible Improved Grinding, Lapping, Polishing, Precision Work . . . Abrasive Research Goes On

By PHILIP H. SMITH



A shower of sparks flies as a workman removes casting gates and risers with a large grinder

THERE was a time, not so long ago, when automobile engine bearings had to be taken up after about 15,000 miles of service. Today, the motorist seldom gives a thought to bearings. He expects fine performance for an indefinite number of miles and gets it because the automobile is the beneficiary of progress in the field of abrasives.

It is probable that the motor vehicle owner has a mechanical refrigerator which he may not class as a piece of fine mechanism, but from which he expects performance as dependable as that given by his car. Here, too, he gets excellent service day in and day out because modern abrasives permit manufacture of precision parts at low cost.

Labor-saving machinery, which characterizes this modern age, depends heavily upon grinding, honing, and lapping —all operations employing abrasives in some form—and industry, too, benefits directly. Abrasive wheels having the capacity to cut through one-inch steel bars in a few seconds have recently revolutionized the production cutting of many materials. Metal working plants use abrasive wheels for grinding, cutting, and polishing; so do the stone, ceramic, and jewelry industries. Stone monuments are cut, polished, and even lettered with abrasives. Such varied products as metal foils, flour, paint, textiles, and sugar, all require rolls in their production and the rolls require grinding for fine surface finish.

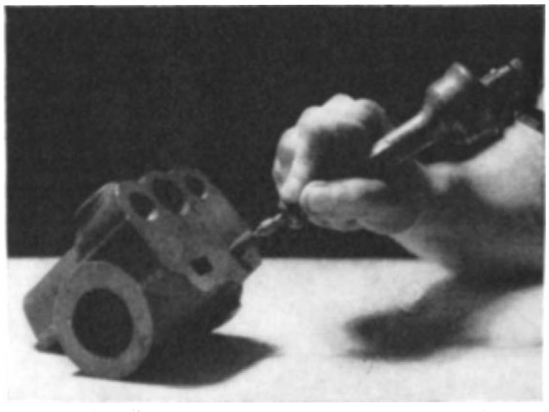
Research made the abrasive industry what it is today. Indeed, you will have to hunt far to discover a single business in which it has played so vital a rôle. When Edward Goodrich Acheson made the first carbide of silicon in an electric furnace some 40 years ago, he did more than develop a new abrasive; he established the precedent of the scientific approach from which the industry has never departed. We can appreciate this discovery now as a momentous occasion because it launched the break-away from natural abrasives and inaugurated the era of the synthetic or artificial. Had industry been forced to remain dependent upon the natural with all its lack of uniformity we could not boast today of fine finish and close tolerances in mass production. It took the slow substitution of artificially created materials which could be controlled as to nature and performance to make abrasives the handmaiden of mechanical precision.

THIS matter of control is important to an understanding of what abrasives are, what can be accomplished with them, and where developments are likely to lead. Control is what has enabled the manufacturer of abrasives to meet industrial needs as fast as they have been generated. It explains the great variety of abrasives in use today and hints that there are more to come.

One can appreciate best what this control means by stopping to think of the range of products which are handled with abrasives and then consider the abrading action itself. Slitting a fountain pen point with a gap .006 of an inch wide, removing the heavy gates from steel castings, and grinding pulpwood for paper making, are all distinct operations if for no other reason than that the materials are quite unlike. Each material offers a different resistance to the abrasive and the abrasive must be able to "take it." Control of abrasive manufacture, therefore, must begin with the basic ingredients and be maintained throughout the process in order that the shape and toughness of the grains may be pre-determined.

Two artificially made products—silicon carbide and aluminum oxide—are the mainstay of abrasives. The former is made by the electric furnace reaction of silica sand and coke; the latter by the fusion of the mineral bauxite. When these products come from the furnace they must be crushed to form grains and a second control established by careful grading for size.

If an abrasive is to be used in wheel form, another problem presents itself over which control must be imposed. The grains must be bonded together so that their cutting edges will do the prescribed work, and the bond must be so made as to regulate the rate of wear. If the bond wears away faster than the grain, the wheel will appear soft and wear down at an excessive rate; if the grains break down more rapidly than the bond, the wheel will

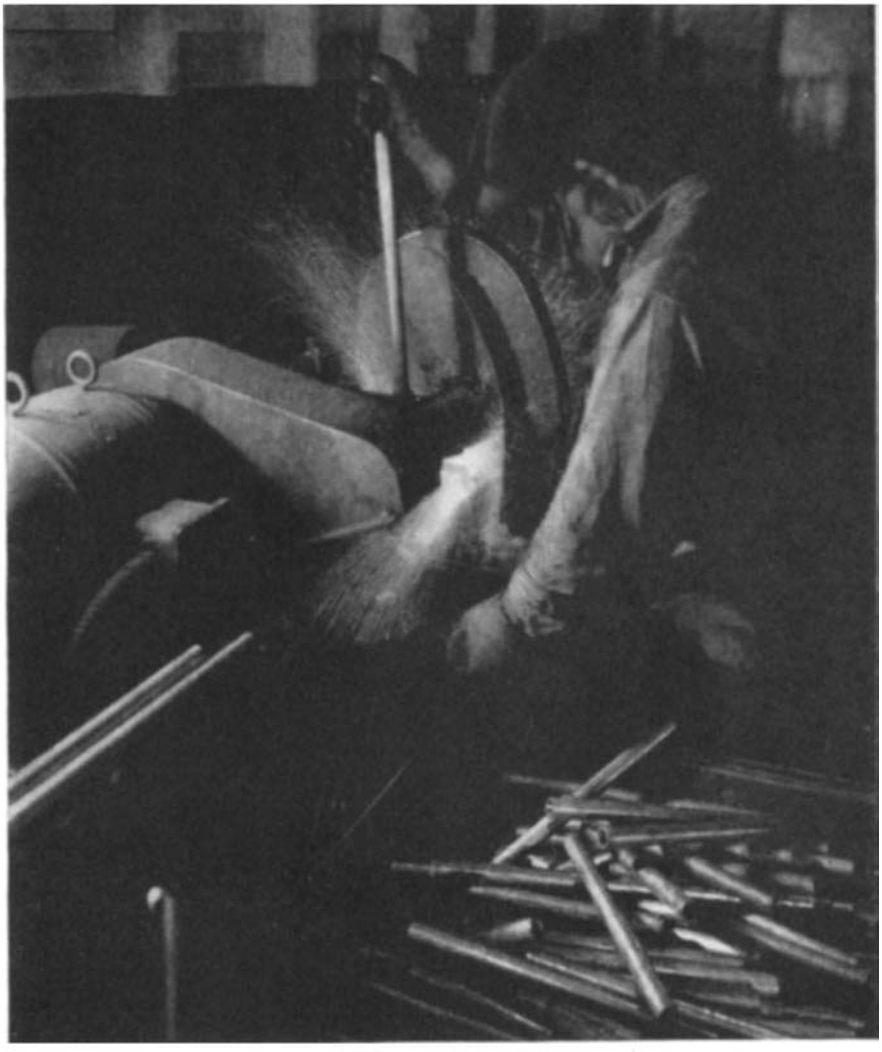


In contrast to the above photograph, a tiny high-speed hand grinder touches up a casting

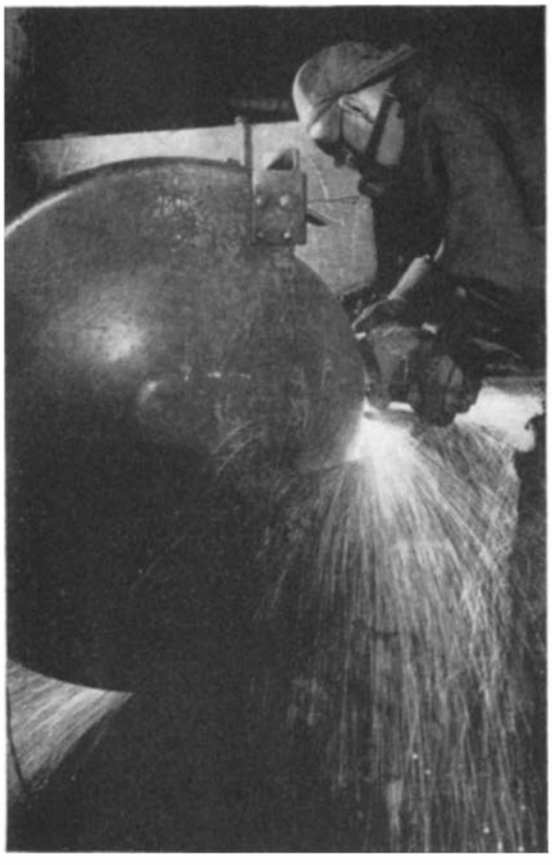
glaze and cut poorly. Bonds, therefore, must be controlled with respect to type and amount according to the character of work to be performed. The bonds may be made of vitrified clay, sodium silicate, resinoid, rubber, or shellac. Finally comes a fourth factor which controls the size of the pores between the cutting grains to provide clearance for the chips removed in grinding.

Countless examples of grinding practice can be taken from the automobile industry where it has been carried to a fine art, but instead let's look at the manufacture of the household refrigerator where the human hair, with its .003 of an inch diameter, is no longer fine enough to measure tolerances. In the production of compressor crankshafts, one manufacturer is grinding them at the rate of 40 an hour, holding to limits of .0003 of an inch plane and .0005 of an inch diameter. Another producer is holding to limits of .0001 of an inch in the grinding of the face of a small rotor.

SUCH fine tolerances under mass production methods are a development of no more than six years. They are possible only because abrasives and grinding equipment have been refined to a point where they will duplicate operating results quite irrespective of human skill in the operation. To grind piston pins within a tolerance of one-fourth of a thousandth of an inch at satisfactory production speeds, for example, requires the use of wheels that are new and distinctive in grit sizes and bonds. Not only must the grit be graded for size with extreme care, but it must also be controlled with regard to crystal shape and structure, while the machine must grind with accuracy down to the last finishing pass where the stock removal is infinitesimal.



**A grinding disk does a speedy job of cutting off sections of tubing**



**This high-speed floor-stand wheel does a rough grinding job on an irregular casting**

Operations of this kind which involve the use of highly refined equipment are often termed lap grinding. It carries precision in grinding to a point where the older requirement of a finishing lapping operation is frequently unnecessary. Rolls for finish transfer to sheet or foil are now rarely lapped, while lapping has been largely eliminated on practically all cylindrical, centerless, and some internal and surface-grinding operations.

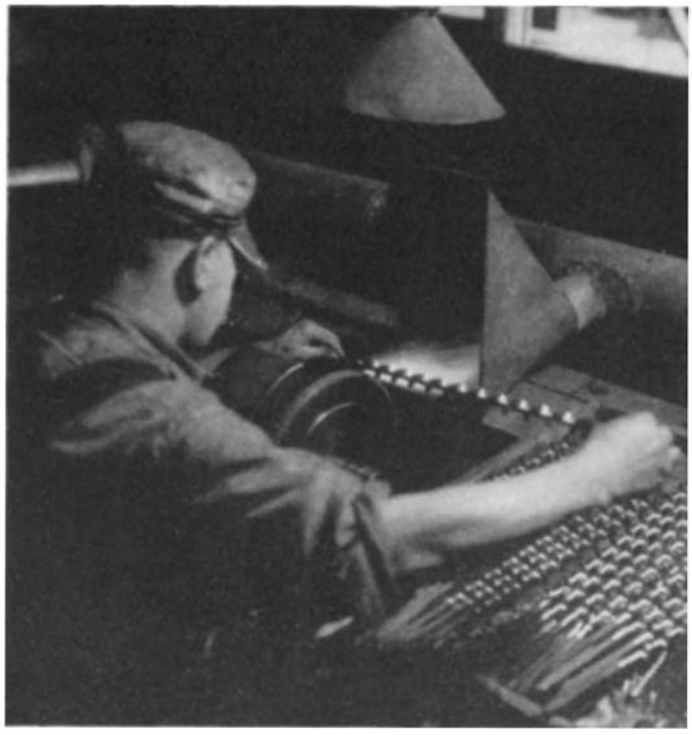
Similar refinements have been made in honing tools and the abrasives used with them. Boring and reaming operations now produce accuracy in motor bores and finishes hitherto undreamed of on a production basis. Special abrasive honing tools have been developed for the honing of crankshaft pins and journals which produce bearing surfaces that eliminate running-in time, while the honing of splines for closer fits and accuracy has provided mass production with a new technique.

As grinding technique has improved, so has the science of lapping. Abrasive grains are now graded in size to minute powders under microscopic control and new carrier mediums or vehicles have been developed. Industry now has at its command new compounds which are unaffected by temperature changes as were the older greases and oils; vehicles which hold grains uniformly separated; which control the speed of cut to prevent deep grain marks; which are non-corrosive and do not require special cleaners for removal. These compounds are widely used in the lapping of gears, worms, machine tool spindles, slide and rotary valves, to mention only a few applications. Lapping operations

also have been developed for handling soft metals such as bronze or babbitt, while fine compounds are now available for metal polishing where buffing wheels are not suited.

Occasionally a new development appears which taxes the ingenuity of the abrasive manufacturer. The advent of cemented carbides was such a case. When tool tips of this extremely hard material came into use, there arose a need to grind them to keep them sharp. Special brittle or friable grades of silicon carbide and new bonds were employed to produce a vitrified wheel, and while results in general were satisfactory, the operation was slow and cutting edges on the ground tools frequently had to be lapped or highly finished to give maximum efficiency.

STILL further development led to a wheel employing diamonds as the abrasive, in a synthetic resin bond. Despite the higher cost of the diamond grits, the initial expense was offset by savings in labor, the extended tool life between grinds and the savings in scrapped tools due to the generation of less heat. In most cases subsequent lapping operations were eliminated.



A skilled workman polishes an augur on a grinding wheel

Diamond wheel operations have proved particularly satisfactory on multiple point tools such as milling cutters, where they promote extreme accuracy and better finishes. What this new wheel means in time saving may be gleaned from the following examples: 12 piston grooving tools ground in 12 minutes as contrasted with six hours using a vitrified wheel. Since a lapping operation followed the use of the vitrified wheel the total time by this method was 30 minutes per tool as contrasted with one minute with the diamond wheel. The grinding of one work rest blade provides another example. Here the diamond wheel took five minutes; the vitrified wheel, 30 minutes.

The foregoing illustrates with peculiar clarity the scientific nature of abrasive manufacture. The bonding of diamond grits with a resinoid involved more than using one laboratory product—resinoid—to handle another, the cemented carbide. Phenolic resins came into use because of the accumulated knowledge of what was required to make satisfactory bonds. The chemist had already formulated relationships between abrasives and bonds in respect to wear and heat generation and he was able to seize upon the new material because it permitted manufacture of a free and cool cutting wheel.

One is accustomed to think of an abrasive in wheel form strictly as a tool to machine a surface by grinding, but abrasive wheels are also used for sawing. In the past few years so-called cut-off wheels have come into very wide use in industry. Originally employed for the cutting of metal stock which could not be handled with a steel saw, the trend has been toward cutting-off a vast number of softer materials where high production rates called for faster cutting time and lower cost. Comparative studies between cutting bar stock with a power hack saw and an abrasive wheel have shown reductions as high as 20 to one. Then, too, there is the added advantage that the cutting leaves smooth, parallel faces, requiring no further machining.

Cut-off wheels look like phonograph records and are so designed that the abrasive points on the periphery simulate the teeth of a saw. The thousands of little cutting teeth actually cut rather than "burn" through, as one might expect. Both silicon carbide and aluminum oxide abrasives are used, and the bonds are, variously: shellac, rubber, and resinoid, according to intended use. If you want to cut off agate or ivory you would use a shellac-bonded wheel, while pen points or tungsten rod would require a rubber bond.

It was the advent of the synthetic resin bond which really put the cut-off wheel on the industrial map. It made possible the increase of wheel speeds from 9000 to 16,000 surface (peripheral) feet per minute, and that is the difference between non-economical and economical cutting speed for a number of materials. One manufacturer found he was able to save ten dollars a day by using the cut-off wheel to cut 1-inch steel tubing required for furniture production. Other producers report savings of 65 to 85 percent in cutting high speed steel, tool steel, and cold rolled steel. Resinoid-bonded diamond cut-off wheels as thin as .020 of an inch are being employed successfully to cut off tool tips from solid bars of cemented carbide.

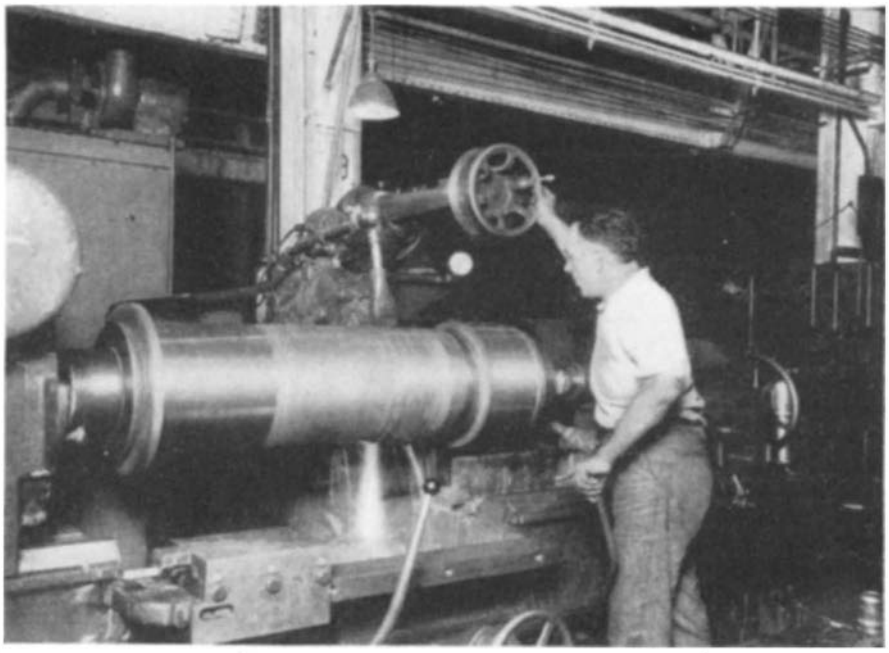
Rubber-bonded wheels are now commonly used for submerged or wet cutting, which are developments opening the way for cutting off many materials which hitherto could not be so handled because of the damage from heat. Thus we find glass rod and tubing, plastics, and heat-sensitized steel being cut with ease, while metallographic specimens cut by the submerged process require less final preparation.

Abrasives appear in still other bonded forms which are called, as a group, mounted wheels and mounted points. These mounted abrasives are made in a great variety of special shapes, but all are very small in size and, as a rule, are used with portable machines. The development of machines with rated spindle speeds of 60,000 to 65,000 r.p.m. have made these small diameter wheels and points both effective and efficient grinding tools and we find a rapid growth in their use. Where it is necessary to remove surplus material from dies and molds, these abrasives work much faster than any hand filing, scraping, or chiseling. Aside from strictly industrial use in foundries, die shops, pottery plants, and many other establishments, these newer abrasives have proved a boon to the craftsman with a home workshop.

THE scientific control over all stages of manufacture which has been responsible for fitting the abrasive to the job, has been applied to the making of coated abrasives (sandpaper) quite as much as to wheels. Flint, garnet, and emery are still employed but the artificial abrasives are used more extensively. Improvements in sandpaper are mainly in method of application rather than in the materials themselves, although treatment of the grains to obtain uniformity of size and hardness is given to coatings quite as much as to bonded materials. By far the most striking development of

recent years is the coating of paper and cloth by an electrostatic process.

It can be understood readily that grains dropped upon a glued surface will fall in haphazard manner and that there will be no uniformity in arrangement of the cutting points, which, after all, do the work. To overcome this weakness, the electrostatic process was devised. It works this way: During the process of manufacture, the coating takes place in a powerful electrostatic field which charges each grain to make it stand point up. Likewise, the electric force spaces the grains equi-distantly because every grain having a like charge repels every other grain. When one learns that the number of grains per square inch of surface may run as high as 609,000, it is obvious that the electric force does a very neat job of regimentation. The accomplishment is reflected in increased efficiency to be had from the coated material, estimated to run from 20 to 50 percent according to the character of the work.



**Hand-wheel control on a machine for grinding rolls**

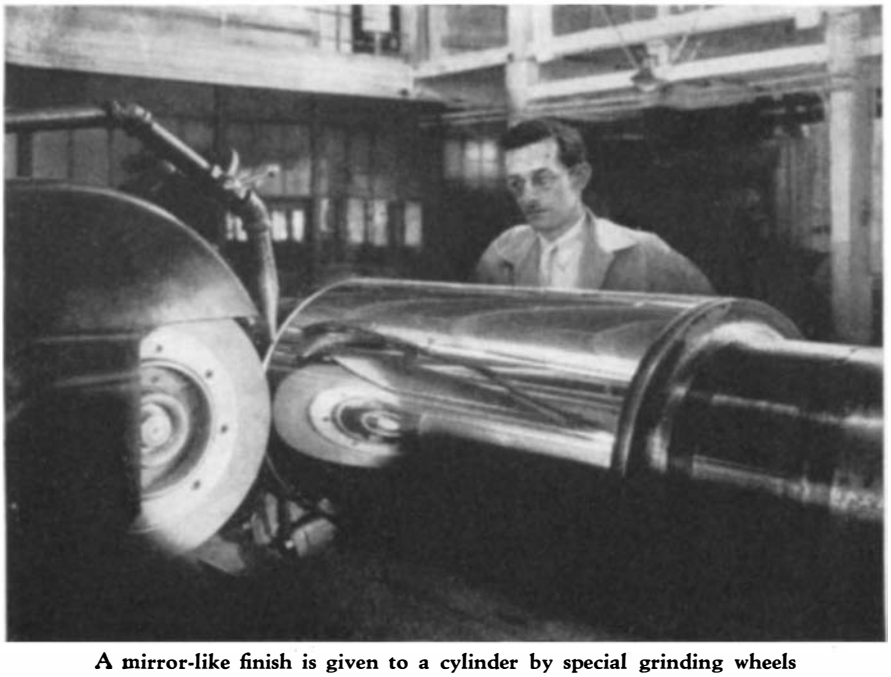
ONE might reasonably ask what there is left to be developed now that so high a degree of control has been established in the abrasive arts. Is even greater manufacturing control possible or desirable? The men most responsible for accomplishment thus far would say that much remains to be done.

The history of abrasives is a story of keeping abreast of other technological gains. New materials have created the demand for new methods of fabrication and that course is by no means run. An age that calls for greater speed and continuous refinement of mechanical devices imposes new demands on materials and methods. Materials must be lighter and stronger and better means must be found for fabricating them.

Between silicon carbide and the diamond there is a great gap in the scale of hardness—a gap which the abrasive chemist would like to fill. A few years ago he thought he had it in boron carbide, second only to the diamond in hardness. This material is made in an electric furnace from coke and boric acid, two inexpensive and commonplace materials. The fact that a way had been found to eliminate the free graphite present in large amounts and thus to make a product of high purity, coupled with the fact that it was self-bonding, gave high hope that it could be molded into wheels to grind such tough materials as cemented carbide. These hopes were dashed when it failed to perform properly in wheel form, but it did go immediately into use as a lapping abrasive to replace diamond dust. Today, boron carbide is employed for lapping both cemented carbide wire-drawing dies and flat tools of the carbide, and by lapidaries for cutting and polishing gems.

MENTION that boron carbide can be molded into form leads directly to another phase of the abrasive industry. Abrasives by their very nature are wear- and heat-resistant. They are, therefore, used to fight wear and heat. Boron carbide, for example, makes an excellent thread guide, pressure blast nozzle, and extrusion die for porcelain. Silicon carbide and aluminum oxide in the form of crystalline alumina have wide use as refractory materials, while the latter, bonded in rubber, makes safety stair treads.

If there are any doubts as to what abrasives mean to industry they are cleared up immediately by imagining our industrial civilization dependent upon nature's rock and stone. Without abrasives we would have to go back to the buggy and all that went with it. Almost everything connected with this industry comes from research and is primarily Twentieth Century. The abrasives, the electric furnace that produces them, the resinoids that bond them together in wheel form, were not conceived by nature but by man. The "can't be done" has been accomplished by considering the most minute grain, studying its chemical composition and atomic structure and learning to manipulate the grain at will. By acquiring understanding—the highest type of research—a reservoir of fact has been accumulated which promises to yield still greater benefits to industry.



**A mirror-like finish is given to a cylinder by special grinding wheels**

Photographs and data courtesy: The Carborundum Company, The Fellows Gear Shaper Company, Landis Tool Company, Norton Company.

# Number One Rocket Man

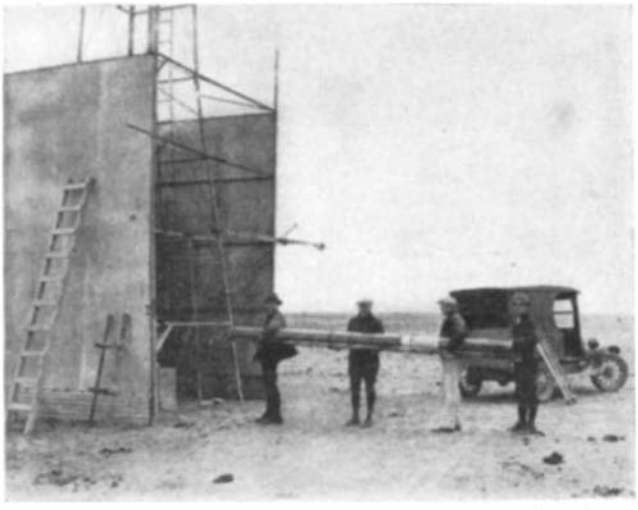
## A Silhouette of the Shy Massachusetts Physicist Who Pioneered in Rocket Research . . . Much to His Distress He Broke into the Noisier Newspapers

By G. EDWARD PENDRAY
Past President, the American Rocket Society
Editor of *Astronautics*

ON a flat, dry plain, 18 miles north of Roswell, New Mexico, rises a 60-foot tower of steel that has roused more curiosity, and has probably had a greater influence on the future of the world, than any other feature of all New Mexico's arresting landscape.

From this tower, at irregular intervals, a Massachusetts physicist and his assistants send roaring into the skies certain gleaming, cigar-shaped projectiles of metal, powered by gasoline and liquid oxygen, and landed by parachutes.

The physicist is Dr. Robert Hutchings Goddard, a bald, spare, pleasant man who will be 56 years old next October 5 (1938). Rocket experimenters the world over recognize him as their Number One man. Not only has he made more contributions to the new field of rocket engineering than any other one individual, but it was Dr. Goddard who launched modern rocket research with his clear presentation of the possibilities of rockets, both their limitations and advantages, 19 years ago. His publication, modestly entitled "A Method of Reaching Extreme Altitudes," was published by the Smithsonian Institution in 1919.



**A rocket being placed in the 60-foot launching tower on the plains 18 miles north of Roswell, New Mexico**

DR. GODDARD at that time had already been a rocket experimenter for nearly ten years. His first trials were made during some studies of the upper atmosphere while he was an instructor at the Worcester Polytechnic Institute, in 1909. Baffled by the uncertainty and limitations of sounding balloons, he imagined that by building some kind of huge skyrocket he could shoot self-recording instruments high into the stratosphere and bring back information of value to science.

This idea of reaching high altitudes with rockets was by no means new with Dr. Goddard. In fact, we are told that a certain Chinese mandarin in the 13th Century sought to lift himself to the moon by fastening rockets to the legs of his chair. Cyrano de Bergerac, the novelist, wrote a story 300 years ago in which the hero transported himself by rocket power. Warmen saw in rockets a potential carrier of explosives centuries ago, and in the Napoleonic wars rocket brigades blossomed in Europe. In the siege of Boulogne, the English succeeded in setting the town afire with rockets designed by Sir William Congreve.

But those early efforts were rule-of-thumb procedures, and really came to little. What Dr. Goddard proposed, 29 years ago, was to apply the methods of modern engineering to the construction of rockets. He perceived that several diverse and complicated problems would have to be tackled, seriatim: (1) the fuel, (2) the materials, (3) the methods of feeding the fuels, (4) the aerodynamic design, (5) control in flight, (6) the further unknowns.

For the rocket, though a seemingly simple device, is really very complicated. It works by recoil—by application of the ancient principle that every action has an equal and opposite reaction. The action is produced by rapid combustion and simultaneous ejection of gas at high velocity. The reaction occurs in the body of the rocket, which flies at an accelerated rate in the direction opposite that of the ejected gases.

Had Dr. Goddard been a less practical man he would have been content to write an article about the idea, or give a lecture on it, and sit back to await the development at someone else's hands. But it happened that he was of the sort who undertake to test their notions before they talk about them. The only successful examples of rockets in his day were skyrockets and life-saving rockets—both powered by modified gunpowder. Beginning at this point, Dr. Goddard tested powder fuel rockets. As new teaching appointments took him to Princeton, and then to Clark University, the idea went with him.

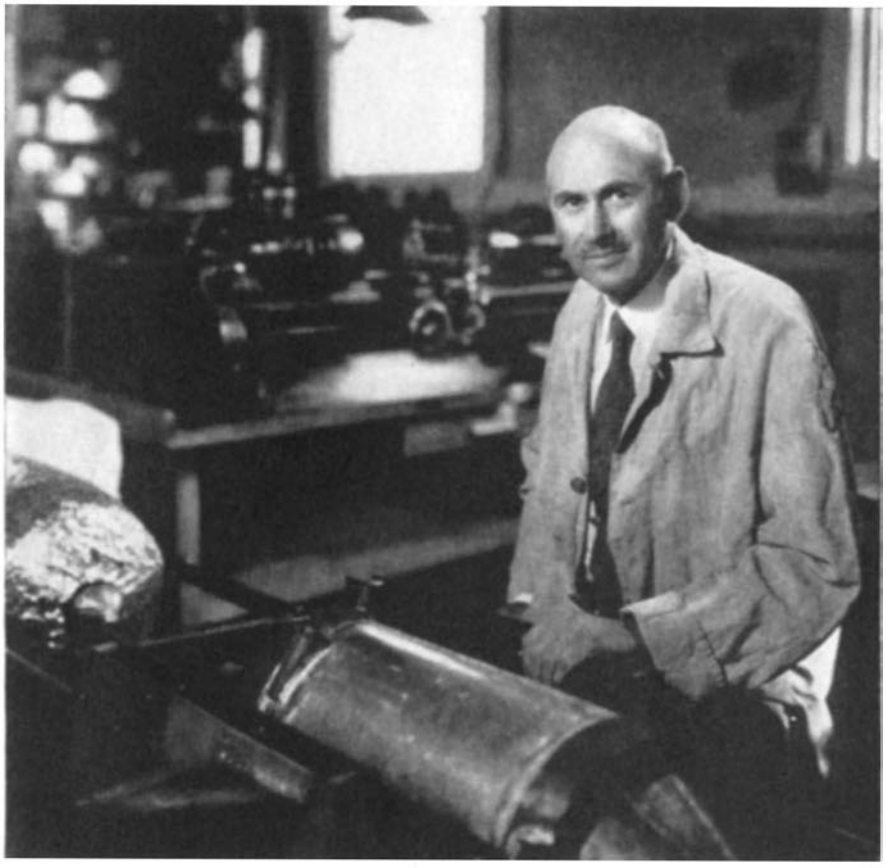
Talk of rockets is so commonplace today—such success has attended the efforts of experimenters—that rocketry is almost respectable. But in the old days of 1914 and earlier, few sane engineers spoke of them except humorously, and physicists who entertained the idea of rocket transportation must have been as rare as one-armed flute players. Nevertheless, Dr. Goddard succeeded, one by one, in convincing his colleagues. In 1914, plugging away on his own, he took out two basic patents on rockets, pertaining to combustion chambers and nozzles. A short time later he talked the problem of rocketry through with Dr. Charles G. Abbot, Secretary of the Smithsonian Institution. So convincing was his argument that the conservative old Institution agreed to grant him modest funds for a series of experiments. In the tests that followed, Dr. Goddard demonstrated that rockets really need no air to push against, and that they are capable of development. He also proved that gunpowder-like fuels must be abandoned in favor of more powerful, more easily controlled kinds, probably liquefied gases.

Thus started what rocket engineers now refer to as the era of "liquid-fuel" rockets—the real beginning of scientific rocketry. Simple calculations show that the most powerful release of energy, pound for pound, occurs during the combustion of carbon or hydrogen with oxy-

gen. The problem was to produce this combustion at the right time, in the right place, and under the right conditions.

After some preliminary trials, Dr. Goddard decided that the best fuel would be a chemical combination of hydrogen and carbon, as in gasoline, and that oxygen could most conveniently be supplied in the pure form, liquefied. These early tests were carried on very secretly near Auburn, Massachusetts, and apparently were the first "proving-stand" experiments with liquid-fuel rocket motors —primitive, to be sure, but they set the foundation upon which a great deal of experimental work has since been built. Dr. Goddard tried out liquid oxygen and various members of the hydro-carbon series, including gasoline, kerosene, liquid propane, also ether. He finally discarded the others and settled on gasoline and oxygen. Virtually all of his experiments since have been made with these.

By 1923 he felt ready to try an actual liquid-fuel rocket. On November 1 of that year he completed and tried out a small one on his proving-stand, tying it down so it couldn't fly. It seemed promising, but wasn't good enough. For one thing, there was the problem of getting the fuels from the tanks into the combustion chamber fast enough. He had used small pumps on the rocket, but pumps are slow, heavy, and troublesome.



**Professor Robert H. Goddard, "Number One Rocket Man," in the well-equipped shop three miles from Roswell, New Mexico, where his rockets are prepared**

IT took two more years to overcome that problem. In December, 1925, he completed and tested a second liquid-fuel rocket in which the fuels were forced into the chamber by the pressure of an inert gas, nitrogen. This method worked well, but still the experimenter cautiously denied himself the experience of turning it loose to see it fly.

That pleasure was reserved until three months later, when on March 16, 1926, at Auburn, he put an improved liquid-fuel rocket into his improvised launching rack and let her go. So far as I have been able to find evidence, this was the first actual flight of a liquid-fuel rocket in this country or anywhere in the world. It was in no sense a public shot. The only witnesses were Dr. Goddard and a couple of helpers. The experimenter timed it with a stop watch and later reported that it fired for two and a half seconds, during which time it flew 184 feet, "making the speed along the trajectory about 60 miles an hour."

A queer-looking rocket it was, too, compared with the sleek projectiles Dr. Goddard's shop in New Mexico now turns out. The fuel tanks were slender tubes, placed one behind the other. The motor, consisting of the combustion chamber and its exhaust nozzle, was well ahead, supported on spidery arms which also carried the fuel lines. The whole contrivance was about ten feet long, but only about half of this length was actual rocket; the rest was the harness that joined the motor to the tanks. Pressure to force the fuels into the combustion chamber was furnished by an outside pressure tank and, after launching, by an alcohol heater carried on the rocket.

The idea of putting the motor ahead of the tanks was the mistaken one that this method of "pulling" the rocket, instead of pushing it, would make it fly better. In practice it did nothing of the kind; it only added to the difficulties of construction. Dr. Goddard abandoned the design at once in favor of rockets with the motor at the rear. Between 1926 and 1929 he shot a number of these, with varying success.

And then, quite unexpectedly, Dr. Goddard broke into the newspapers—much to his distress. Naturally reserved and somewhat uncommunicative, he had early discovered what most rocket experimenters find out sooner or later—that next to an injurious explosion, publicity is the worst possible disaster. (Most newspaper writers still seem to believe that every rocket is aimed at the moon.)

It was his shot of July 17, 1929, at Auburn, that brought Dr. Goddard this great and unexpected burst of notoriety. The rocket was a fairly large one, carrying a small barometer and a camera. Being large enough to carry instruments, it also made a great deal of noise. Neighbors telephoned the police that an airplane had crashed in flames. A few excited Auburnites were certain a meteor had fallen. When fire and police departments arrived, they found only a rocket experimenter, examining the remains of his rocket, pleased at the notable fact that his instrument, shot several hundred feet heavenward, had parachuted gently back from the flight and landed intact.

But the simple facts were by no means enough for the newspapers. Some, of course, had sensible stories, but they were in the minority. It was widely reported that he had shot a rocket to the moon, but had failed, that his rocket had exploded, that it had contained tons of explosive, that his intentions were to fly to Mars.

Fortunately the flurry was short-lived. Also, it had some good results, for it is said that as a result of the publicity Col. Charles A. Lindbergh first became interested in Dr. Goddard and his rockets. At any rate, it was in 1929 that the flyer brought rocketry to the attention of the late Daniel Guggenheim. The result was a grant that made possible the present establishment in New Mexico, under conditions that many experimenters consider ideal for rocket research.

About three miles north of Roswell, a shop 30 by 55 feet was erected, and near it a 20-foot tower built for proving-stand tests of motors and rockets. Fifteen miles farther north, on the plains, stands the 60-foot launching tower from which actual rocket shots are made. The region

thereabout has an altitude of about 3500 feet—enough to reduce noticeably the resistance of the air to rapid flight, as compared with the denser air at sea level. The country is level and open. There is space for high experimental flights without much danger of the rocket landing on an indignant bystander.

Gasoline and liquid oxygen, mixed, form a peculiarly violent detonator, yielding about five times as much energy pound for pound as TNT. Dr. Goddard has taken what may seem like extreme precautions against accident and injury. At the launching tower, all experiments are managed by remote control. The operator and observers are stationed 1000 feet away, in a shelter protected by sand bags on the roof. The observer whose task it is to clock the rocket flight, and who therefore cannot conveniently work from a shelter, is stationed 3000 feet from the tower. For close observations, to watch the firing, launching, and so on, there is a concrete dugout 50 feet from the launching tower. The observer looks through four-inch peepholes in a tilted slab of concrete three inches thick.

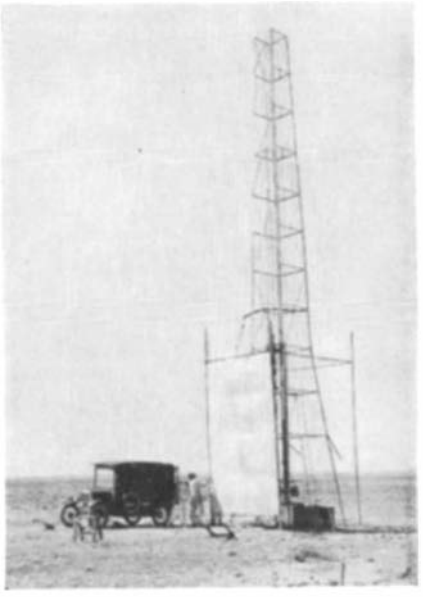
THE rocket motor used by Dr. Goddard in his New Mexico shots is 5¾ inches in diameter and weighs five pounds. It usually fires about 20 seconds, and delivers a maximum thrust of 289 pounds. Such a motor can hoist a real projectile into the air, and such, indeed, have been the projectiles that Dr. Goddard has been attaching to them. His first New Mexico rocket was shot on December 30, 1930. It was 11 feet long and weighed 33.5 pounds without fuel. It reached an altitude of 2000 feet, and a maximum speed of 500 miles an hour.

This was only the beginning. Heavier, more powerful rockets were to come. In August, 1934, the experimenter shot a pendulum-controlled rocket that made an altitude of 1000 feet, then turned horizontally for 11,000 feet, landing a little over two miles from the launching tower. At one point its velocity touched 700 miles an hour.

In none of these shots was altitude or speed the chief object. The experimenter, having tentatively solved, in order, the problems of fuel, material, methods of feeding the fuel, and aerodynamic design, was by now working on the hardest knot of all—control. Specifically, he was trying to build a rocket that would be capable of sure, dependable upward flight. After 25 years of experiment his eyes were still on the stratosphere.

Now there may be some trick of aerodynamics or design that will guarantee vertical flight without special control mechanisms and the extra complications they entail. Many rocket experimenters hope so, but to date they haven't discovered it. After his early experiences with cantankerous projectiles, whishing through the air at express speed but following whimsical air-paths all their own, Dr. Goddard decided that a gyroscopically-operated control mechanism would have to be devised.

In the beginning he tried some other devices, notably the pendulum, but these depend on gravity and are affected by the course and acceleration of the rocket. The gyroscope, however, holds its position with relation to space, regardless of the torque or acceleration of the projectile carrying it.



**Erection of the 60-foot launching tower formerly employed in the east**

The main problem was to construct a sensitive servo-mechanism that would steer the rocket back on course without disturbing the gyro. Dr. Goddard's idea was to have small vanes pushed into the path of the exhaust gases in such a manner as to deflect the flight. In his first trial the system didn't work as well as expected. The performance led the physicist to suspect that the vanes were too small, and he resolved later to try again with larger ones.

The improved system worked better. The vanes, driven by gas pressure into the rocket exhaust stream, were set to apply controlling force when the axis of the projectile deviated as much as 10 degrees from the vertical. The finest shot so far reported with this system reached an altitude of 7500 feet. Rising slowly from the launching tower, the rocket undulated from side to side as the gyro-control continually corrected the course. "The first few hundred feet of the flight," reported the experimenter, "reminded one of a fish swimming in a vertical direction." After the rocket had gained more speed, the curves smoothed out.

Such a flight, of course, is not ideal. Much power is lost in useless undulations. But flight control had at least been started, and the physicist of Worcester could check off one more step in the series of conquests leading to the development of the rocket. Still before him are those problems classified as "the further unknowns." One of them is the problem of reducing the weight of the rocket, for every extra ounce requires extra fuel to lift it, and extra fuel to lift the extra fuel, *ad infinitum*. There are no filling stations on the route to extreme altitudes. The rocket must start with a full tank, and one filling is all it can expect.

Other problems are those of improving the efficiency of the rocket motor, which is still far from that which is theoretically expected; improving the aerodynamic design for flight at super-sonic velocities; smoother control; and a surer technique for releasing the parachute or other landing apparatus at the exact top of the flight.

IN justice it should be said that Dr. Goddard is no longer alone in the colossal task of mastering these difficulties. All over the world, since 1928, rocket societies and rocket experimenters have sprung up, some to make a few tests and drop the subject, others to plow on toward the goal as doggedly as does Dr. Goddard himself. In this country there are at least 20 other active experimenters, and a rocket society that numbers nearly 300 members. In England an experimental group has about 50 members. There are rocket experimenters in Austria, Russia, France, Japan, New Zealand, Canada. The American Rocket Society has an active affiliate at Yale University. Other American universities are considering the establishment of affiliate groups of experimenters among their engineering students and faculties. California experimenters cross the continent to report their work in New York before the Institute of Aeronautical Engineers.

Dr. Goddard's work thus may have opened a new era in transportation, for rockets can do more than explore the upper atmosphere. They ultimately may carry mail and goods—and possibly even passengers—with speed rivaling that of the telegraph; usher in an epoch of swift communication more spectacular than that brought by the telephone and airplane; alter once more the complexion of civilization as only basic inventions can alter it.

It was Col. Lindbergh who, in a letter recently to the President of Clark University, put the matter most directly:

"The rocket is now in that most interesting period of discovery where the shore lines are unplotted and the future limited only by imagination. We cannot state what speeds or ranges the rocket may attain, but it is not restricted by the rotation of an engine or by dependence on the atmosphere.

"As the airplane gave man freedom from the earth, the rocket offers him freedom from the air."

# Soon to be Flooded

By JOHNS HARRINGTON

SAND-BLOWN and desolate ruins of the Lost City of Nevada will soon rub elbows with the fishes. The continued rise of the water behind Boulder Dam will shortly form a great lake which will cover the area of the ancient city completely. Since this was anticipated, the Southwest Museum in Los Angeles, California, through its curator, M. R. Harrington, has collaborated with the Federal Government in removing the relics from the prehistoric Indian homes, located about 65 miles from Las Vegas, near the small town of Overton, Nevada. The ruins of the settlement are scattered along a semi-desert valley for more than five miles, and now the approaching water has come within approximately two miles of the one-time city. Recognized as the largest discovered group of dwellings of its early period, the Lost City is 50 miles from the dam in a straight line. The inland sea, known as Lake Mead, has already extended, in another direction, from Black Canyon into the portals of Grand Canyon, a distance of 115 miles.

The aboriginal homes varied from one to 100 rooms in size, being constructed either of adobe and stone or adobe alone. The larger dwellings had semi-circular shapes, and consisted of a succession of single, connected rooms grouped around courts.

A MUSEUM has been erected above the water line of the oncoming lake, where most of the specimens from the more recent excavations are on display. A replica of one of the prehistoric Indian homes was built nearby; the remains of a habitation belonging to an even earlier period, which happened to be on the grounds, were restored.

Harrington, the director of the later excavations, has estimated that the Lost City was probably an active center of Indian habitation about 800 A.D.

The Indian methods of making arrowheads, basketry, and pottery, of weaving cotton cloth, and even of tilling crops of squash, corn, and beans, were revealed by archeologists. In growing crops, the aborigines first made brush dams in the small river of the valley to raise the level of the water so that it would flow into irrigation ditches. The dams were constructed by driving stakes into the river bottom, and piling brush and rocks on the upstream side, which stopped the water sufficiently for the purpose for which it was needed.

Generally, the pueblo Indians of the Lost City were short-statured and lightly-built, having the round skull type. Both men and women wore fiber sandals, and the women were usually garbed in cotton gowns which reached to their knees. The material was either white or dyed a purplish color; a woven belt of cotton, with decorations in red or black, was often worn. The men were dressed in a white cotton breech-clout or kilt, which was kept in place by a loose string belt. A head-band, with fringe on the lower edge, was also worn.

A baby was carried on his mother's back in a cradleboard, which eventually caused a slight deformation in the back of the infant's skull as a result of being strapped to the board for long periods at a time, this effect being permanent.

A portion of the Lost City, soon to be inundated by the waters of Lake Mead

"The Temple," as viewed from Lake Mead, behind Boulder Dam

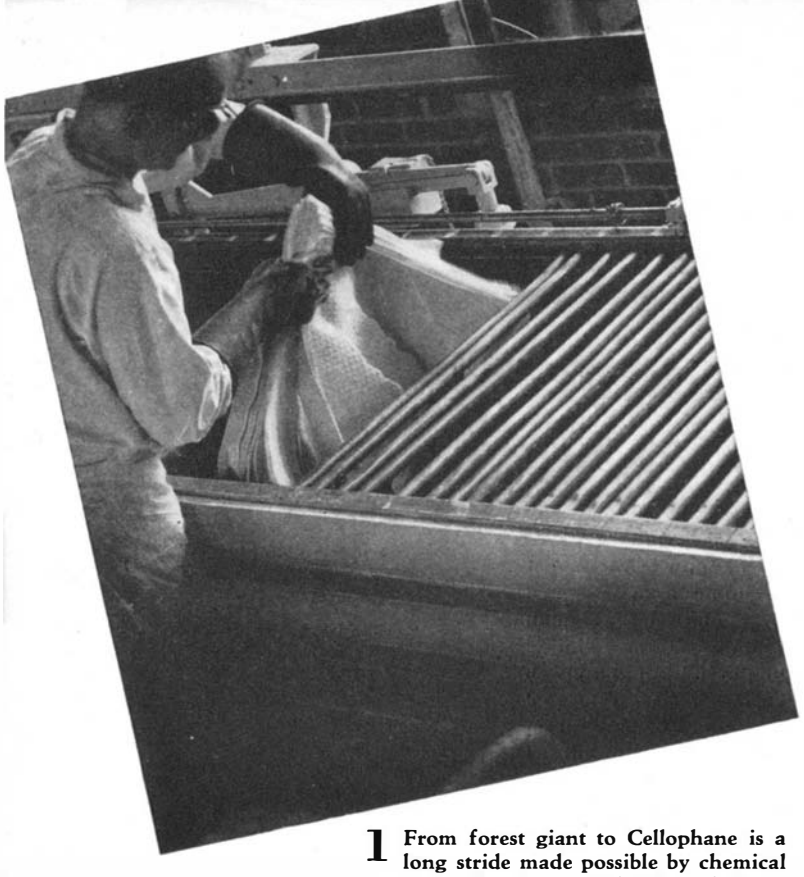
Judging both from archeological evidences and comparisons with modern Indians who are related to the Lost City residents, much of the distribution of labor in the ancient colony has been surmised, probably with fair accuracy. The men were responsible for the heavy work, such as hunting, most of the farming, and house-building; they also did the weaving and spinning. House work, the preparation of food, pottery and basket making, curing of skins, and gathering of seasonal natural crops such as the mesquite-bean, were the women's labor. They also were probably owners of the land and houses.

Several miles from the Lost City were some salt mines, which are now inundated. Here the aborigines mined the salt with crude stone hammers, lighting their work by torches often made of bundles of small sticks. The Indians probably traded their local product for elk-antlers from the mountains far to the west, and for shells from the Pacific, also hundreds of miles away.

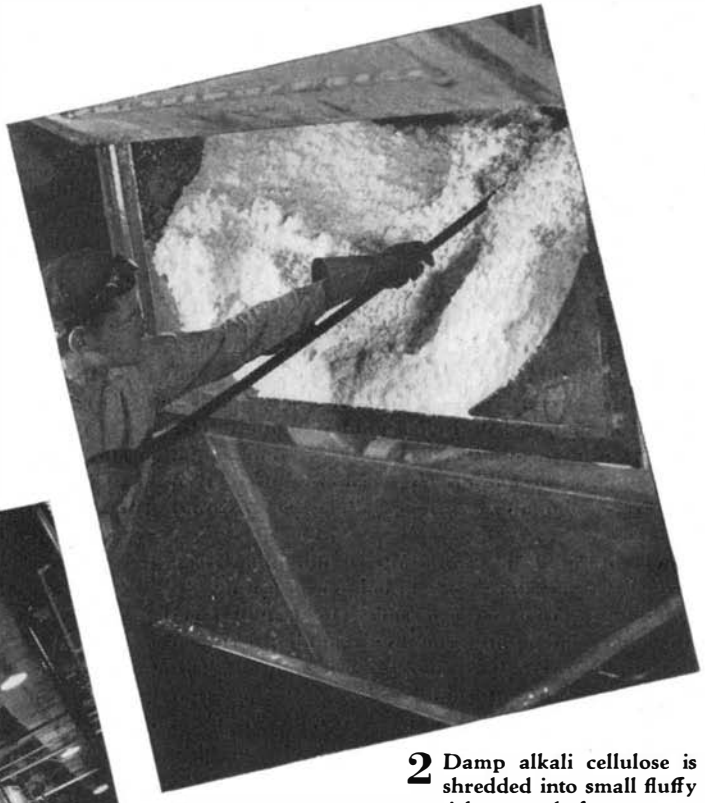
More than a thousand years have passed since the Lost City was deserted; the walls of the prehistoric dwellings have crumbled to the ground, and will soon be covered by a great lake. Yet, through the efforts of archeologists, the culture of these people has been preserved for those who seek knowledge of peoples, civilizations, that have lived, and, during the unceasing tread of time, have fallen and been lost.

# CELLOPHANE IS BORN

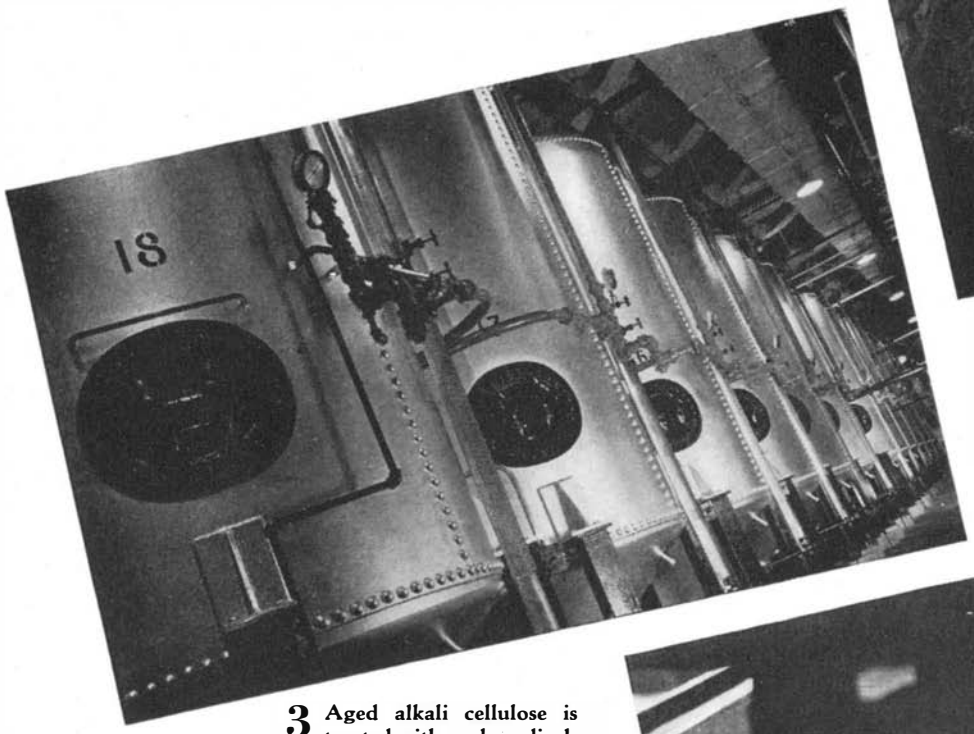
By A. P. PECK



**1** From forest giant to Cellophane is a long stride made possible by chemical research. For the manufacture of Cellophane, the Du Pont Company buys wood pulp—purified cellulose—in square sheets, soaks them in a caustic soda solution (above); the result is "alkali cellulose"

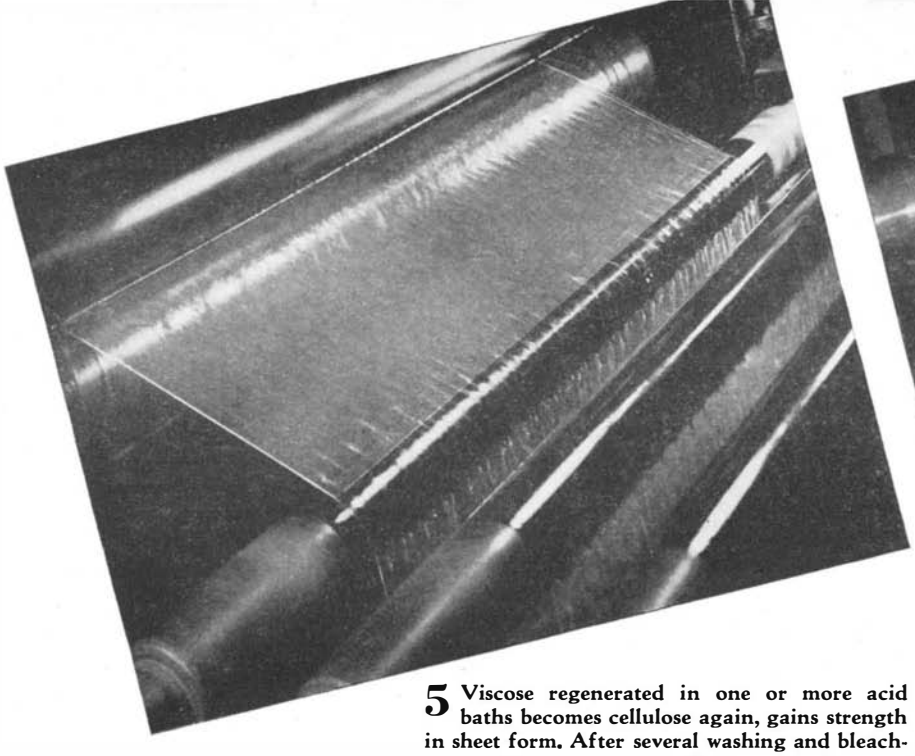


**2** Damp alkali cellulose is shredded into small fluffy particles, aged for two to three days in order that later steps in production may be carried out successfully. *Above:* Unloading ground-up chemically treated cellulose from shredder




**3** Aged alkali cellulose is treated with carbon disulfide, result of the reaction being cellulose xanthate. This compound, dissolved in caustic soda, becomes viscose, which in turn is aged or ripened in battery of tanks shown above

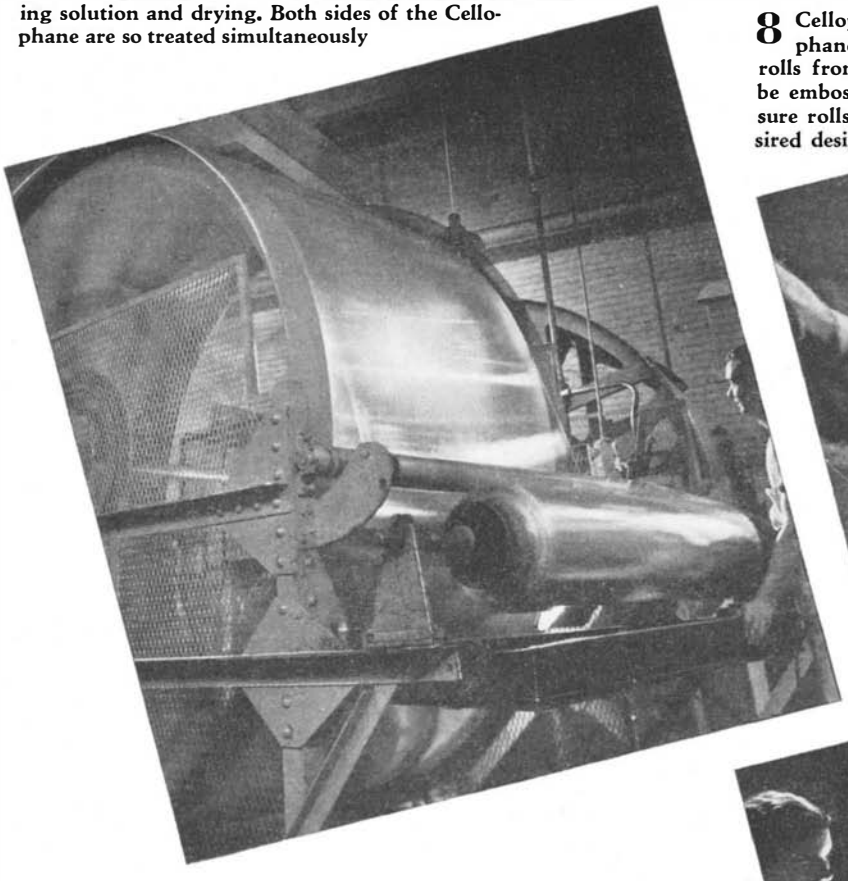
**4** Viscose ripened under controlled conditions, checked to insure uniformity, is filtered and re-filtered to remove all solid particles. Ripened viscose emerges from a narrow slot in a casting machine as a thin, weak sheet (right), is treated with dilute sulfuric acid and sodium sulfate



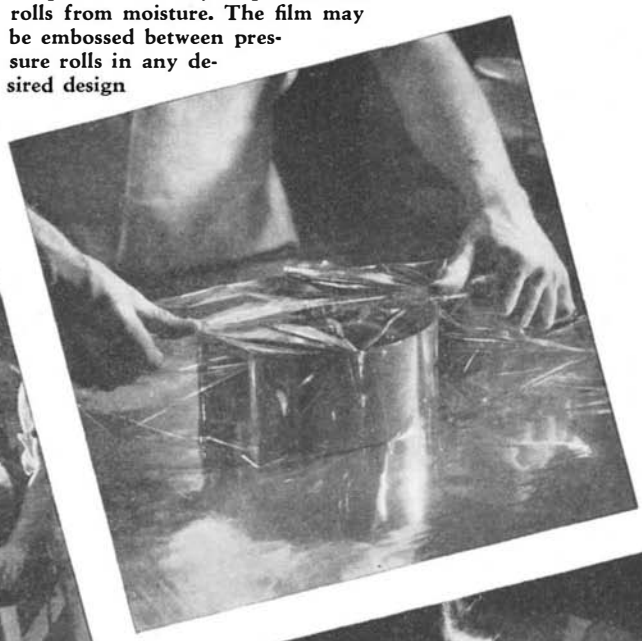
**5** Viscose regenerated in one or more acid baths becomes cellulose again, gains strength in sheet form. After several washing and bleaching operations to remove all chemicals, the sheet passes through a glycerin and water bath and through heavy squeeze rolls (above). In the last bath the film absorbs enough glycerin to keep it pliable

**6** If colored Cellophane is being produced, the sheet is dyed before the glycerin bath. *Above:* The finished Cellophane film being wound on large cores. Winding was proceeding at full speed when photograph was taken. The next step is cutting the finished film to length

**7** Rolls of Cellophane are run off onto huge drums (below) and then cut to length. Moisture-proof Cellophane is produced by passing a moist film through a moisture-proofing solution and drying. Both sides of the Cellophane are so treated simultaneously



**8** Cellophane wrapped in Cellophane (below), to protect the rolls from moisture. The film may be embossed between pressure rolls in any desired design



**9** Keen-eyed girls (right) are employed to assort and inspect sheets of Cellophane, cut from long strips made by the process described, at the Richmond, Virginia, plant of E. I. du Pont de Nemours and Company. Cellophane film is usually made about .0009 or .0013 of an inch thick, some being made .0018 of an inch thick. Thicker sheets than this are made by cementing several thin sheets together, since it is difficult in production to make a single sheet thicker than .0018 of an inch

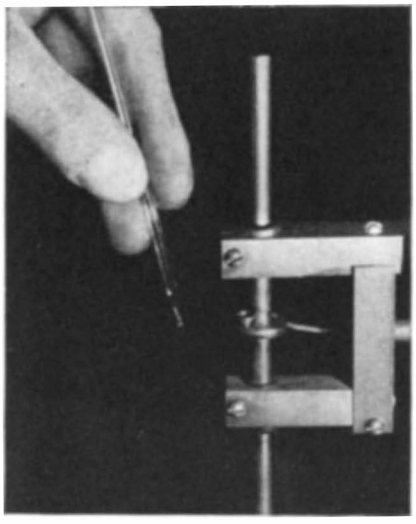
# CHEMISTRY'S NEWEST SLEUTH

## Micro-Analysis Enables Chemists to Study Minute Samples . . . Diagnoses Product Flaws and Ailments . . . Supplements Usual Laboratory Methods

By A. L. WHITE

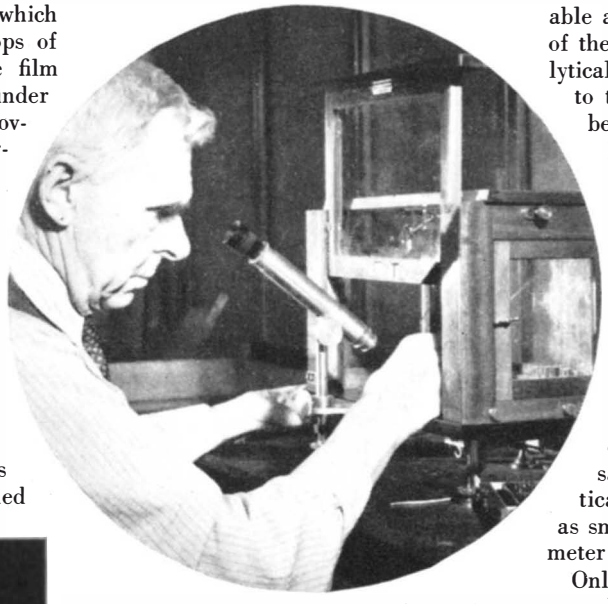
IN one of the early experimental sulfur-dioxide refrigerators, a deposit formed and caused stalling. A minute sample of this film, procured by scratching a needle over the surface, showed a white salt when placed under a microscope. This white salt film was washed with petroleum ether, a solvent which removes undecomposed oil, after which it was wet with water. When drops of water and acid drawn from the film through a capillary were studied under a microscope, sulfo-salt was discovered. It was concluded that the original salt had been altered by exposure and that the cause of the trouble arose from the effect of moisture upon sulfur dioxide. By getting rid of all moisture from the materials and in the assembly, the deposits of film were obviated.

This process of discovering the cause of such deposits, of flaws and mishaps, by dealing chemically with very minute quantities of a chemical substance is termed micro-analysis. It is the most recent sleuth to join the forces of applied chemistry. It snoops into the hidden recesses of tiny particles too small to be seen by the human eye, and finds the culprit hidden away in places requiring high magnification for observation.



A micro-chemical device to measure electrical quality of an oil drop

The use of this method has helped to make possible the perfect operation of many of the present-day household machines and appliances. It has been used to discover flaws in refrigerators, in heating units, in telephone apparatus,



Tiny quantities in micro-chemical analysis require delicate balances

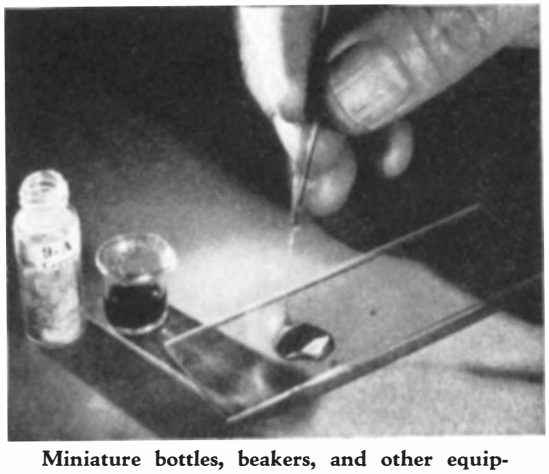
and in vacuum tubes, for analyzing minute specimens in biology and medicine, and in solving engineering problems.

It is a law of Nature that, no sooner has an engineer's creation been completed than deterioration or decay begins to set in. At the beginning this may be caused by foreign substances that are almost always microscopic and usually manifest themselves by abnormal deposits, corrosion, or operation. However, a few specks of dust from the windings of a motor, a bit of "gum" from a bearing, a small smudge from an electric contact point, or a tiny scraping of the faint discoloration on the bulb of a vacuum tube may serve as sufficient material for analysis by micro-chemical methods, and the analysis will be as conclusive as it would be if an unlimited amount of the specimen were available.

In the past, chemists have been faced with many difficulties in attempting to work with materials when only small particles were obtainable as samples. In such cases, the size of the apparatus used in the usual analytical chemistry was out of proportion to the quantities of the chemicals to be analyzed. Many errors resulted. But a chemical reaction obeys the same laws in the volume of a pinhead which it does in that of a tank. Therefore it is entirely feasible to perform chemical tests and manipulations on a reduced scale and observe the results under a microscope with appropriate magnification and illumination. By means of micro-chemical analysis, work can be effectively done even when the sample obtainable without practically destroying the object may be as small as five-thousandths of a millimeter in size.

Only about that amount of a specimen was obtained from sheets of iron-cobalt alloy which, when rolled very thin, changed in magnetic properties. With a pure silica abrasive a very tiny specimen was taken from the surface of the sheets, extracted from the abrasive and examined micro-chemically. This examination showed that the sheets lost iron through oxidation and subsequent mechanical removal; hence the change in its magnetism.

For this work, specialized apparatus, often of greatly reduced size, takes the place of the relatively large beakers,



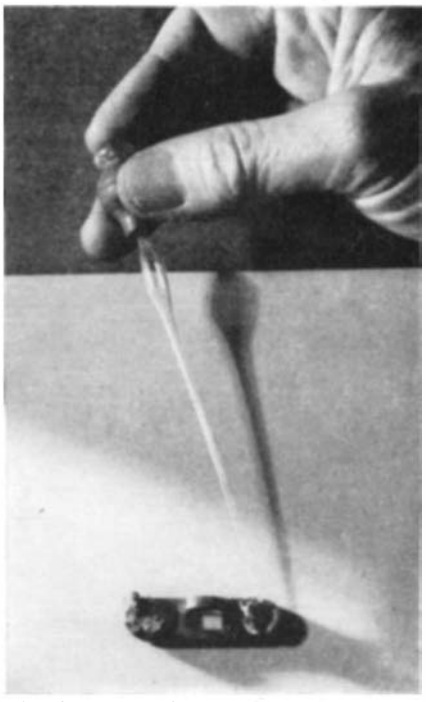
Miniature bottles, beakers, and other equipment are necessary in micro-analysis method

flasks, test tubes, and the like, developed centuries ago. These are augmented by instruments such as the microscope, centrifuge, and micro-balance.

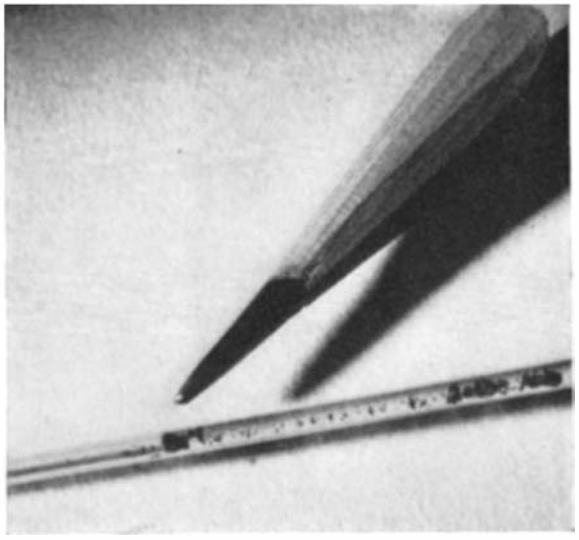
Often in making tests to determine the quality of some substance, the microscope and the capillary are sufficient. Such was the case when tiny discolorations appeared on the surface of a polished silver sheet used in the manufacture of photo-electric cells. A very small drop of nitric acid was allowed to act for a few seconds on the discolored spot. When part of this was redissolved in a small drop of water and drawn up into a capillary tube, heated, then examined under the microscope, minute droplets of mercury were discovered.

IN telephone apparatus, contact points of various metals and alloys are extensively used. In case defects occur in contact points, obviously only the very smallest particle of the metal can be taken as a sample in order not to impair the operation of the contact point. Consequently, micro-analysis must be used. Usually, a drop of acid is deposited on the contact by means of a micro-pipette, then drawn back into the pipette by capillary action as a slurry, or mud. The slurry of loose smudge in the barrel of the pipette is drawn out into a tiny tube with a conical bottom into which the solid particles are driven by centrifuging, a clear acid being then withdrawn from the pipette. Now the smudge is ready for the analysis.

A similar method was followed in determining the nature of a deposit on the shaft of an experimental electric meter which had caused stalling. A small drop of oil was first applied, and the deposit was gently rubbed with a special glass tool to loosen it. The oil slurry which was formed was taken up in a capillary pipette and separated by centrifuging for its analysis with chemical reagents.



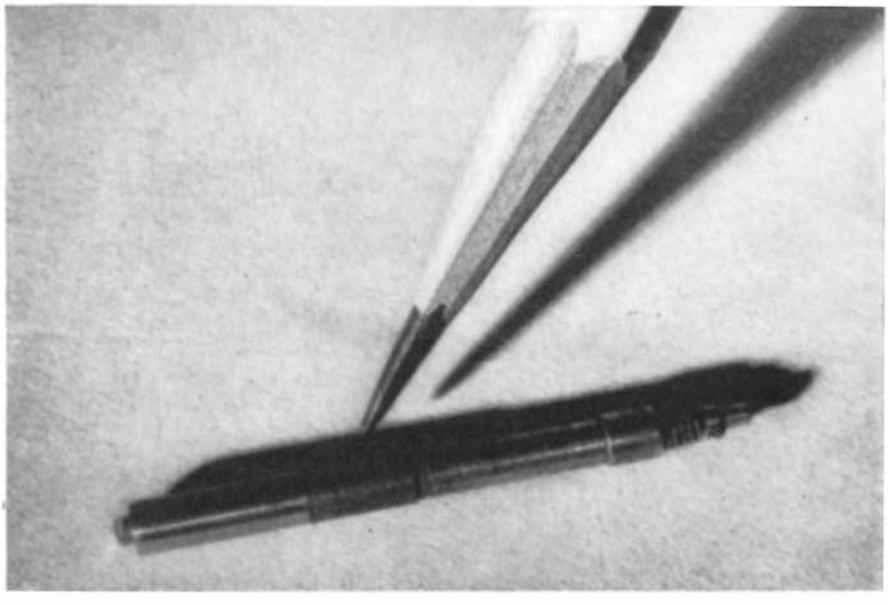
**The first step, above, in determining the cause of a defective electrical contact. A smudge is "lifted" by a drop of acid first deposited and then removed by the micro-pipette. At the right is shown the slurry, or loose smudge, in the barrel of the pipette. From this, it will be blown into a tube and centrifuged. The clear acid is then drawn off and the deposit analyzed**



Many instances occur where micro-analysis is the means of determining faults. Recently some chromium alloy heating units scaled seriously when at a red heat. Chromium alloys are subject to attack by alkalis when heated in the presence of air; upon examination of the heating units, traces of sodium were found in the surface material. Microscopic examination of the surfaces of the plates from which the units were fabricated showed the plates to be covered with a pasty film. Micro-chemical tests showed that this film was a soda soap. Upon inquiry, it was learned that a grease, which is a soap-oil compound, had been used as a lubricant during manufacture and that the solvent used to rinse off the grease dissolved the oil but did not remove the soap. When heated, soap is converted into ordinary soda, a powerful alkali; hence the scaling of the heater elements.

Micro-analysis has found a large variety of uses. It is used for diagnosing corrosion causes; for the identification of surface contaminants such as tarnish films; for composition studies on thin layers or small areas to determine the constituents; for the analysis of dust; for determining the causes of transformation and deterioration in materials; and for the identification of foreign substances in any material.

While it works with smaller quantities than are used in regular analytical laboratory work, and many of the processes are the same, it must not be considered a mere reduction in scale of methods and standard laboratory procedure. Nor does micro-chemical analysis supersede the standard laboratory practice; it supplements it by providing a means of analyzing specimens which cannot be handled by standard procedure. As the application of micro-analysis to engineering problems increases, we can look for greatly improved products and materials in the future.



**This deposit on the shaft of an experimental electric meter has caused stalling. It will be taken off by using oil and a tiny pipette and then analyzed**

# INSULIN FOR SCHIZOPHRENIA

## An Estimate of the New Insulin Shock Treatment for Schizophrenic Insanity . . . The Enthusiasm for this Astounding New Method Apparently is Justified

By BARCLAY MOON NEWMAN

THERE is a new and strikingly valuable treatment for insanity. No longer ago than 1930, Dr. Manfred Sakel, psychiatrist of Vienna, Austria, was interesting himself in the problem of morphine addicts just taken off their drug. As had many before him, he noted the symptoms of high excitement, frenzy, mania, and even real though brief insanity which immediately follow when an addict is denied his morphine. But Sakel pondered the problem more deeply and to far better purpose than had any other psychiatrist. He developed a theory.

Keenly observing the shifting mental states of addict after addict under treatment as dope fiends, Sakel concluded that some physical or bodily change is suffered by the addict, as well as a mental change. He believed that the cells of the brain, under the influence of the morphine—of course a poison—undergo actual injury, and in this injured condition attract to themselves more than usual quantities of exciting substances from the body's glands.

Now, the depressing action of insulin, because of the extensive use of this substance in treating diabetics, was common knowledge. Insulin is normally produced by the healthy pancreas, and aids the body in its use of sugar. In a diabetic, insulin is lacking, and if injections of this substance are not given, hundreds of thousands of diabetics, all over the world, would die early deaths—often with far too much sugar in their blood. But inject the appropriate number of units of insulin, and the quantity of sugar in the blood remains at the normal level. On the other hand, administer an overdose of insulin, and the diabetic's blood sugar drops to a dangerous degree. The diabetic acts as though intoxicated by alcohol, and may even sink into a coma, if the dose has been strong enough, and if sugar is not administered. Hence overdosage followed by drowsiness is not rare. And insulin is not a narcotic in the strict sense of the term. Sakel decided that insulin may safely be used to pacify the excited nerve cells of morphine addicts. His success was astonishing and exceedingly suggestive.

Though only small doses of insulin were used in treating the morphine addicts, striking mental changes were observed. Violent patients became calm. Those immersed so deep within their own sad inner world as to appear lost, were brought back to reality. Unfriendliness gave way to friendliness, and angry antagonism to cheerful co-operation. Such alterations in behavior were frequent even during the first days after denying addicts their morphine. And the first days are the worst.

In the physician's mind, a great hope and a great discovery were dawning. Insulin apparently caused the excited patient to relax, to be normal, often for lengthy periods, sometimes permanently, though only small doses were administered. What will insulin, perhaps in larger doses, do to the insane brain? This was Sakel's daring thought.

OUR Columbus of the world of the mind proceeded slowly, cautiously, painstakingly. Of course, from experience with diabetics and morphine addicts, he had already learned that comparatively large doses of insulin are not harmful, except in rare instances, and then prompt feeding or injection of glucose removes all ill effects. But naturally he wanted to be doubly sure. He was a most conscientious physician.

Dr. Sakel had not devoted his life to his patients in vain. Each step, thought out carefully and carried out with utmost regard for his patient's safety, marked a success. Hence this pioneer early learned the main restriction to his work among the insane: all types of psychoses do not respond equally well. Schizophrenics as a group are highly benefited, manic-depressives are not.

Schizophrenics ("split personalities") include those whose minds are weirdly wandering inward, lost within themselves. They elaborate a vast dream world all their own, and live and continually converse with non-existent kings, queens, Indian princesses, as well as other royalty. Generally, a schizophrenic believes himself to be another person. This creation represents an escape from reality. Such psychoses constitute the greatest group of our insane —and are described as driven out of their minds by "functional" causes. "Functional," however, means practically nothing—beyond the fact that the cause of schizophrenia is not known, and cannot be traced to a physical defect.

There is another great class of functional psychoses: the manic-depressives. These patients alternately exhibit excessive excitement and excessive depression of spirits. In this case too, the term "functional psychosis" indicates entire lack of knowledge as to underlying causes. And, as a matter of fact, no one is sure whether the schizophrenic's bizarre dreams and the manic-depressive's fluctuating emotions are diseases in themselves or merely symptoms of some hidden bodily affliction, having a secondary rather than a primary connection with the brain.

Therefore it is all the more remarkable that Sakel has found a treatment for a disease whose creeping cause is entirely a mystery, and for that disease which possibly accounts for the greatest percentage of the 100,000 annually admitted as new cases to institutions for the insane in this country.

Dr. Sakel determined that the best results are achieved when increasing doses of insulin are given, until the so-called shock dose is reached. This maximum dose varies according to the individual, and ranges anywhere from a mere 15 units of insulin to 450 units.

By shock dose, Dr. Sakel means the quantity of insulin needed to produce deep coma in any individual within four to five hours after injection. After the shock dose has been reached, this dosage is given three to six times a week until the patient has received the greatest possible benefit. Provided that the patient does not respond—not all patients do—no more than 50 injections are given. In case a patient reacts unfavorably to a shock dose, by sinking into too deep a coma, or by developing too rapid or too slow a pulse, he must be allowed to rest for two or three days. In all instances, at least one rest day per week is allowed.

Dr. Sakel's greatest difficulty has been in finding out how long to leave a patient in the coma and how many shocks to give. Some individuals need no more than eight shocks. Others do not respond

until about 50 shocks have been given. The treatment is ended by a tapering-off process—a smaller quantity of insulin is given each day until the first low dosage is reached.

The patient is not allowed to eat before the injection. Typically, the insulin is given about 6 A.M., before breakfast. At about 10 A.M., the action of the insulin is terminated by administering a solution of sugar in water, by mouth or vein. During this four-hour period, if a shock dose and coma are in order, the patient is kept in bed and carefully observed for any untoward effects. Bath and breakfast follow the sugar. The patient may spend the remainder of the day up and around. But close watching is essential, because the blood sugar sometimes stages a second and unexpected sharp drop, even after three full meals. Then more sugar must be given.

And so, in 1933, Sakel reported the cure of his first patient, and afterward many patients, and published conservative reports of his success. These reports upset the psychiatric world, which found them at first incredible, despite Dr. Sakel's already high reputation. Specialists came to see for themselves: first from Austria, then from every nation. The most eminent among them were impressed, and stayed to be astonished. Sakel's methods spread everywhere, and everywhere a high percentage of apparent recoveries has confirmed, and more than confirmed, his own results. In 1936, Sakel's technique was introduced into this country, and Sakel himself came to America. Now every large mental hospital in the United States is experimenting with this treatment.

WE can imagine the eagerness with which medicine has taken up Sakel's method, and with which it observes the response of more and more patients. Even the small doses at the start of the treatment often cause remarkable improvement. Tension is diminished. The patient is far calmer. As the shock dose is approached, the changes in mental powers and in attitude are dramatic. To the most confused and excited people, with minds seemingly utterly gone, periods of sanity return. Frequently the most unpromising patients, with a long history of insanity behind them, suddenly lose their vivid hallucinations and snap back to full mental clarity and enduring mental health. Among specialists throughout civilization, Sakel's own marveling thoughts are echoed:

"These changes are so dramatic that it is difficult to do justice to them in words."

Early in the treatment, the patient usually becomes aware—during brief, lucid moments—that he has been indulging in abnormal thinking and behavior. For a little while at least, a new style of thinking replaces the former stream of muddled ideas. The further the treatment progresses, the longer does the normal personality stay with the patient. But, almost invariably, in the early stages of the treatment, as blood sugar rises back to normal, the insanity creeps back again. Then, in patients who react favorably, the periods of mental clarity begin to endure even after the sugar in the blood has risen to its normal concentration. And in the majority of instances, termination of the treatment means that the gloom of insanity has been dispelled —frequently forever, it is believed.

One patient had a long and evil record. At 32, he had been a schizophrenic for six years—a chronic case. Disorderly conduct, burglary, imprisonment were part of his story. Thirty-one injections, including 18 shock doses of insulin altered him from a discontented, sexually perverted, dangerous criminal to a contented, normal laborer in a cannery. At last reports, he was putting in 12 hours a day on his job.

If other chronic cases of schizophrenia reacted as well, then a huge load would be removed from taxpayers' shoulders. Mental hospitals are full to overflowing with chronic cases. But this schizophrenic criminal is one of the few chronic cases which do show improvement and which do not relapse after insulin shocks. For insulin treatment is efficacious chiefly in early stages. Often a chronic schizophrenic will show temporary restoration to the normal condition —and then fade back into his world of delusion, inexplicably. Even doses of more than 200 units of insulin, and rather severe shocks or deep comas, do not permanently affect a dismayingly large percentage of those ill for a long time.

No one can deny, however, that Sakel has given to medicine a most astounding method. Into the saddest, gloomiest realm of all affliction he has brought brilliant light. What is more, he has provided the most hopeful of knowledge—that man can indeed learn to cure his millions of insane.

What happens to the patient's brain as insulin reduces the quantity of sugar in his blood? What takes place during the coma? How does the insane mind, made unconscious, turn into a sane mind when consciousness comes back? These are the chief mysteries which Sakel and all others engaged in this work of reconstructing shattered brains would like to solve.

One girl was questioned concerning her experiences during the insulin therapy. She replied that, after an injection, a sense of fatigue came over her. Next she felt very hungry. Gradually, awareness left her, and finally she sank into a blank unconsciousness, which she describes as a state entirely without sensation, without dreams: "I was merely asleep, but nothing more."

She had no idea how long she was unconscious at any time. Other patients say that as they lose awareness, they have a feeling of increasing intoxication or perhaps "poisoning," ending in complete oblivion. All agree that there are no dreams or sensations of any kind during their coma.

NO more is known concerning what happens during the rare spontaneous recoveries of untreated patients. The few schizophrenics that of their own accord snap out of their dreams, as it were, have no explanation nor any hint of what kind of healing goes on in their brains. Nevertheless, recovery due to insulin treatment has a definite advantage over any of these (infrequent) spontaneous recoveries. Patients who get well without treatment are evasive about their hallucinations and their illness as a whole (though insanity is no more to be ashamed of than measles). That is, they do not fully understand what has occurred nor entirely realize that they have been mentally ill. They tend to blame external circumstances for what has happened to them, thus often complaining that some mysterious event such as a blow on the head brought on the mental difficulties.

A healthier condition exists among those cured by insulin. They recognize that something serious has been wrong, and freely admit: "I guess I was just crazy for a while, Doc, but I'm O.K. now."

This is a far more normal attitude. One who admits the truth does not have the odd brain twist evident in those who distort or falsify. And mental cases treated by insulin get well much more rapidly than any who recover without any treatment. Even in the fairly rare instances where it does occur, spontaneous recovery is always slow, uncertain, and expensive.

What is the danger in shocking the mentally ill back to health? Many physicians report no ill effects of any kind. Without careful control and experience the method may, however, result fatally.

What is the extent to which patients retain their recovered mental health? Sakel's first patient is still altogether normal mentally after five years. Many other patients appear likely to stay well. Yet, Sakel is the first to point out that not all recoveries are permanent. A small percentage relapse.

All in all, Sakel's insulin technique may be considered a great stride toward treating our major classes of insanity by physical methods. As Sakel puts it: "Psychiatrists need no longer have that paralyzing sense of insufficiency toward their psychotic patients that they used to have."

He has brought more: confidence that someday, perhaps soon, as suddenly as his discovery appeared, there will come cures for other types of insanity.

# Starch from the Sweet Potato

**A general view of the sweet-potato starch factory at Laurel, Mississippi, possibly the forerunner of many similar plants in southern sweet-potato-growing regions**

IN Laurel, Mississippi, in the heart of one of the South's principal sweet-potato-growing sections, there is being manufactured a product that bids fair from present indications to form the basis of a flourishing new southern industry—the production of sweet-potato starch. Long existing only in the minds of chemists, sweet-potato starch of a purity, color, and quality equal to that of the finest starches is now an actuality, and hundreds of thousands of pounds are being produced commercially at the Mississippi plant.

The full capacity of the new starch factory is 200,000 bushels of sweet potatoes per 100-day season, yielding, on an average, approximately two million pounds of starch. During the manufacturing season, the plant operates on a 24-hour basis, including Sundays. It is estimated that no fewer than 150 plants as large as the one now in operation will be necessary to fill this country's demand for root starch.

Cull potatoes are, at present, the main source of sweet-potato starch, although there is an increasing tendency on the part of farmers to deliver field-run potatoes, grown especially for starch-making.

In the manufacture of starch, the sweet potatoes, delivered by farmers, are weighed and placed in large bins, from which they are fed into a flume leading to the washers. Here power sprayers remove every vestige of grit and foreign matter. The potatoes are then ground to break up the starch granules; during the grinding process chemicals are added for bleaching purposes. Following this, the mixture is screened to separate the starch-bearing liquid from the pulp. From the screens this liquid is drained off into mixing machines for another step in the bleaching process. The pulp is dried and sold as stock feed, a by-product of the factory. From the vats where the second and last step in the bleaching process takes place, the starch water is routed to troughs or tables, where the particles of starch settle to the bottom and the surplus water is drawn off. The starch is then transported to the dryers where all but an infinitesimal part of the remaining moisture is removed.

THE success of the plant at Laurel has been brought about through the development of a successful process for removing the undesirable, yellowish color which has always prevented sweet-potato starch from being more widely used. During the grinding process, at which time the cell membranes enclosing the starch granules of the sweet potato are ruptured and the starch set free, a continuous stream of water carrying sulfur dioxide in a concentration of 0.15 percent is fed to the pulp. If no further treatment were given, the finished product would have the desirable degree of whiteness, but further treatment is needed to insure stability of color.

This additional treatment consists of draining off the water containing the starch and sulfur dioxide from the pulp and concentrating the former in mixers. Sodium hydroxide is added, and the mass stirred constantly for three to five hours. At the expiration of this operation, the starchy liquid is fed on to the settling tables. The finished product is a starch of the desired degree of whiteness and will retain its color indefinitely under practically all conditions.

Sweet-potato starch was not placed on the market until it had been conclusively

**A typical southern field of sweet potatoes. Either culls or field-run roots, grown especially for starch-making, may be delivered to the starch factory by the farmer**

demonstrated that it was fully as good as other root starches, and far superior to some. In the textile industry, for instance, where tremendous quantities of starch are used for warp-sizing and finishing cotton goods, mill operators say that where this new starch is used results have shown less loom stoppage, less shedding, and better-feeling cloth. As all of this contributes substantially to the finished product and lessens production costs, this industry at present consumes almost the entire output of the Mississippi plant.

In tests conducted jointly by the Bureau of Chemistry and Soils and the Bureau of Engraving and Printing, it was found that sweet-potato starch is the only starch produced in the United States meeting the requirements for an adhesive for postage stamps, labels, and envelopes. This is because sweet-potato starch makes possible the high degree of viscosity demanded by the Bureau of Engraving and Printing in its adhesives, and because it has a high degree of purity and an inoffensive taste. At present, foreign-produced and imported cassava root starch is used exclusively by the Federal Government for this purpose.

# Purity, Color, and Quality Equal to the Finest Starches...Bleaching Process Perfected...Of Great Economic Significance . . . Now in Production

By FRANK A. MONTGOMERY

In the research laboratory of the Mississippi starch factory. Note particularly the size of the sweet-potato root that is held in the hands of the worker at the right

THE United States consumes more than one billion pounds of starch a year, most of which is manufactured in this country from cereals such as corn, wheat, and rice. Large quantities, however, are also made from white potatoes, which furnished industry in the United States with its only native root starch until the advent of the sweet-potato starch factory in Mississippi. It is not unusual that so much starch is used in this country when one considers that the following products use starch in greater or lesser quantities: Adhesives, food products, textiles, paper, soap, explosives, veneers, toys, salt, yeast, baking powder, cosmetics, alcohol, and batteries.

Although, as has been pointed out, the United States does produce most of the starch needed by industry, such starch is cereal starch and is unfit for certain uses. These other uses require a root starch, making it necessary for this country annually to import some three hundred million pounds of such starch. Most of this foreign-produced starch is made from the cassava root; it has been ascertained that starch from the sweet potato can replace this starch in every department.

Consequently, because sweet-potato starch as produced in this country is a high-quality root starch, because the raw product from which it is obtained can be produced cheaply in this country, and because such starch can be used satisfactorily for every purpose for which the imported root starch is used, it is felt by authorities that the plant in Mississippi will undoubtedly be the forerunner of many such plants in the southern sweet-potato-growing regions.

When sweet potatoes are harvested during the 100-day season, the roots are exposed by running a plow along the rows, turning furrows as shown in the photo

IF such an event does come to pass—and it seems logical to suppose that it will in view of the success already attained by this new industry—this nation will be relieved for all time of its dependence upon foreign nations for the root starch it consumes.

The Laurel plant was financed and sponsored by the Federal Government with the objectives of developing an industry that would alleviate the rural-relief situation in southern Mississippi, and that would, at the same time, be of permanent benefit to southern agriculture. A second plant, privately financed, is being planned in Florida.

# A Great Work Completed

## The Monumental New General Catalog of Stars for the Professional Astronomer, in Preparation More than 30 Years, is Finished . . . An Enormous Task

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.

FIVE substantial volumes, arriving at observatories the world over, have been welcomed with unusual interest, for they contain the great General Catalogue of the positions and motions of the stars which has been in preparation for more than 30 years.

At the beginning of the present century, a vast amount of observations of the positions of the stars had been collected by the independent activities of astronomers in many places. These formed an important part of the accumulated capital of astronomical knowledge—assets which must have represented an actual financial outlay of hundreds of thousands of dollars—mainly in salaries. The late Professor E. C. Pickering told the writer, years ago, that he had found that the salaries paid the observers and computers who worked on the preparation of the two Harvard Zone Catalogues, of a few thousand stars each, had in each case added up to much more than the original cost of the instrument with which the observations were made—and a meridian circle is not a cheap kind of telescope.

BUT, 30 years ago, this vast and valuable accumulation, in an audit of the existing state of the science, would in large part have been listed as "frozen assets"—to use a modern phrase. The extant catalogues gave the positions (right ascensions and declinations) of great numbers of stars. But it is of little interest to know merely the fact that a star is in a given place in the sky. Sometimes, indeed, this is what the astronomer wants. He may have observed a comet, in the usual fashion, by comparing it with a near-by star, and measuring the differences of right-ascension and declination. Then he wants badly to know where the star was when he observed it. By looking in one or another of the long shelf of star-catalogues which are an essential part of every observatory library, he may find his star and a good observation of its position—very likely in 1885 or thereabouts. But this does not give him what he wants, for the stars are moving in the heavens, and there is a considerable chance that the motion in 50 years or so, if not allowed for, will throw his results out by considerably more than the error of his own measures. Hence even the simon-pure positional astronomer—who uses the stars only as reference points for his measurements, without worrying at all about their distance, brightness, or physical nature—requires catalogues of reference which give not only the position of the star at a given date, but also its proper motion per year or per century, so that he may find where it was when he observed it. But the utilization of star-positions as points of reference, though essential for certain types of work, represents only a small part of the whole value of the data. The proper-motions of the stars, indeed, are much more valuable than the positions—for it is from a study of these that moving clusters have been detected, that the sun's motion among the general field of stars has been revealed, and that good average values have been found for the parallaxes and distances of stars of almost every kind—many of them much too far off for direct measurement.

The astronomical assets of 1900 could fairly be described as frozen, for a reason only too familiar in these days—it cost too much to realize on them. If an individual worker greatly desired to know the proper-motion of a particular star, he could look it up in all the star-catalogues in his library—he might find it in half-a-dozen or more. Some of these would give the position for 1875—that is, referred to the equator and equinox of that date as standards, others for 1900, others perhaps for a different date.

To allow for the motions of equinox and equator in the interval, and reduce them all to a common standard, is simple enough in principle but time-consuming in practice—even though the catalogues give data which greatly shorten the calculations. After this had been done, our student would have a set of positions at different times of observation, all referred to the same standard. By plotting the right ascensions or the declinations against the time, he could see whether the star was moving and how fast. But, even then, his troubles were not all over. The observations, like all other human products, are not perfect; they are affected by errors, which will reveal themselves by throwing the plotted points off the straight line representing uniform motion. Some catalogues will be more accurate than others, and the allowable tolerance—as an engineer would say—for deviations of the points representing them should be smaller.

It is easy enough to take this into account, if one knows which observations are better, and how much. But we have no *a priori* way of finding out how accurate anybody's observations are; this can be determined only from the degree of their agreement with one another and with other people's observations. Hence the lone student, trying to work up the particular star, would be at a loss, and his results, though they would reveal any conspicuous motion, would not attain the full accuracy that was obtainable from a complete discussion of the material.

IN 1900, of course, the isolated worker would often have been spared this labor. Comprehensive catalogues of large numbers of stars—especially the brighter ones, and those of large proper motion—had been published and were at his service. But even these had not all been prepared on exactly the same system. The allowances for precession (the motion of the equinox) might, for example, be slightly different in different catalogues.

More than 35 years ago, Professor Lewis Boss—director of the Dudley Observatory at Albany, and a recognized expert in this field—was so much impressed with the importance of constructing a general catalogue of star-positions and motions, that he convinced the Trustees of the Carnegie Institution of the great scientific value of the plan. After preliminary trials, the Institution established a Department of Meridian Astrometry to undertake the work.

The task was enormous. The tens—nay, hundreds—of thousands of observations made since 1755 (when Bradley did the first work which meets modern tests of accuracy) had to be collected, and reduced to a uniform system. Moreover, all the stars were re-observed, with

every care for the utmost accuracy, so that a longer time-interval should be available for the determination of their motions. In this part of the program the Albany meridian circle was most carefully dismounted, packed, and set up at San Luis in Argentina, where 87,000 observations of southern stars were obtained. It was then returned to Albany, where 110,000 observations of northern stars were secured.

Finally all this vast mass of material had to be assembled, card-catalogued, discussed with great care to remove all recognizable sources of error, and at last assembled into the Catalogue. The computations were numerous, and, to avoid error, every one of them was done twice independently. It is no wonder that all of this has taken a long time.

A "PRELIMINARY General Catalogue" containing 6188 of the brighter stars (and hence practically all that are visible to the naked eye) was published in 1910, and has been the stand-by of astronomers everywhere ever since. The final General Catalogue contains 33,342 stars, including all brighter than the seventh magnitude, and many fainter ones for which good observations were available.

Professor Lewis Boss lived to see the Preliminary General Catalogue welcomed by the astronomical world. In 1912 he died. His son, Dr. Benjamin Boss, with several collaborators, has spent a quarter of a century in bringing his father's plans to complete fruition. In preparing this great catalogue no less than 238 individual catalogues were utilized—each based on original and independent observations. The earliest observations date from 1755. The last which could be incorporated into the work go down to 1925 (and were published some years later). Every one of these catalogues was the object of detailed and painstaking study —for the hardest part of all the work has not yet been mentioned.

Observations with any particular instrument—even the best—are subject to small "systematic" errors which do not "average out" in the mean of a large number of measures, as ordinary casual errors do. A good example is the magnitude equation in observations of right ascension. When an observer notes the time of transit of a star across fixed wires in his telescopic field of view, he is more likely than not to record the passage of a bright star earlier than that of a faint one. For some of the older observers, the extreme difference was as great as a tenth of a second of time. Usually it is less; but it shows up definitely in the average. To find the amount of this error, close-woven wire screens were placed in front of the telescope, acting simply as obstructions to the light, so that only one percent or less passed through. A bright star could thus be made to look, to the observer's eye, just like a faint one, and, by comparing numerous observations made with and without screens of different transmission, the amount of the error for different stellar magnitudes could be determined. The modern method of following the star by a moving wire, which automatically sends electric signals when it reaches definite positions in the field, much diminishes this error.

If in the preparation of a given catalogue observations with screens have been made to determine this correction, the compilers of the General Catalogue have none the less to go carefully over their published accounts of what they did, checking up on every point. If no such observations were made, the compiler still has a chance. He may compare the results of this catalogue with the average from other catalogues in which correction for magnitude error was made, and so find how much, on the average, faint stars were observed late compared with the corrected observations. With a large enough number of stars, this process gives reliable values of the corrections necessary to reduce the results of the particular observer to the general average of all.

Many other sources of error present in the observations of a century ago have been reduced by modern refinements. For example, the clock upon which the transit observations depend, might not be perfectly compensated for temperature, and might run slower by night than by day. Modern clocks, in constant-temperature vaults, are free from this danger; but minute differences of the same sort between the results of different observers are present, and must be found and allowed for.

ONE of the most curious of these affects the declinations. The main part of the determination of these depends upon the graduated circles which are attached to the telescope, and read by four microscopes. The maker of the instrument has graduated this circle with the utmost practicable accuracy; but the small outstanding "division errors" have to be determined by the astronomer who uses the instrument—which is simple in principle, but takes a lot of work in practice.

After the telescope has been set so that the star, as it transits the field, passes near the center, the exact distance by which it goes north or south of it is measured by setting a micrometer-thread on the star. When a meridian-circle telescope is pointed almost straight upward, its eye-end is lower than a man sitting in a chair could reach, so that it has always been customary for the observer to be on a sort of couch, adjustable so that he can get his head under the eyepiece and look up without getting into a strained position. When observing a star south of the zenith, his head is north of the piers on which the axis of the telescope is carried, and his feet extend to the southward; for northern stars, his head is south and his feet north.

Now, in a great many cases, comparison with the general run of observations shows a discontinuity in the declinations measured at a given observatory, just at its zenith. The explanation is not far off. In setting a micrometer wire—which, as he looks, runs parallel to the line joining his eyes—upon a star-image, an observer may tend to place it slightly "above" the star, as he sees it, or perhaps below. When the observer changes ends in passing from northern to southern stars, what is "below" to him (toward his feet) alters its direction with respect to the telescope, and to the stars.

This is but one of many possibilities which the compiler of a general catalogue must have in mind. Only an astronomer thoroughly familiar both with the actual methods of observation, and with all the refinements of the theory of errors, should attempt so delicate a task: and years of experience are required before his judgment upon the relative weights which should be applied to the results of different catalogues is fully mature.

Almost half of the 339 pages of the first volume of the General Catalogue are occupied with tables of the various systematic corrections which have been applied to reduce the results of each catalogue to the adopted standard system. Another hundred pages deal with stars close to the poles, where the right ascensions change so rapidly that it is necessary to tabulate them at intervals of ten years, or even for five, as for the Pole-star. The remaining four volumes, averaging 330 pages each, contain the main body of the Catalogue. Beside the positions (for 1950) and the all-important proper-motions, it gives the magnitude of each star, and its spectral class. More than 6700 stars were specially observed photometrically at San Luis, to make the list of magnitudes more accurate, and those spectra, which had not already been observed at Harvard were specially looked up there.

THE completed volumes represent a transformation of the great mass of frozen assets into liquid and available form. A wealth of information about the distances and motions of stars of all sorts is contained in the proper motion —only waiting to be worked up in detail. In this phase of astronomy, we can be quite sure that the immediate future threatens neither a depression nor a recession.—*Princeton University Observatory, March 5, 1938.*

[The Catalog is fairly expensive.—*Ed.*]

# UNPUZZLING COLOR

## Color Names Cause Confusion . . . A New System is Being Developed to Bring About Definite Standards . . . Like Sections of Grapefruit

By JOHN H. CRIDER

IN an age when science reproduces with dazzling accuracy the myriad colors of nature, we are inclined to take color for granted. Until related colors are examined closely, side by side, or until someone disagrees with us over the description of a color, we do not worry much about color names. After all, "what's in a name?"

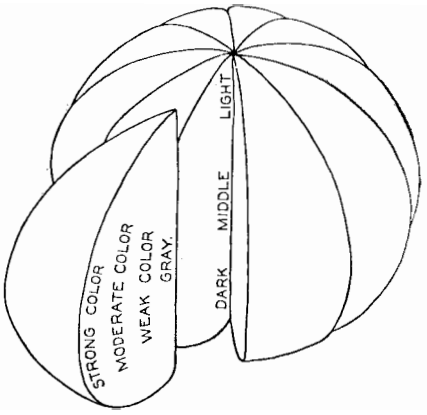
There is a great deal in a name when the name happens to be the only means people have for conveying a specific color designation. It is important, for example, that when you tell your decorator to make your drapes of *orchid* your decorator should have precisely the same idea of *orchid* as yourself. Orchids are flowers which derive much of their beauty from a blending of numerous colors. How, then, can different people be expected to associate the name *orchid* with a single color?

A color name might cause a lot of trouble, for example, if a lady had to depend upon ordering by telephone to match a new garment. Suppose she has a new *light green* sweater and wishes to order skirt, gloves, hat, and bag to match. Actually, she probably would have to shop for hours to match them properly, if at all. It would be convenient for her, and thousands like her, if *light green* always meant the same thing —if *purple* always could be *purple* and *blue* always *blue*.

The poets, of course, have license. They call colors what they like and there are no arguments. It's all in the interest of art. But for ordinary folk this question of naming colors is one that is controversial, argument-provoking.

THE ancient Egyptians managed to create some brilliant colors—so did the Chinese, Persians, and Indians—but it was not until the Germans popularized synthetic dyes, a process now highly developed in this country, that commercial use of color reached the baffling stage. The number of shades produced by our great dye companies is enough to make your head swim. Fortunately for the fashion creators, and unfortunately for the scientist, these shades or colors have to be named, otherwise how could the new vogues be sold to the public?

It is fortunate for the fashion creator because with industry's capacity for turning out new variations of color it is important that interesting new color names be kept before the consuming public. It is unimportant that none but a few experts can distinguish between




**The color solid, reproduced by permission of the Munsell Color Company, Inc., is described in the text**

the *coral* of this season and the *rose petal* of last year. The important thing, commercially, is to create consumer demand.

To the man of science this is a careless use of words. The multiplicity of color names is as provoking to him as it is pleasing to the fashion originator. Science requires precision. Names must always have the same meaning.

For the consumer the confusion of color names is perhaps worst of all. As long as people keep giving different names to the same color, arguments will crop up and dissatisfaction will be encountered. The average individual bases his use of color names on personal experience and everyone seems to have had a different experience.

Experts tell us that there are about 100,000,000 barely distinguishable colors. Very few people can recognize all of them; the difference is very slight. Only an expert paper grader can, for example, distinguish from memory more than 300 shades of white in paper!

To no group has this color puzzle been more troublesome than to your corner druggist who makes up prescriptions from a large variety of solid and liquid chemicals. He has two standard books to guide him—the National Formulary and the United States Pharmacopoeia. They describe each of the drugs your druggist uses, and one of the important means of description is by color. You can readily appreciate that the ability to recognize a chemical or drug by color would be most essential to those working in places where there are so many little bottles of powders and liquids which often mean life or death to stricken humans.

Thanks to the corner druggist, and to the national association of which he is a member, science has at last undertaken the job of solving the color name problem. In fact, the National Bureau of Standards in Washington, backed by the American Pharmaceutical Association, has just about finished the classification of the color names of powdered drugs; the naming of microscopic structures and crude drugs is well under way.

ALTHOUGH the project was instituted by the pharmacists, the system which has been worked out is capable of universal application. Already many other industries have evidenced an interest in the color name standardization project. It is hoped that through adoption of the new system by leading industries, the public generally will come to understand and use the new names. When that day comes, it will mean farewell to confusion in the naming of colors.

This standardization started 15 years ago when Dr. E. N. Gathercoal of Chicago threw up his hands in disgust over such terms as "blackish white," "reddish green," and "whitish." These virtually meaningless words and phrases had actually found their way into the official books. What was the poor pharmacist to do? Dr. Gathercoal found the answer by organizing a Color Convention in Washington. From this meeting the Inter-society Color Council was formed, and the job of scientifically standardizing color names was soon under way.

The object of the work at the Bureau of Standards, financed by the American Pharmaceutical Association, was to provide: "A means of designating colors in the United States Pharmacopoeia, in the National Formulary, and in general pharmaceutical literature; such designation to be sufficiently standardized as to be acceptable to science, sufficiently broad to be appreciated and usable in science, art, and industry; and sufficiently commonplace to be understood, at least in a general way, by the whole public."

Kenneth L. Kelly, research associate who has worked out the new system at

the Bureau of Standards with Dr. Deane B. Judd of that institution, believes that the objectives have been achieved.

The Munsell Book of Color was adopted as the basis of the new system. Under the Munsell System the colors are numbered but not named. It divides the color solid into 20 sections or segments, breaks the segments into pieces, and gives a number to each. The new color project went further and gave a name to each piece. The names in the new color system, like the numbers in the Munsell System, represent a range of color—not simply one color.

*Below:* **Kenneth L. Kelly, research associate at the Bureau of Standards, who has been active in developing the new standards of color nomenclature described in the accompanying article, is shown here trying to determine by eye the proper color name for a powdered drug. The drug itself is compared with a color chart**

*Above:* **Confronted with a border-line case, Mr. Kelly makes use of the colorimeter, a device which makes it possible to measure differences in color which are visible to but can not be calculated by unassisted eyesight**

The color solid, which is the foundation of the whole project, may be described as a grapefruit, the top white, the bottom black, with the color spectrum running around the middle as the Equator circles the earth. Theoretically, all of the known colors and shades of color are in this solid. The color namers, following the Munsell principles, broke the solid into sections, each section corresponding to the natural sections of a grapefruit. There are 20 sections and, as you can understand from the description of the solid, the colors in each one of these sections range in lightness from top to bottom (the darkest at the bottom), and in intensity from the center to the outer surface.

After the segments were broken into approximately equal pieces, still following the Munsell principle, the research workers were ready for their real job—naming the pieces. After considerable experimentation, they adopted 23 common English words as the words they would use in the naming system. Since the color solid had been divided into 320 pieces—about 16 pieces to a segment (some more, some less)—they had to put these 23 words into 320 combinations to describe the colors.

It is significant that there are no *midnight, schooner blue, leafmold, sistina, quimper,* or other such names among those selected. You may recall having seen some of the names just mentioned used in connection with feminine fashions or interior decoration. Words like these have meaning to the Textile Color Card Association of New York, which performs a great service to the textile industry by supplying such appealing names to newly created fashions. But to you, for example, what does *queen blue* mean? Compare such words to those used by the color namers at the Bureau of Standards. Here they are:

BASIC COLORS—Red, Yellow, Green, Blue, Purple, White, Black, Grey.

COMPONENT HUES—Pink, Orange, Olive, Brown.

MODIFIERS—Pale, Brilliant, Vivid, Faint, Dusky, Deep, Light, Dark, Weak, Strong.

THE ADVERB—Very.

Having tentatively adopted these names—and the indications are that they will stick—the color namers then had to go through the National Formulary and the United States Pharmacopoeia to look at each of the drugs mentioned to see what color names from the new system correctly described them. Sometimes the same color had been named variously. There will be no more "blackish white" or plain "whitish," although the color namers are using the "ish" ending as a modifier of definite names, such as "reddish purple," "yellowish green," and so on. Such combinations have a definite meaning in the new word system, while formerly they were used simply to suit the fancy of the observer and with no relation to a standard system.

When the druggists' committee has completed checking the new color names which have been assigned to the drugs mentioned in the two books, it is expected that these accurate designations will be officially approved and adopted for use in future editions of these important volumes.

ANY visitor to the Colorimetry Section of the Bureau of Standards may see the namers at work, as well as the exhibits which they have prepared to illustrate their achievements. In one case the visitor will see three samples of the same drug from three reputable wholesale houses. The difference in color is obvious to anyone, yet in the National Formulary they are all classified as *Light Brown.* Under the new naming system tentatively adopted for these specimens, they will be called *light yellow brown, weak red brown,* and *brown,* respectively. The beauty of the system is that each name has a definite meaning. If there is any question about it all the questioner has to do is look at the color solid to see what color the name describes.

The system also has the advantage of being workable by anyone with good eyesight. In a few minutes' time a person understanding the system can definitely classify almost any color under the new system. When fine points arise, resort is had to the colorimeter, a machine which enables the worker to measure differences in color which are not calculable by the unaided eye.

When the results have been officially adopted *purple* will be *purple* and *blue* will be *blue.* Arguments over color will be solved at once by recourse to the color solid and the new naming system.

# THE SCIENTIFIC AMERICAN DIGEST


**Conducted by F. D. McHUGH**

Contributing Editors

ALEXANDER KLEMIN
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D. H. KILLEFFER
Chemical Engineer


## Giant Strip Mill

THE largest, fastest, and most modern wide continuous strip mill in the world, Republic Steel's huge new 98-inch strip mill recently opened in Cleveland, is, in sheer size and in a thousand and one details, a masterpiece of engineering.

A colossus in an industry where machinery and equipment is commonly gigantic, the new mill embodies in its design every technological improvement that the country's best mechanical, electrical, and metallurgical engineers have thus far developed in the art of processing steel. Recent improvements and developments in lubrication, hydraulics, welding, design of bearings and electrical control, which make possible the production of extra wide sheet steel at the terrific speeds employed in Republic's new mill, are featured throughout the plant. So, too, are latest advanced factory management practices and technique in the efficient handling of materials, in the metallurgical control of products being processed, in the coordinating of all mill operations, and in the establishment of safe, healthful working conditions for humans in the plant.

**Rolled strip steel being delivered from the newest continuous hot mill**

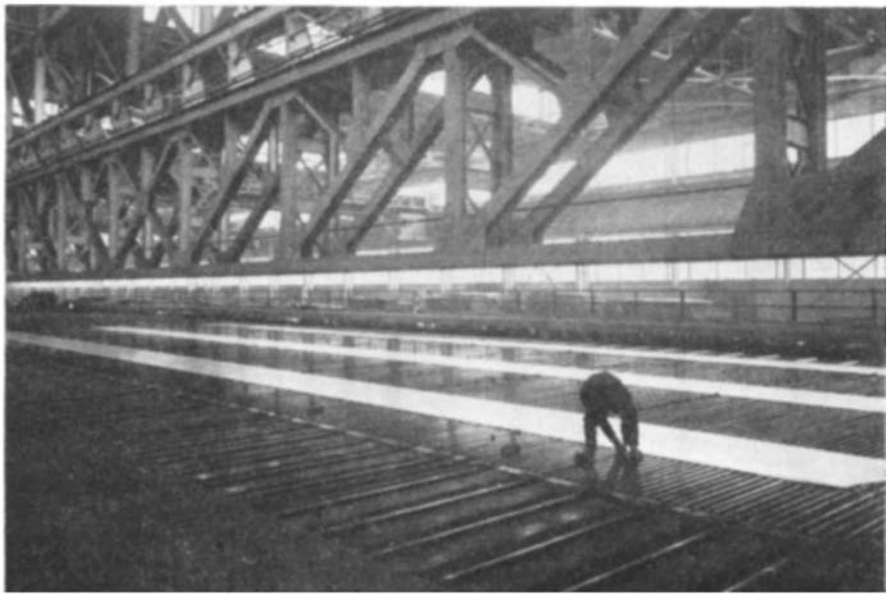
Maximum delivery speed of the hot mill is 2121 feet (more than two fifths of a mile) per minute. It can roll all finished widths from 30 to 94 inches and all finished thicknesses from 18 gage strip to half-inch plate. The plant has a nominal rated capacity of 70,000 gross tons per month.

## Binocular Magnifier

PRODUCT inspectors, proofreaders, botanists, artists, process workers, and many others who constantly use magnifying glasses of various kinds are always searching for more efficient or more convenient glasses for their work. They can get the convenience if not high power in the new Zeiss Binocular Head Magnifier which is distributed by the George Scherr Company. Since this device provides binocular vision, is worn before the eyes in a manner somewhat similar to the way spectacles are worn, and since stray light is excluded by the molded frame, both a stereoscopic effect and enhanced visual acuity are given.

The magnification of the binocular head magnifier is 2.25, which is ample for most

**For use where binocular magnification is essential to aid the vision**



**Steel is gaged on this transfer table on its way to finishing**

fine work. The field of vision is about seven inches and the working distance is about eight inches. No focusing or adjustments are required, as the magnifier is suitable for use with any vision.

**TAXES**

**ONE oil company reports, for 1937, payment of 104,909,408 dollars in taxes against 23,319,728 in dividends. This figures out per share of stock at $9.65 for taxes and $2.25 for dividends.**

## Acreage Determined by Weight

A NOVEL method of ascertaining acreages of crops and other vegetation, by using aerial maps, was employed by the Bureau of Agricultural Engineering in surveying the basin of the Rio Grande in Colorado, New Mexico, and western Texas for the National Resources Committee. A total area of more than 2,000,000 acres was mapped in 18 classifications in a single season, with only a small force and limited funds. The system was devised by F. C. Scobey, of the Irrigation Division, Bureau of Agricultural Engineering.

Practically all the basin was mapped on aerial photostatic prints having a scale of two inches to the mile in the more open country and four inches in the more congested areas in New Mexico. On these prints the fields were readily identified and numbered or colored according to the classification scheme.

To obtain totals of areas so identified, the field maps were traced on clear celluloid sheets, which were then cut up along boundary lines. The pieces for each classification were weighed, in groups, on laboratory balance-scales. These weights were converted into acreages by comparison with previously ascertained weights of templates or accurately dimensioned unit samples of the celluloid.

A pattern sheet consisting of a template of heavy celluloid, representing 1000 acres at the two-inch scale and 250 acres at the four-inch scale, was cut out and carefully trimmed to exactness with a file, fine drafting scales being used to determine dimensions. One of these test blocks was cut for each field sheet.

A direct check on the weighing, and thus on the summation of areas, was made for each field sheet. Before being divided, the piece of celluloid covering the field sheet was carefully weighed. When all the areas and the test block had been broken out, the fragments remaining also were carefully weighed.

The sum of the weights of scraps, plus the group-pieces, plus the test block, had to equal the weight of the original piece of celluloid. A tolerance of 1 part in 1000 was adopted. If the lack of agreement exceeded that ratio, weighings were repeated until the discrepancy was found.

**Paper mill requirements necessitated the construction of this huge tank**

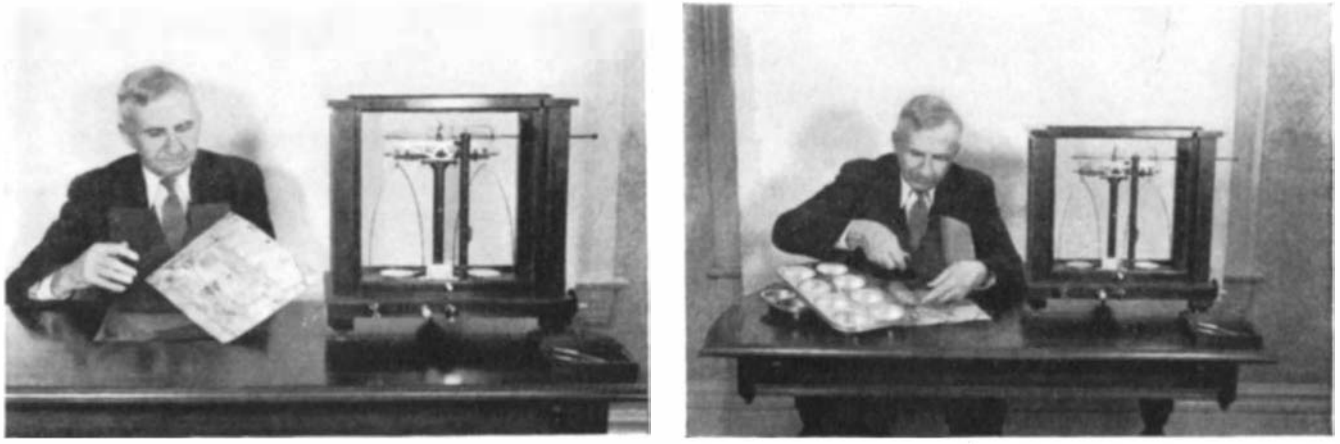
## Huge Reinforced Concrete Tank

CONSTRUCTION of a reinforced concrete, filtered-water storage tank of 1,500,000-gallon capacity to serve the Crown Willamette mill of the Crown Zellerbach Corporation at Camas, Washington, has been completed by The Austin Company. It is situated on the Columbia River, about 40 miles from Portland.

In order to meet requirements of this mill, one of the largest pulp and paper producing units in the northwest, with a concrete tank suitable for long, continuous service, the Hewitt system of concrete tank design was employed. The result has been a tank costing approximately 30,000 dollars, considerably less in cost and claimed to be more permanent in structure than others of comparable size built in accordance with usual engineering practice.

Under the patented Hewitt system, the tank walls were constructed in vertical sections. Recesses are provided for in the forming of wall exteriors, to permit attachment of turnbuckles to the circular rods which are placed after the tank walls and the dome have been completely poured. Spacing of these rods is provided for in the design and they are taken up with special tools to provide specified initial stress in the rods and in the concrete. The turnbuckle rods are covered over with gunite after the adjustments have been made. In this way the concrete is placed in compression, and difficulties caused by expansion and contraction are reduced to a minimum.

Particularly interesting in The Austin Company's work at Camas were the sequence and method of applying the Hewitt system. The site, on a heavily wooded hillside, was cleared, excavation completed, and the concrete foundation ring and floor then poured. Then an inside form, 1/7 of the inside circumference of the tank, was constructed. This form was braced back to a king-pin in the center of the floor and was constructed on rollers. Sectional forms for the exterior of the tank were built up so that they might



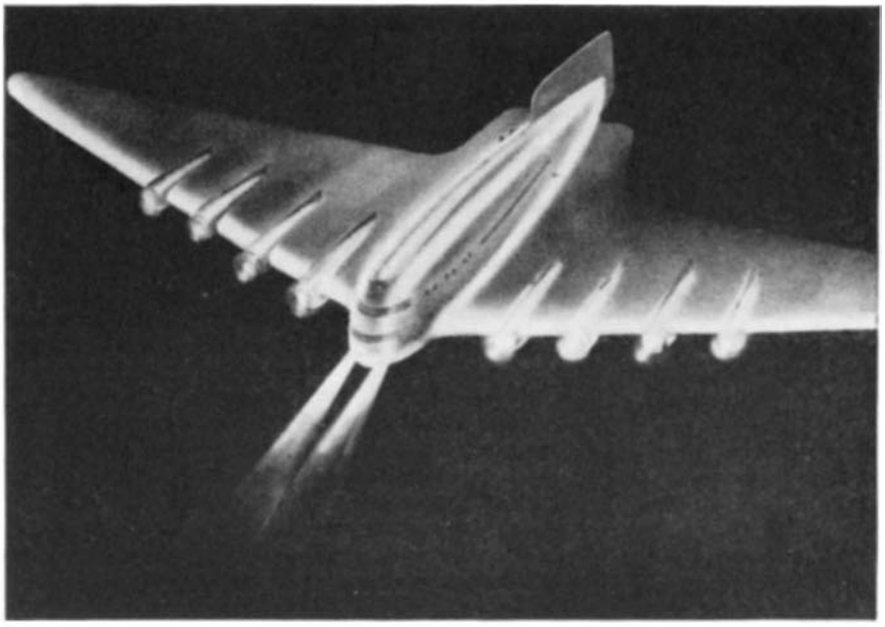
**Sections of celluloid, cut from map tracings and weighed, determine crop or woodland acreages**

be readily handled from a traveling A-frame, which ran on a track provided at the top of the tank on the movable form section. The inside movable form was pulled away from the wall by a chain block when the concrete had set in a completed section, and then rolled to the next position. A movement toward the center of the tank of approximately four inches was provided for by a slot in the horizontal bracing connecting the form to the king-pin. Accuracy in establishing the proper position of the inside form was assured by its position with respect to the king-pin and slot, as well as by a line scribed on the floor of the tank.

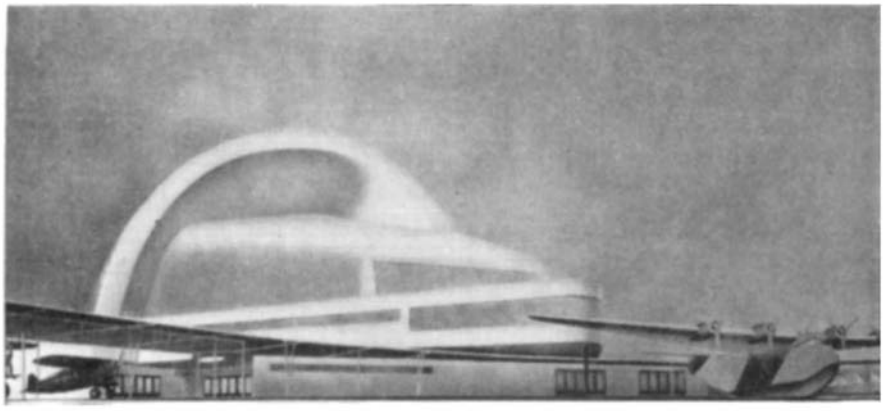
The tank is 24 feet high at the side walls and 36 feet in the center and has an inside diameter of 106 feet. A total of 1200 barrels of cement was employed on the job.

## Imagination

ARCHITECTS and industrial designers have given free play to their imagination in the aviation section of the New York World's Fair. The aviation building, designed by William Lescaze and J. Gordon Carr, will have a huge awning-shaped entrance, and is well calculated to give the impression that the visitor is at a large and modern airport. At "anchor" in front of the building will be found one of the largest "Clipper" flying boats. On entering the building, the visitor will find himself in a high, wide chamber with arching roof rising at its far end to a height of nearly 90 feet. A persistent and familiar drone will assail his ears. Invisibly suspended from the roof he will see a huge transport plane, with lights flashing, propellers whirling. Moving clouds and glowing sunlight on the wall behind it will complete the illusion that the plane is in flight.



The artist's airliner of the future does not meet with complete approval



Part of the aviation section of the New York World's Fair

One of Raymond Loewy's models in the Transportation Building will picture the airliner of the future. It is rather curious to see what an artist imagines the plane of the future to be like. According to the drawing it will have eight engines mounted in nacelles at the leading edge of the wing. Let us point out to the artist that the engines in the ship of the future will disappear completely inside the wing. The drag of eight engine nacelles will never be tolerated. Again, in a plane of this size, the fuselage will certainly not be allowed to project so far above the wing, nor will it have so blunt a bow. On the other hand, the artist is perfectly right in making the fuselage very much shorter than in the conventional airplane of today. That is certain to be the tendency as the years go by. We are really tempted to attempt an imaginative drawing ourselves! Yet, at the same time, the general impression created by Mr. Loewy is certainly one of beauty, power, and speed.—*A. K.*

## Scientific Pilots

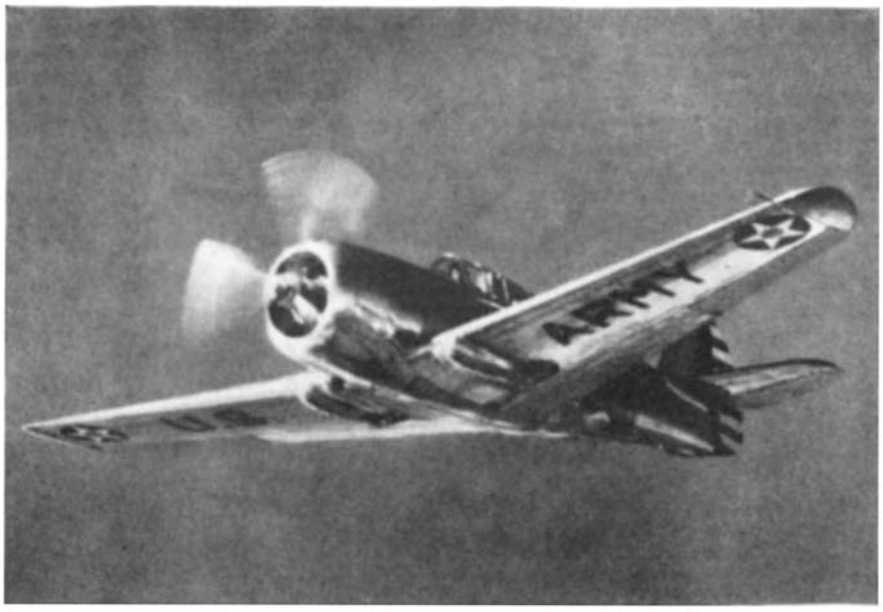
THE tendency of transport operators is to demand more and more knowledge from their pilots. Courage, calmness in emergencies, and instinctive flying skill are no longer sufficient. Transport pilots must understand radio signals, complicated air regulations, blind flying instruments, and a dozen other topics. Also, they must follow flight plans and know precisely how to regulate their engines so as to secure maximum fuel economy. As a part of the effort to secure fuel economy they must know exactly the horsepower delivered by the engine at a given altitude, a given revolutions per minute, and a given pressure in the manifold (which varies with the degree of supercharging).

Unfortunately, the pilot has no time to look up curves or to use a slide rule. To ease the pilot's job, the manufacturers of the Wright Cyclone engine now provide a special Cruising Power Calculator. The calculator is marked off with horsepower at the left, inches of manifold pressure in mercury on curved lines, and revolutions per minute on diagonally inclined lines. The case of the card which carries these indications is of celluloid, and its top diagonal edge slopes appropriately with the characteristics of the engine. This diagonal edge is marked off into 20 divisions, each corresponding to an altitude of 500 feet. The pilot slides the card in or out until the edge of the celluloid meets the intersection of a given revolutions per minute and a given manifold pressure. He then reads power at the left, and altitude on the celluloid scale. The whole process can be learned in a few minutes at most. The usefulness of the Cruising Power Calculator has been demonstrated by the fact that 4000 of them have been supplied to date. —*A. K.*

## Midget Aircraft Radio Transmitter

THE new Civil Air Regulations of the Department of Commerce, which we have already had occasion to discuss, are likely to increase the safety of airline operation, but they will also make life exceedingly hard for the private flier, particularly when he is trying to fly anywhere near the airways. It would appear that every private flier will have to have two-way radio at his disposal, and, what is more, know how to use it so that he can keep in touch with the control officers at the airports. Com-

A scientific pilot makes use of the new engine power calculator



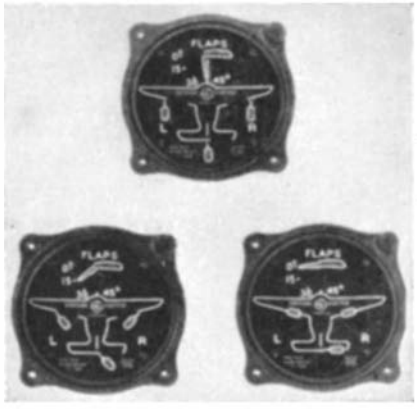
**A modern Army pursuit ship, analogous to the P-37 described**

panies building aircraft radio equipment are therefore giving considerable attention to the problem of supplying the private operator with light and simple apparatus for use on his plane.

It is remarkable what the electrical engineers can do in this direction. Thus, Westinghouse announces a new midget transmitter known as the 25 A, which weighs only 25 pounds complete with its audio-power unit, radio frequency control units, and ability to deliver 15 watts carrier power to a suitable antenna. Arranged for frequencies of 3105, 3120, and 6210 kilocycles, it will also transmit on any of the 42 airline frequencies for which the plane is licensed. Shifting from one frequency to another in flight is simple, and constant frequency is readily maintained. A built-in relay permits the same antenna to be used for both transmitting and receiving. A push button on the microphone controls the two-way communication feature, being pressed while the user is talking and released while he is listening. Either telegraph or telephone transmission may be employed. Installation is easy, and the complete unit measures only 7⅛ inches in width, 5 inches in height and 4¾ inches in depth.—*A. K.*

## Help in Landing

SELSYN is a well known trade name for a system of transmitting the indications of an instrument to a distance. The instrument turns a rotor at one point and through electrical communication a rotor at a distance turns in exactly the same manner. The Selsyn system of instrument-reading transmission has hitherto been possible only where alternating current was available. On board the airplane, alternating current is not provided, as a rule, and 12-volt direct-current batteries are apt to be the only source of supply of electricity. Now General Electric engineers have developed a method whereby Selsyns can operate on direct current, so that they may be adapted in aircraft work.



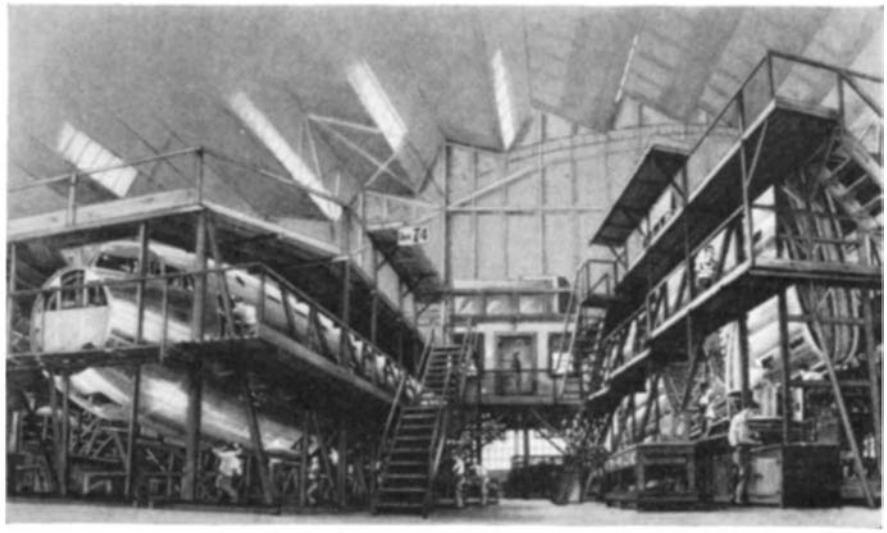

**An aid in airplane landings**

Two devices are used in a Selsyn system: one which operates at the sending point is called the transmitter; the other at the receiving point is called the indicator. Wires from the transmitter are connected to the coils of the indicator. As the transmitter turns, it changes the strength of the current in the wires. This change in turn alters the character of the magnetic field at the receiving end, and the indicator (a rotor of the permanent magnet type) rotates freely to take up the position of "minimum magnetic reluctance." Thus the transmitter and indicator rotor move in perfect harmony and accurate indications are given.

The first application of the Direct Current Selsyn has been to give to the pilot an indication of flap and landing gear position. The advantages of such indicating devices to the pilot are obvious. The complete system, of four transmitters, necessary electric wiring, and one four-element indicating unit weighs only 35 ounces.—*A. K.*

## Curtiss P-37 Pursuit

THE Army Air Corps has just purchased a number of Curtiss P-37 pursuit airplanes, which incorporate all the latest devices—enclosed cockpit, a steerable tail wheel, flaps, and landing gear retractable into the wing. But perhaps its greatest claims to attention are the top speed, which is well over 300 miles per hour, and the fact that for the first time in several years a fast Army pursuit ship has been equipped with a liquid-cooled engine. By the use of such a power-plant, the nose of the ship becomes considerably neater than the nose of an air-cooled job, even when provided with a streamline cowling, and the vision is greatly improved. With chemical cooling of the engine, the radiator becomes quite small and can be neatly tucked away against the side of the fuselage. Except for the engine, the P-37 is similar in many respects to the plane illustrated in the photograph at the left, above.—*A. K.*



**In the shop where the *DC-4* is nearing completion**

## Douglas "DC-4" Nearing Completion

THE Douglas *DC-4* has been engineered and is being built to the order of the five biggest airlines in the United States. The huge four-engined monoplane is nearing completion, and gives every promise of success. It will have a gross weight of 65,000 pounds, will utilize every new development, and will ultimately be equipped with supercharged cabins for use in the "sub-stratosphere." Parties to the contract (dated March 23, 1936) were United Airlines; T. W. A., American Airlines, Pan American, and North American Aviation. To date, the enormous sum of 1,500,000 dollars has been spent in development work and more than 500,000 engineering hours will go into the design and supervision of the complete construction.

In addition to a crew of five, the *DC-4*

will carry 42 passengers. Its wing span will be 138 feet 3 inches, its length will be 97 feet, and it will tower 24 feet above the ground when supported on its landing gear. At take-off the four engines will deliver 5600 horsepower. Cruising range will be 2200 miles, and cruising speed at the most efficient altitude will be 240 miles per hour. The highest mountain in the United States will be cleared by a 5000-foot margin. The useful load will be 20,000 pounds with 6500 pounds of mail and express in addition to the passengers and crew.

We have often spoken of nose wheels or tricycle landing gear. So efficient has this type of landing gear proved on smaller ships that Douglas engineers had no hesitation in adopting it for the new giant.

Wind-tunnel tests, hundreds of structural tests, and the most refined calculations have gone into this ambitious enterprise. The artist's drawing gives a splendid conception of the size of the ship and the methods employed in the task of final assembly.—*A. K.*

## To Detect Enemy Aircraft

TO detect enemy aircraft, flying at night without lights, Army engineers are using a delicate heat detector or radiometer, similar to the radiometers used in detecting the heat of distant stars. The aircraft may not carry lights, but the heat of their motors cannot fail to betray them. Experiments made at Fort Monmouth, New Jersey, have been entirely successful in spotting aircraft flying in complete darkness.—*A. K.*

## The Airport Orientator

INVENTED by Horace Stark of the Pennsylvania-Central Airlines, and developed by the Sperry Gyroscope Company, under an order from the Department of Commerce, the Airport Orientator will free the pilot from many headaches.

In the conception of this instrument, Mr. Stark argued that it would be highly desirable for the pilot always to have a chart available which would show him the exact location of the terrain beneath him, no matter in what direction his plane might be heading. This he achieved by using a circular chart, one of which was made for each terminal airport en route, as well as for alternate airports. The chart is so light and so mounted that it is controlled by the directional gyro, and is always set to the true geographic north without affecting the directional gyro in any way. This chart is shown on top of the instrument in one of our photographs. Besides the airport, there are shown the directions of the radio beams. With this instrument the pilot is certain of heading either towards the station or directly away from it. It then becomes quite easy to make a desired maneuver towards the airport, without any complicated mental calculations.—*A. K.*

"Headache saver"

## Keeping Fish Fresh

BY dipping fresh fish fillets in a 0.3 percent solution of hydrogen peroxide before packing in ice an increase in the keeping period of as much as three to six days has been realized. No change in the appearance, odor, or flavor of the fish is caused by the treatment.—*D. H. K.*

## Pickwick Dam Thrust Bearings

MORE than 6500 gallons of oil will be used to dissipate the small amount of heat generated in the two giant thrust bearings that will form a part of the generating units at TVA's Pickwick Landing Dam power plant.

Approaching completion as the fourth in the chain of the Tennessee Valley Authority's river control projects, the dam at Pickwick Landing, Tennessee, will harness the river to two water-wheel generators, each capable of developing approximately 48,000 horsepower.

**Smoothing the running surface of the world's largest thrust bearing**

The largest thrust bearings of this type in the world will be required to carry the weight of the moving parts in the generators and water-wheels, and the thrust of the water, a load of about 2,500,000 pounds or 1250 tons. The generators and bearings are being built at the East Pittsburgh works of Westinghouse.

For this weight-carrying job, Westinghouse engineers designed the bearing on the pattern of a giant washer with a diameter of 105 inches.

In order to shoulder its load, the bearing has an under surface or running plate of highly polished cast iron resting on 10 bearing shoes, the whole being submerged in a bath of oil which forms a film between working surfaces so that the rotating parts literally float on oil.

To aid in dissipating the small amount of heat generated in each bearing, water-cooling coils will be immersed in the oil, through which will be circulated cold water at the rate of about 100 gallons per minute.

## Mercury Vapor Detector

MERCURIAL poisoning is the serious and sometimes fatal result of absorption and retention in the body of even a small amount of metallic mercury. It has been found that, in the greatest number of cases, such poisoning is due to inhalation of vapor released by the metal at ordinary temperatures.

**To detect mercury vapor**

Workers in many fields are exposed to the possible presence of vapor in manufacturing processes where mercury is used, even where elaborate ventilating systems and other precautions are employed, and to meet this insidious challenge the Mercury Vapor Detector was created. It has been placed on the market by Mine Safety Appliances Co. The instrument plainly indicates the presence of mercury vapor in air, even in infinitesimal amounts.

The M.S.A. Mercury Vapor Detector is based upon the property of selenium sulfide to darken when exposed to metallic mercury vapor. The degree of darkening depends upon the mercury vapor concentration, the velocity of air passing over the sensitive surface of selenium sulfide, the temperature of the air, and the length of exposure.

The Detector proper consists of a metal truncated cone with a 25-watt red Mazda lamp contained in the base and a curved paperholder fastened to the top. The cone, which acts as a chimney, carries air—heated by the lamp to a reasonably constant temperature—upward past the holder containing a strip of selenium sulfide paper. To prevent air other than that in the chimney from striking the paper, a cross-draft eliminator is provided in the form of a cylinder mounted around the holder. An observation window renders the paper easily visible at all times, and the eliminator is removable for access to the holder.

The positive, tested method employed in this apparatus is fool-proof and precise. A simple comparison of the darkened sensi-

tized paper with a color chart gives an easily-read warning of the mercury-vapor content of the air under test. So sensitive is the method that it is possible to detect one part of mercury vapor in 100,000,000 parts of air by an eight-hour exposure—which is equivalent to .082 milligrams of mercury vapor in each cubic meter of air.

## Shell for Interior Decoration

THERE are so many new materials and new forms of old ones clamoring for the attention of the architect and the interior decorator that we are inclined to forget that

**Decorated with kapa shell**

certain natural products can be made into forms that will, in some respects, be superior to the synthetic variety. Of the few new natural products that are being offered today, kapa shell is one of the oddest and, at the same time, a most attractive decorating material. After being processed, it is a pearly, pliable scale resembling a three-inch fish scale, and may be laid on flat or curved surfaces to give an iridescent pattern.

Kapa shell comes from the Philippines and is processed in the United States by J. C. Edgar, sole producer. Stiff when collected, the kapa shells are boiled in secret chemicals until they are pliable and have a pearly translucent sheen. They can be given a variety of colors including gold and silver. Applied to overlap like miniature shingles, they provide a moisture-proof, non-flammable surface for entire walls or inserts, ceilings, bath rooms, elevator cabs, furniture, and the like.

## Removing Fluorine From Drinking Water

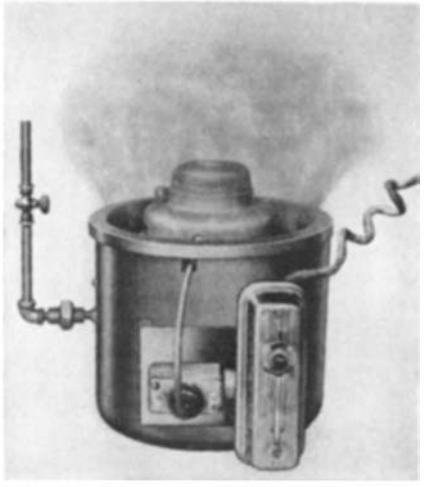
BECAUSE calcium fluor-apatite is much less soluble in water than calcium phosphate, the latter has been proposed as a method of removing fluorine from water to prevent mottling of the teeth, a trouble caused by the intake of that chemical in drinking water. By merely adding a small amount of tricalcium phosphate to water containing fluorine, or, by passing the water through a bed of granulated tricalcium phosphate, dangerous waters can be made safe. Like many other important discoveries, this one has been made by two groups of investigators at very nearly the same time. One of these groups was working on problems of the Tennessee Valley Authority at the University of Tennessee, and the other in the laboratory of the Victor Chemical Works in Chicago. The value of the method, particularly on account of its simplicity, is great, whichever of the two groups may finally be awarded credit for it.—*D. H. K.*

## New Automatic Humidifier

THE small humidifying unit shown in one of our illustrations, with a capacity of 1½ pints of water per hour, has many adaptations in industrial, commercial, and domestic fields, according to the manufacturer. The introduction of one or more units will serve as a partial air conditioner and meet any desired humidity specifications, and because it can be tapped into the regular water supply or storage tank, there is no necessity to install special equipment to handle water.

Mounted inside the spun-copper bowl, which forms the housing of this unit, is a waterproof motor. It drives a mechanism to break water in the bowl into finely divided mist and mixes it for delivery with sufficient air to complete vaporization. The vapor rises from the top of the bowl, as indicated in the illustration. This bowl measures 13½ inches in diameter by 11½ inches high, and the complete unit weighs but 35 pounds. It can be placed on a table or suspended from wall or ceiling.

Makeup water is supplied through a small connection in the side of the bowl, the connection being equipped with a brass float-valve, employing a valve cap containing a live-rubber disk which fits over the water inlet. Its operation is controlled by a Friez-humidistat with a range of 10 to 100 percent, and a working range of 10 to 85 percent, at temperatures from 40 to 150 degrees Fahrenheit. The humidistat is mounted on the side of the bowl and is wired for 110 volts, 60 cycle alternating current.



**Humidity as required**

## Even Milk is Not Always Beneficent

MILK contains over 300 times as much organic matter as sewage and is, therefore, capable of creating far more serious conditions of nuisance in streams, and complications in operating problems in a municipal sewage treatment plant.

The solids content of average domestic sewage is about 800 parts per million, more or less, depending on the total solids content of the water supply. The volatile or organic solids of such sewage, which are more nearly a criterion of its nuisance-producing power, amount to about 400 parts per million. The total solids in whole milk, on the other hand, amount to about 130,000 parts per million, of which 123,000 parts per million are organic. Even in diluted milk wastes from a milk receiving station, such as washings from cans, floors, equipment, and the like, the normal milk solids content frequently amounts to approximately 1300 parts per million, of which 1230 parts per million are organic. The biochemical oxygen demand (amount of oxygen necessary to oxidize and stabilize the organic constituents) of such wastes is several times greater than that of ordinary domestic sewage.—*Health News* (New York State Department of Health).

### FUNNELS

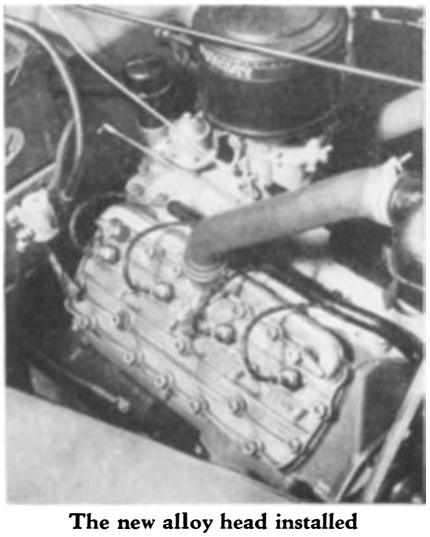
**TO save weight and to prevent corrosion, aluminum alloy funnels will be used on the new 30,000 ton Cunard White Star Liner, *Mauretania*. She will be the first of her size to have such funnels.**

## Copper-Alloy Automobile Engine Head

FURTHER developments in the copper alloy used in the production of the Thermo-Flow power head, manufactured by the Federal-Mogul Corporation, and use of a new "spot and fin" cooling principle, have made possible the production of an improved type of power head for 1937-38 Ford 85-horsepower engines, states the manufacturer.

Road tests of the new power head, it is claimed, have clearly demonstrated the practicality of up to 20 percent higher compression ratios, resulting in up to 15 percent more power, up to 20 percent more mileage and "remarkable acceleration and traffic agility." Oil dilution, carbon formation, and "pinging" under severe road or load conditions, it is added, have been practically eliminated.

The special copper alloy has interesting characteristics. Because of its high expan-



**The new alloy head installed**

sion coefficient and substantial elongation, it cannot crack due to over-heating, freezing, or sudden chilling, a problem faced by all highway haulers and many motorists in sections where extreme temperatures or mountainous driving are encountered.

It is also of unusual interest to note that the high heat conductivity of this new copper alloy is such that it cannot be cut by an acetylene torch; the heat flows away from the point of contact of the torch too rapidly to build up a melting heat.

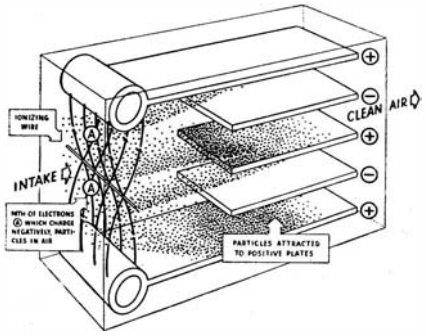
The use of the new head has already extended to truck and bus fleets—the former because of the extra power offered and economy both in fuel and maintenance, the latter, because stop-and-go driving makes high acceleration extremely desirable; economy is also a factor. The extra power, speed, and economy interest police and fire departments and ambulance operators because additional speed and unusual traffic flexibility are essential in emergency service.

## Modern Retail Store Pioneers in Use of 99% Clean Air

THE first retail store to utilize air freed of 99 percent of all dust particles is the newly opened and ultra-modern F. W. Woolworth and Company store at 39th Street and Fifth Avenue, New York City. In this pioneering installation, all air for the store passes through the "Precipitron," an electrical air-cleaning device developed by Westinghouse research engineers, which removes 99 percent by weight of all particles in the atmosphere, even those as small as four-millionths of an inch in diameter. This installation will enable New York shoppers to breathe almost pure air for the first time.

In the area surrounding the new Woolworth store, it is estimated that dirt is deposited out of the atmosphere at the rate of 100 tons per square mile annually. In a year's time hundreds of bushels of atmospheric impurities, of which about 90 percent will consist of particles no bigger in diameter than the hundredth part of the width of a human hair, will be collected on the plates of the Woolworth "Precipitrons." By weight, engineers estimate this collection will consist of one-third ash; another third of fixed carbon, such as soot, lampblack, and other derivatives; and the remaining third made up of volatile matter such as oils and greases. Sulfur, bacteria, pollen in season, and many other substances found in the atmosphere of any city, will also be deposited. Every month, or as often as needed, the dirt collection will be washed off the plates down the sewer; a collection of harmful substances removed which otherwise would have been breathed within the store or deposited on the walls and store stock.

**In the clean-air system described below, the air enters through an intake (right in photograph at the right) passes through the ionizer cells (left in photo at right), where it is freed from dust, and then enters the store through the grille at left in photograph at the left. *Below:* Drawing shows in simplified form the construction of the air-cleaning cells, and indicates direction of the flow of air through them**




The air inside the new Woolworth store is said to be purer than any ocean breeze. In the cleaning process, the air is first bombarded by ions—minute electrical charges—emitted by wires as fine as human hairs which carry a charge of 12,000 volts. The ions attach themselves to particles in the air, thus giving the particles an electrical charge. Next, the treated air is drawn through a series of coils consisting of alternately spaced high-potential and grounded plates. By charging the high-potential plates at 5000 volts, an electrical field is established. As the treated air passes through these cells, the charged particles adhere to the plates and the air, now cleansed of all solid matter, passes on through ducts that lead to the areas being served by the equipment.

Physicians have already tested the reactions of hay fever and asthma patients to electrically cleaned air. Those with hay fever caused by breathing pollen-laden air found almost immediate relief. Asthma sufferers whose troubles result from breathing the dusty air of cities also have been aided. Certain types of sinus ailments likewise yielded, and continuing laboratory work is expected to develop more data for treatment.

**New nickel-molybdenum-steel shovels are so tempered that they are extremely flexible. They may even be clamped in a vise (*above*) and bent as shown, yet will spring back to original shape when released. Users can see many resulting advantages**

### FRONTIER

**DIXIE will be the chemical frontier of the nation during the next quarter century, according to Dean Frank C. Whitmore, of Pennsylvania State College. The raw materials the South will supply include sugar, petroleum, sulfur, natural gas and coal, cellulose, starch, and vegetable oils.**

## Better Glass Stoppers

GLASS stoppers used in bottles containing chemical reagents have a disagreeable tendency to stick but they have been used because no better closure could be had. A recently patented combination stopper avoids sticking, is completely interchangeable from one bottle to another, and has only glass in contact with the bottle's contents. This stopper consists of a flat glass disk held in place against the ground neck of the bottle by a plastic screw cap. Experience with these closures has proved highly satisfactory. They are much cheaper than ground-glass stoppers—*D. H. K.*

## Cigarettes Filter Tobacco Smoke

SEVERAL readers have written to us asking whether it is true that the widely sold Zeus cigarette holder, employing a complete cigarette as a filter, actually removes nicotine and other products of combustion from the inspirated smoke. The answer is: "Yes, a very large percentage of them." This is shown in recent careful and authoritative research.

When this filter-holder was first developed as a result of discussions between Count Giuseppe Cippico, who now heads the Zeus

Corporation, and Mr. Arthur Davis, Chairman of the Board of the Aluminum Company of America, tests showed that it filtered out an average of over 50 percent of the nicotine in tobacco smoke. These tests were conducted by chemists in the Aluminum Research Laboratories. Since then, the holder has been improved so that now all smoke must pass through the inserted filter-cigarette, and the nicotine-removal percentage correspondingly raised. An official report rendered by the Laboratories of the Italian Government Tobacco Monopoly states that the holder with a single filter-cigarette removes 70.5 percent of the nicotine, and the one with two cigarettes removes 93.8 percent.

While this scientific development may seem an obvious one to laymen, it is the result of considerable research. The aluminum barrel, for example, was not a mere haphazard choice for the sake of convenience; it was selected because a metal of high heat conductivity was needed so that the volatile substances in the smoke would cool rapidly and be deposited within the filter cigarette.

**DRIVERS**

**ALTHOUGH the accident repeaters among automobile drivers constitute less than 4 percent of the driving population, this small group is responsible for nearly 40 percent of the automobile accidents in this country. Much of the study of the accident prevention problem should therefore be concentrated on these individuals.**

## Polaroid for Desk Illumination

AN entirely new type of illumination completely free from reflected glare was recently shown to the public when Polaroid Lighting, Inc., introduced the first lighting unit of this type, a desk lamp.

Polaroid, the material effecting this control of light, is the invention of the Boston scientist Edwin H. Land. It has also been mentioned as the solution to the problem of eliminating automobile headlight glare, and has been used in sunglasses.

Mr. Wheelwright, of the Land-Wheelwright Laboratories, explains the action of Polaroid as used to eliminate glare in illumination. The accepted scientific version of many aspects of ordinary light is a series of waves vibrating in all directions at right angles to the light beam. Light waves vibrating up and down penetrate the paper and ink when they meet the reading surface and come out with the color message and detail. Other light waves, vibrating from side to side in the same beam, strike the paper horizontally and glance off the surface as a stone does when skipped on water. These latter waves represent the glare which conflicts with useful light and impairs vision.

**The first Polarized lighting unit, intended primarily for desk use**

**Ordinary lighting of a magazine (*top*) and resulting glare. *Bottom:* Same, lighted with polarized light**

Polaroid acts as a selector, letting through the vertical waves but shutting off the horizontal ones that cause glare. With glare eliminated, other lighting problems can be solved, he pointed out. The light source may be placed directly in front of the reader, thus assuring even distribution of light across the page without concern as to reflections. While the reader has no sense of brightness with Polaroid illumination, much higher intensities can be maintained.

Professor Robert W. Wood, regarded as the greatest American authority on optics, has said of Polaroid: "It is the most significant invention in the field of optics, certainly within the last generation, probably in the last century."

## Marihuana More Dangerous than Heroin or Cocaine

MARIHUANA is "a more dangerous drug than heroin or cocaine." Authority for this statement is United States Commissioner of Narcotics H. J. Anslinger. Mr. Anslinger's statement was made as part of a report on narcotics appearing in the bulletin of the Federal Bureau of Investigation.

"I am surprised to learn that certain police officers have been inclined to minimize the effects of the use of marihuana," *Science Service* quotes Mr. Anslinger. "These officers should review some of the cases that are reported to the Bureau. They would, I am sure, be convinced that the drug is adhering to its Old World traditions of murder, assault, rape, physical demoralization, and mental breakdown. A study of the effects of marihuana shows clearly that it is a dangerous drug, and Bureau records prove that its use is associated with insanity and crime."

Effects of marihuana, according to an authority quoted by Mr. Anslinger, are as follows:

"1. Feeling of unaccountable hilarity.

"2. Excitation and a disassociation of ideas; the weakening of power to direct thoughts.

"3. Errors in time and space.

"4. Intensification of auditory sensibilities, causing profound dejection or mad gayety.

"5. Fixed ideas; delirious conviction. This is a type of intellectual injury so frequent in mental alienation. The user imagines the most unbelievable things, giving way to monstrous extravagances.

"6. Emotional disturbance during which the user is powerless to direct his thoughts, loses the power to resist emotions, and may commit violence which knows no bounds when disorders of the intellect have reached a point of incoherence. During this dangerous phenomenon, evil instincts are brought to the surface and cause a fury to rage within the user.

"7. Irresistible impulses which may result in suicide.

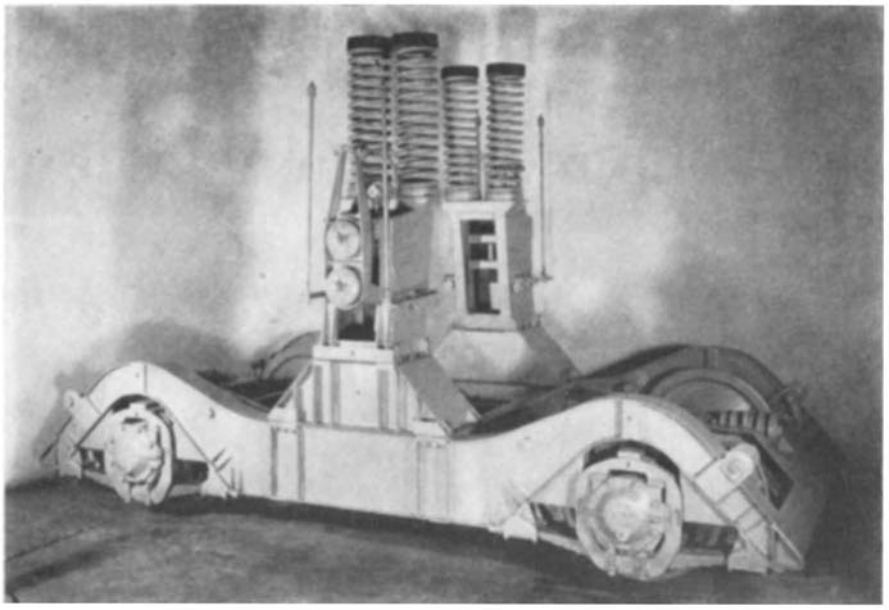
"The illusions are those of sight, hearing, and sense. The mind loses all idea of space and extent, and tends to exaggeration in all things; the slightest impulse or suggestion carries it away."

## Calculator Saves Millions

ENGINEERS completed recently their 184th "inspection trip," covering thousands of miles of the nation's power systems without moving outside their laboratory in the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company.

The inspections, rounding out a seven-year study of abstract problems with concrete results, enabled the engineers to tell the utility companies exactly what power load their systems were capable of carrying with safety and economy without additional equipment. They also determined quickly what additional equipment was required for expansion of the power transmission services.

**Adjusting a circuit on the alternating current network calculator**



The turn of a dial, the snap of a switch, reproduce in the laboratory a miniature replica of any power system in the world. This instrument that "thinks" for electricity is called an alternating current network calculator.

Westinghouse started the calculator study in 1930 to investigate system problems involving voltage regulation, stability, and loading of electrical equipment.

Like a G-man of electricity, the calculator discovers why, for no obvious reasons, transformers are overloaded and determines means of better controlling the circulation of power. It helped the United States Army engineers study the behavior of various proposed system designs for the generators, motors, and transmission lines for Boulder Dam, Bonneville, and other Federal projects.

The calculator studies have indirectly saved the power consumers of the nation many millions of dollars by enabling the utilities to carry larger loads efficiently, safely, and economically without the expenditure of money on unnecessary extra equipment.

Before the calculator went to work, utilities frequently had to invest in expensive lines and equipment as a safety measure. One company installed 50 miles of transmission line in order to carry an estimated peak load. The calculator later disclosed that the existing line would have carried the load safely.

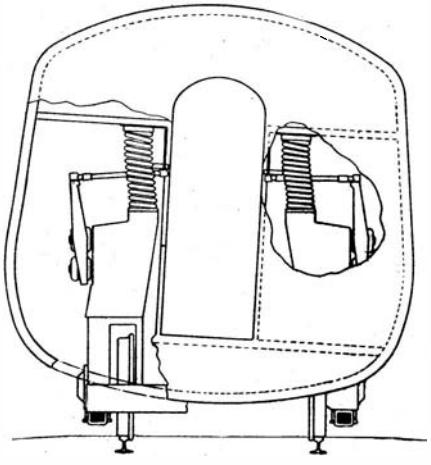
## New Surgical Anesthetic

BY mixing three parts of ethyl ether and one part of vinyl ether, a volatile surgical anesthetic superior to either alone is being produced. Vinyl ether alone was introduced a few years ago for this purpose but developed defects which are avoided by using such a mixture with the customary ethyl ether.—*D. H. K.*

## Spring-Suspended Rail Car

POSSIBILITY of adapting aircraft design and production technique to the railroad industry is demonstrated in the development

**Full-scale unit (*above*) of a new type of railway car truck in which coil springs and control arms project up into the car body. *Below:* Partial section of a car body shows how the weight is spring suspended**



of a new type of railway car of spring-suspended design recently successfully tested. The familiar monocoque, or stressed-skin principle, and construction of full scale Douglas fir plywood models, or mock-ups, were two of the aircraft industry's methods employed.

The experimental two-car train incorporates an ingenious method of body suspension. The car body is suspended on springs and control arms mounted on pedestals, or towers, which rise several feet into the car body from the railroad trucks.

Weight reduction through stressed-skin construction is another feature of the experimental cars. With this method, the entire body—sides, roof and floor—carry the stresses, instead of letting heavy side trusses do all the work, with the superstructure serving merely as weather protection and an added weight burden.

Use of Douglas fir plywood and lumber in the experimental car bodies made it possible to build them with a minimum of equipment and in a much shorter period than if they had been built of metal. The cost was considerably less and there was a degree of flexibility of design which is necessary to a project of this sort. In actual service-trains, the cars would be built of metal. Advantages predicted and already realized in road tests on the plywood models are superior riding comfort, light weight, economy of operation, low first cost, and safety.

Cortland T. Hill, grandson of James J. Hill, the famed "Empire Builder," is sponsor of the project. Directly associated with Mr. Hill are William E. Van Dorn, originator of the project, and Dr. F. C. Lindvall, of the California Institute of Technology. Important contributions to the design and construction of these new cars have been made by Paul K. Beemer, Eliot F. Stoner, and Herbert J. Wieden, aircraft and automotive engineers who have introduced many innovations from those transportation industries. In this experimental work, the Atchison, Topeka and Santa Fe Railway is co-operating in providing motive power and testing facilities.

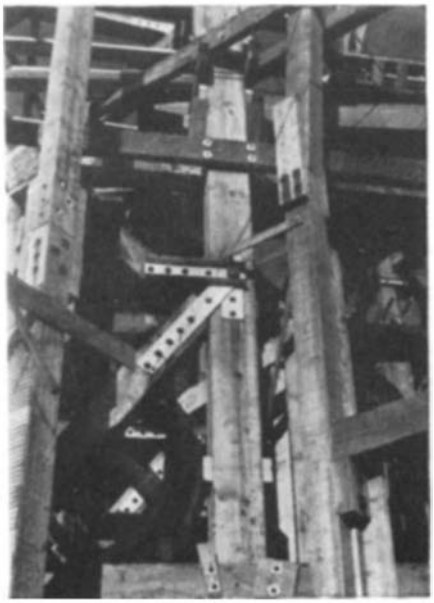
### TEMPERATURES

**A RECENT well drilled at Palestine, Texas, 9000 feet deep, showed a bottom temperature of 225 degrees, Fahrenheit. One deep well in the Kettleman Hills region produced 200 degree, Fahrenheit, water at the rate of over 5000 barrels a day—instead of oil.**

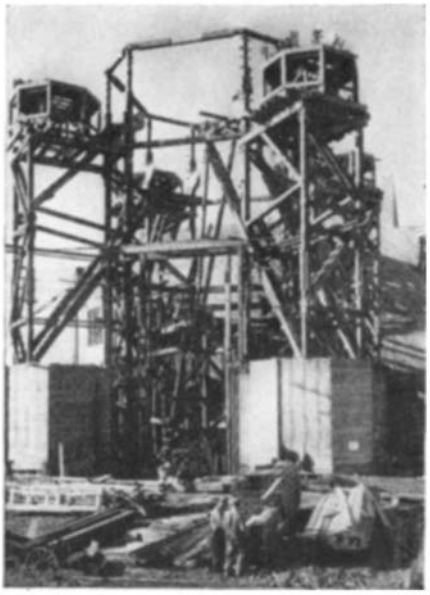
## New Type of Timber Construction

TO speed erection of buildings for the 1939 Golden Gate International Exposition on San Francisco Bay, as well as to facilitate dismantling after the 288 days of the Fair, a new type of timber joint was evolved. It is said to be one of the most important developments in heavy frame construction in recent years.

On several of the structures, the majority of the timber joints were constructed with a strap and pin type joint, consisting of a series of steel straps and channels interconnected by means of a pin bolt. The steel straps are connected to the timbers by flush type sheer plates and bolts. The joint is so designed that it can take either tension or



**Interconnected steel straps and channels hold timbers together**



**A 108-foot tower constructed with the new timber joints described**

compression. The joint was developed under the direction of John J. Gould, Chief Structural Engineer of the exposition.

In the construction of the 105-foot Triumphal Arch, the main frame was constructed with this new type joint. All framing was prefabricated on the ground, the lower 60 feet of each side of the arch being erected in six hours. All studding and sheathing were assembled in panels and the sections provided with Byrkit lath ready for plastering.

This new type of joint will greatly facilitate dismantling, an important factor in the economy of temporary structures such as the exhibit palaces of an exposition. It is claimed that the new design is also particularly well adapted for the re-erection of framework, thus making possible a maximum of salvage from the exposition.

## Why Leap from Frying Pan to Fire?

THE United States has made greater progress in providing medical care for its people under the present system than any country that has abandoned that system, and the nation should, therefore, hesitate to adopt any system that would give less progress toward good health.

That is the American Medical Association's answer to the report of Miss Josephine Roche, head of the Inter-departmental Committee to Co-ordinate Health and Welfare Activities of the United States Government, recently presented to the President. The American Medical Association commented on it in an editorial in the association's *Journal.*

Miss Roche's report, in the opinion of the medical association's editor, says in effect that the answer to the problem of medical care is sickness insurance and federal or other subsidy or both, but the medical association's editor comments that failure of the authors of the report to mention the positive side of present American accomplishments in the field of medicine and health gives their report a dismal tone beyond what the situation warrants. He adds: "Our progress up to now, which is greater than that in any country that has abandoned our system in behalf of some socialized system of medical care, should cause hesitation in rejecting the pattern of progress that has brought such results, in favor of patterns that have been tried elsewhere with far less success."—*Science Service.*

**HYDROGENATION**

**AT the present yearly requirement of one and one half billion barrels of crude oil, the known supply of more than seven quadrillion tons of coal could be converted by hydrogenation and cracking processes into enough oil to supply the world for over 24,000 years.**

## Controls "Brown Patch" and Colors Grass Green

SCIENTISTS have combined the practical with the esthetic in a new fungicide for the control of brown patch, a disease of lawn and golf grasses. The fungicide not only controls the disease but dyes the grass any desired shade of green.

The United States Golf Association, through its greens workers, co-operated with the Department of Agriculture in the research work, which was under the direction of Dr. John Montieth, Jr.

The scientists found they could match any grass with the proper shade of green by adding about half-and-half of malachite green and auramine O, a yellow dye, together with about 2 percent of crystal violet, a red dye. This mixture is just as effective as a fungicide as the original dye.

A half ounce of the mixture, costing about 10 cents, diluted with two to five gallons of water is sufficient to spray 1000 square feet of turf.

The fungicide keeps the grass green from three days to three weeks, depending on the weather. A rain before the fungicide has time to dry washes it off quickly. Too, the color will not stand up as long in hot summer weather as in the winter.

Greens keepers on golf courses have used the fungicide and found that it does not harm healthy grass, and improves both the color of uneven greens and the tempers of crochety members who blame their poor putting on the uneven color of the putting greens. It also has been used on football gridirons and baseball infields.

The fungicide may be applied with an ordinary knapsack spray, or larger equipment if available.

## Whey

A MULTITUDE of uses have been found for whey, formerly milk's equivalent of the famous pig's squeal that couldn't be set to work. Sweetened and dried, whey, a by-product of cheese manufacturing, makes an excellent candy filling. "Whipped cream" can be made from whey. Flavor and food value of canned or home-made soup is improved by the addition of powdered or condensed whey. Tomato juice and fresh whey, when mixed, form an "attractive" beverage or starting point for a variety of tomato soup.

This is the essence of a report by B. H. Webb of the United States Bureau of Dairy Industry before the Food Technology Con-

ference at the Massachusetts Institute of Technology.

"The high nutritive value of whey has prompted the Bureau of Dairy Industry to investigate its use in food for man," Mr. Webb declared. "Whey contains most of the minerals, lactose, and soluble protein of milk." Previously, he explained, small amounts had been used as stock food, only a "very small portion being utilized as human food."

Use of sweetened whey or whey powder allows jam to be whipped to double its volume, Mr. Webb also reported. Canned fruit whips were another food listed by the speaker which whey improves.—*Science Service.*

**EARTH STEAM**

**IN Italy, steam from the earth is used to generate 19,000 horsepower daily. Volcanic steam is used in Sonoma County, California, to generate electricity. Other places not yet developed are: the Valley of Ten Thousand Smokes, Alaska; Lassen Peak in California; Steamboat Springs, near Reno, Nevada; and the Yellowstone Geyser region.**

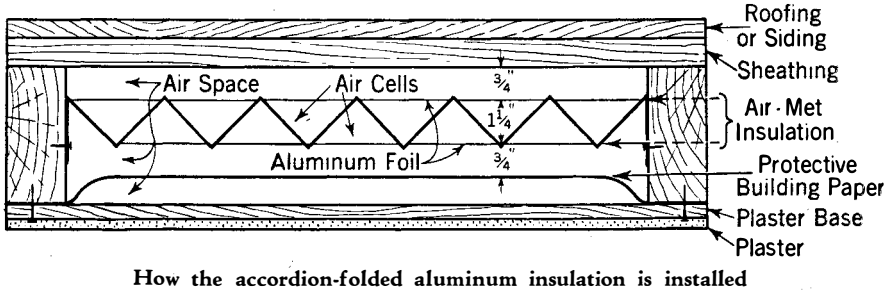
## Accordion-Folded Aluminum Insulation

A NEW type of house insulation—so light in weight that 80 pounds of it is sufficient to insulate more than 1000 square feet of roof or walls, and so easy to apply that the only tools required are a pair of shears, a hammer, and tacks—is called Air-Met. The insulating efficiency of the new product is based to a large extent upon the application of the heat-reflective value of aluminum foil, according to an announcement by The Ruberoid Company. Outstanding advantages claimed, in addition to high thermal efficiency, light weight, and ease of application, are easy portability, imperviousness to moisture and vermin, long life, and elimination of dirt and inconvenience.

The new product consists, primarily, of two thin, parallel sheets of aluminum foil, definitely spaced about an inch apart by a series of triangular air cells of uniform size. Between the two sheets of foil is a light, flame-proof member which, by reason of its truss-like design, serves the double purpose of holding the foil sheets parallel and insuring perfect uniformity in the size and spacing of the intervening air cells. When properly installed, provision is also made for air space between the outer surfaces of the two sheets of foil and the surrounding studs, rafters, sheating, wallboard or protective paper.

The lightness of the material and its convenience for handling is indicated by the fact that enough Air-Met to insulate the average attic, 1000 square feet, is contained in two small cartons, each measuring 8 by 18 by 31 inches.

The material is manufactured in two widths, 15 inches and 23 inches, representing the standard distances between studs, joists, and rafters. It comes in sheets about 80 feet long which, when packed for shipment, are folded together lengthwise like an accordion. For installing, these sheets are simply spread by hand, also as an accordion would be extended.




**How the accordion-folded aluminum insulation is installed**

## Elastic Metal

THE ability to combine steel and rubber into one material is an important discovery in the science of producing artificial working materials. This German "elastic metal," which is composed of a mixture of steel and soft india-rubber, is said to be an excellent material from which to manufacture springs of all kinds, as well as couplings in machinery. This composition can also be used to advantage for sound-absorbing devices.

## Read Paper by Two Billion Candlepower Light at 27 Miles

HOW far can one read a newspaper by the light of the world's most powerful light? A group of technicians sought the answer to this question recently, when the 2,000,000,000 candlepower beacon atop the Colgate-Palmolive-Peet Building in Chicago was turned into the world's largest reading lamp for 90 minutes.

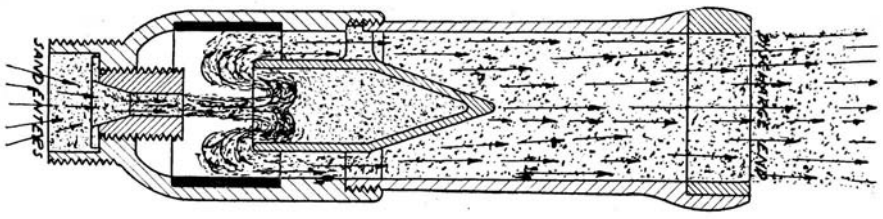
Flying at 7000 feet over Chicago, passengers on board a special United Air Lines' *Mainliner* were able to read a newspaper by the light of the huge airway beacon at a distance of 27 miles.

At one yard from its source, this beacon, the world's most powerful light, is 20,000 times brighter than the noon sunlight at the earth's surface and eight billion times as bright as the full moon.

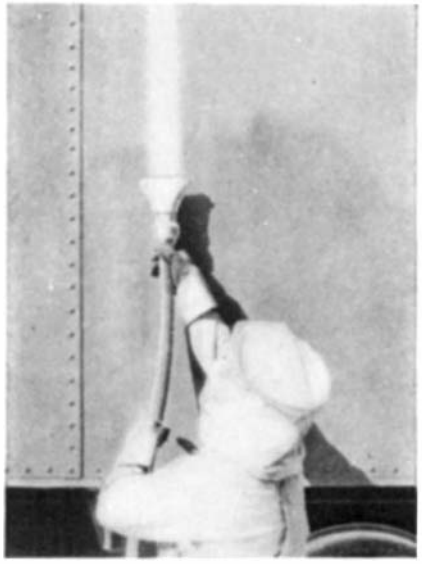
## Sand Blast Gun Has Flat-Mouthed Orifice

A NEW sand blast gun, being manufactured by Michiana Products Corporation, incorporates features of design and principle said to provide better surfaces for painting and finishing wood and steel rapidly and without injury to the surfaces of the materials.

This gun, as the accompanying sketch shows, has a chamber in which the sand meets a baffle which sets up a whirling motion, reducing the sand particles and in-



*Above:* **Cross-section of the orifice of the sand-blast gun that is shown below cleaning a sheet-steel surface**



creasing the number of cutting edges. Sand is delivered under pressure through a flattened orifice fitted with abrasive-resistant alloy steel lips. The result is a flat stream of sand expelled under uniform pressure. It is claimed that this design permits the use of lower cost sand, removes grime, grease, and old finishes faster, and reduces buckling to a minimum on light materials, without cutting or pitting the surfaces.

## Wine in Tank Cars

A NEW type of phenol-aldehyde resin (Bakelite) has been developed which will serve as a coating for lining tank cars and similar steel containers to make them so resistant to chemical corrosion that wine can be carried in them without altering its flavor. The coating of tin cans for beer and wine with resins has become accepted practice but the application of resinous linings to tank cars and tank steamers, which do not have an initial tin lining, represents a substantial advance.—*D. H. K.*

## Common Sense Versus Sentimentality

ACQUITTING criminals because of a mental disease or semi-mental disease is often but a release of wolves to prey on the people. It should no longer be tolerated. Dr. Foster Kennedy, New York psychiatrist, makes the foregoing statement in discussing the psychiatrist's responsibility to the criminally insane and to society in the *Journal of the American Medical Association.*

Dr. Kennedy recommends the following program as one for ardent hope:

1. That in all cases of felony or misdemeanor punishable by prison sentence, the question of responsibility be not submitted to the jury. The jury should be called on to determine only that the offense was committed by the defendant.

2. That the disposition and treatment (including punishment) be based on a study of the individual offender by properly qualified and impartial experts co-operating with the courts.

3. That no maximum term be set to any sentence.

4. That no parole or probation be granted without suitable psychiatric examination.

5. That in considering applications for pardons and commutation, careful attention be given to reports of qualified experts.

6. That there be chosen a panel of qualified medical opinion, if possible from university and major hospital staffs, who would advise the conscience of the court. These physicians would receive adequate remuneration from no private individual or corporation but from the state only.

As a community, thinks Dr. Kennedy, we are too jealous of the life of the killer and not thoughtful enough of the life that has been ended.—*Science Service.*

## Amateur Seismology

A MORE thorough investigation of earthquakes, especially in the western mountain region of the United States, is urged by Dr. N. H. Heck, of the United States Coast and Geodetic Survey, an authority on seismology and on the earthquake history of the United States. He mentions the importance of data supplied by amateur observers. "The growing interest in amateur seismology," he writes, "gives promise of information from simple instruments which will supplement that from other sources. Not only will better estimates of intensity and epicenter be possible, but there will be developed a corps of observers who can better describe their experiences during an earthquake."

## By-Product Utilization

MANUFACTURE of lard-like fats by the hydrogenation of fatty oils is being undertaken by the Hooker Electrochemical Company, manufacturer of caustic soda and chlorine by electrolysis, to utilize the by-product hydrogen from their principal operation. This plant, being erected in Tacoma, Washington, emphasizes the remote fields into which the by-products of apparently simple chemical processes frequently lead.—*D. H. K.*

## Why Do Stranded Whales Die?

WHALES are mammals, not fishes, and they breathe oxygen direct from the air only. They cannot breathe the oxygen dissolved in water, as do the fishes. That being the case, why is it that whales so soon die when washed ashore?

The answer: Probably nobody positively

knows. In *Nature* (London), however, appears a communication from W. A. Osborne of the University of Melbourne, Australia, stating several hypotheses:

"When a school of whales was stranded on an Australian coast, much to the discomfiture of local health authorities, I put to various colleagues in the University of Melbourne the simple query: Why do stranded whales die? I received the following answers, and it was amusing to note that in most instances the explanation was colored by the special study of the colleague interrogated.

"(1) The blood now being acted on by gravity collects in the dependent parts and produces anemia of the brain.

"(2) The weight of the body impedes breathing.

"(3) Vital organs are crushed by the great weight.

"(4) The unaccustomed warmth, especially if there is direct insolation, induces heat stroke.

"(5) The unaccustomed temperature interval between night and day gives rise to internal chills and probably pneumonia.

"(6) The whales do not die because they are stranded; they are stranded because they are dying.

"Perhaps the list can be extended by readers of *Nature*."

Perhaps, too, the same list can be extended by readers of Scientific American, though the list as given seems already to contain some weighty and adequate reasons.

## Ethylene Treatment of Tobacco

ETHYLENE, now widely applied for treating citrus fruits, English walnuts, and other fruits to induce ripening, has a beneficial effect on the curing of leaf tobacco. The treatment matures the leaves, improves the flavor and aroma of the tobacco, and reduces the curing period by as much as 40 percent. Investigations of the commercial application of this new treatment are being conducted by the British Colonial Office.—*D. H. K.*

## Mica Pellets for Insulation

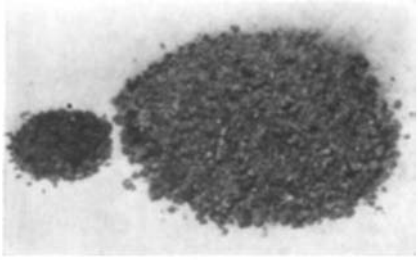
AN extraordinary property has been discovered in little flakes of a type of mica called vermiculite. Upon heating, these tiny flakes act somewhat like popcorn, expanding to about 16 times their original volume and giving a resulting pellet which resembles a miniature accordion. After considerable research, F. E. Schundler and Company, Inc. have developed many uses for these expanded mica pellets, for they are fire-proof, vermin-proof, moisture-proof, are free pouring, harmless to handle, have high dielectric strength, are chemically inert, and are as everlasting as stone.

The varieties of this mica which contain as much as 20 percent of water are heated by passing through huge Schundler furnaces at a temperature of 2000 degrees, Fahrenheit. The water turns to steam and expands each pellet in a direction at right angles to the planes of cleavage. The terrific heat—sufficient to melt steel—transforms the color from black or dark brown to a silvery or golden hue. The raw material

weighs about 100 pounds per cubic foot while the expanded pellets weigh only about six pounds per cubic foot.

These pellets are being used as insulating material in refrigerators, ovens, fireless cookers, incubators, as pipe and boiler coverings, in the hollow spaces over ceilings, and between walls of houses.

Insulating plasters, fireproof insulating boards, roofing slabs, insulating cements,



**Vermiculite mica (*left*) and an equivalent quantity after expansion into pellets for insulation uses**

insulating bricks, combustion chambers, refractory bricks, and acoustical tiles and plasters are some of the products which are made with the Schundler mica pellets as the base. The golden color of the mica pellets is utilized in making gold paint. The material may also be used as a pigment of calsomine by tinting to the desired color. Mica pellets are also used as a decorative material in wall papers.

## New Resins

SULFUR dioxide and the olefins produced as by-products in the cracking of petroleum react in the presence of catalysts or in light of certain characteristic wavelengths to form valuable resins. The two gases are mixed with a catalyst in a sealed container at low temperature; on allowing the vessel to warm up, reaction occurs yielding easily molded resins of valuable characteristics. Catalysts used consist principally of oxidizing agents, such as nitrates and organic peroxides. The resins themselves are easily molded and may be colorless and transparent. They are thermoplastic (softening on heating), and both hard or rubbery resins have been prepared.—*D. H. K.*

## Thunderless Lightning

CONTRARY to general belief, every lightning flash is not accompanied by a clap of thunder, according to K. B. McEachron, General Electric engineer in charge of high voltage and artificial lightning phenomena. His investigations have proved that there are often lightning strokes which produce little or no thunder at all. Such flashes may appear just as bright as others, but their destructive force is less.

"Thunder is the result of a pressure wave caused by the sudden expansion of air created by a quick lightning discharge," Mr. McEachron says. "All flashes do not release energy with the same speed. Our studios during the past three years have revealed that in some cases the electrical current is built up and released slowly; that is, in one or two tenths of a second as compared to millionths of a second in other discharges. This so-called slow lightning produces no thunder. To the human eye it looks the same, and during a general storm the fact that

one has heard no thunder in connection with any given stroke is generally overlooked.

"People have the conception that lightning moves very swiftly, and this conception is true, but the rate at which the current builds up once the path is established may be relatively small, thus giving rise to the phenomenon of lightning without audible thunder. The strokes of lightning which are most destructive, and do the most damage from the point of view of damage to trees or other objects which may be struck, are of a type in which the current builds up very rapidly, not in terms of a fractional part of a second, but in terms of millionths of a second, and this very rapid rise of current produces a correspondingly rapid rate of pressure rise in the air, which transmitted to the ear gives the sound of thunder."

Mr. McEachron also declares that most thunder does not reach one's ears as a single crack because sound travels at the rate of approximately 1100 feet per second, and one portion of a lightning discharge in the clouds may be six seconds away from the earth; whereas that portion of the discharge near the earth may be only one second away. Then, too, Mr. McEachron points out, his investigations have shown that there are often multiple discharges appearing as a single stroke, in which as many as 40 discharges have been recorded in one second of time.

This type of lightning gives rise to a ripping or tearing sound because of the rapid succession of discharges, each producing sound waves which reach one's ears at different intervals. Added to this there is the reflection of sound from clouds, hills, and buildings, all tending to increase the echo effect.

### GOATS AND PIGS

**DOMESTIC goats and pigs gone wild are such pests in Hawaii that, to prevent their destructive feeding on native plant life, tight fences are necessary in some places and it may be necessary to encourage wholesale shooting of both animals.**

## CADMUS OF ALPHABET FAME BELIEVED MYTH

PHOENICIAN Cadmus, popular hero credited with fathering our alphabet, never existed, so far as archeologists can learn. We should honor some unknown Phoenician for teaching the Greeks the ABC's; and the alphabet idea is older than Phoenicians, anyway.

Reporting the latest views on the still-mysterious alphabet, Dr. John Day of Barnard College told the Archeological Institute of America that the Greeks probably derived the alphabet from Phoenicians about the middle of the 9th Century B.C. Dr. Day succeeded in narrowing down the date by demonstrating from old inscriptions that five of the Greek letters could not have evolved later than the 9th Century B.C., and five other Greek letters could not have evolved earlier.

Questioning the recent assertion by "an eminent authority," that Cadmus lived about 1400 B.C., Dr. Day pointed out that when

archeologists dug at the citadel of Thebes, Greek town supposedly founded by Cadmus, they found no trace of Phoenician relics or Phoenician writings.

"We must conclude," he declared, "that the only definite historical element contained in the legend concerning the letters of Cadmus is the fact of the Phoenician origin of the Greek alphabet."

Phoenicians are no longer credited with inventing the alphabet outright, discoveries of old inscriptions having revealed that our alphabet is derived from the Roman, which came from the Greek, which borrowed from the Phoenician, which evolved from letter forms either in Syria to the north or Sinai to the south. —*Science Service.*

## Air Turbine Hand Grinder

HIGH pressure air operates a light weight grinder which is claimed to have exceptional power for fast, heavy-duty grinding. This new air turbine grinder, developed by the Onsrud Machine Works, Inc., has a speed of 50,000 revolutions per minute and

Driven by air

is powered by a ¼-horsepower motor. The grinder unit may be practically concealed in the palm of the worker's hand. Air pressure of 90 to 100 pounds is necessary to operate the air turbine and the air consumption is 8 cubic feet of free air per minute upwards, depending upon the model. Cooling action of the expanded air enables the unit to run continuously at less than room temperature, a feature seldom possible with electrically-operated tools of this sort.

This hand tool is useful in die making, internal grinding, drilling, engraving, and many other operations where high power, vibrationless speed, and light weight are important.

## Petroleum, Source of Feminine Pulchritude

THE women of America, regarded as the most beautiful of all nations, owe much of their charm to petroleum. No other single product contributes so greatly to feminine beauty as does oil.

The American Petroleum Institute reports that many of the haunting, alluring perfumes which modern femininity uses to appeal to the olfactory sense, are made with solvents and essences derived from petroleum sources. Woman's hair, her "crowning beauty," is waved and set by the aid of petroleum products. Even the nail lacquer, so bright and gay, may be made with petroleum solvents.

The soft, smooth glow on the skin of the modern woman's cheeks and hands were put there by Nature—via petroleum. Most of the pomades, facial creams, and other beauty preparations have highly refined petroleum oils as their base; oils created by nature millions of years ago, aged by mother earth, and brought forth by the petroleum industry.

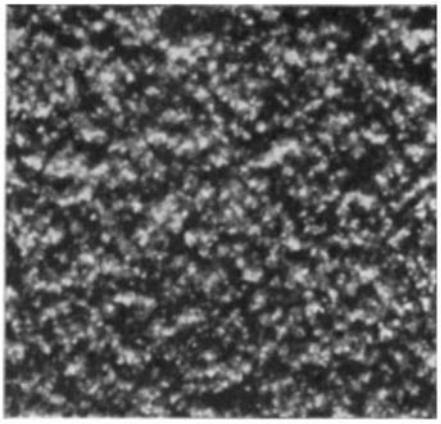
# CAMERA ANGLES

**Conducted by JACOB DESCHIN**

## The Wide-Angle Lens

WHAT'S the use of a wide-angle lens? Ask the man who owns one—the commercial photographer, the news cameraman, the just plain you-and-us chap in search of unusual effects even at the cost of distorted perspective.

Before we go into the use of the wide-angle lens, however, let us see exactly what we mean by the term and in what way it differs from the lens normally employed. We know that the "normal" focal length for a given size negative area is the diagonal measurement of that area. For example, a 3¼ by 4¼ inch film ordinarily calls for a lens having a focal length of 5¼ inches, while a 4 by 5 film, the size usually employed by news cameramen, should have a lens of about 6½ inches focal length. By this rule, therefore, if we were to use the 5¼-inch lens on the 4 by 5 camera, it would no longer be a "normal" lens; it would be relatively "short" for this camera, that is, it would be brought closer to the film plane and therefore include a greater area than the normal, provided it were so made as to give satisfactory definition over the larger area. Conversely, while we are at it, the 6½-inch lens employed on the 3¼ by 4¼ camera would be "long" for the latter; that is, the lens would be removed farther from the film plane than the normal lens and therefore include a lesser area than the latter.



A wide-angle "what is it?"

In general terms, this is the whole story on the nature of the wide-angle or so-called "short-focus" lens. In addition, it must be added that the wide-angle lens is characterized by a relatively greater depth of field, because of its short focal length, at any given distance from the subject; the subject may be approached closely enough to produce so-called photomacrographs or for the merely utilitarian purpose of copying small objects. Such a lens is ordinarily supplied with small maximum apertures to assure full coverage of the negative area without introducing distortion at the corners.

Wide-angle foreshortening

The commercial photographer uses the wide-angle lens in order to cope with "tight" assignments, such as the photography of small interiors and of buildings at close range, as well as for copy work; the newsman makes the "short" lens his normal equipment because his work generally involves surmounting space difficulties; it also permits him a wider guessing range for focusing on those frequent occasions when there is no time to use the ground glass.

An example of a tight-place situation that was overcome through the use of a wide-angle lens is shown in the illustration of the coin dealer behind his grating. The lobby just outside the grating was very small and would have created quite a difficulty for the photographer, who had to include as much of the grating as possible, had he not been ready for the emergency and had he tried to use a normal instead of a wide-angle lens.

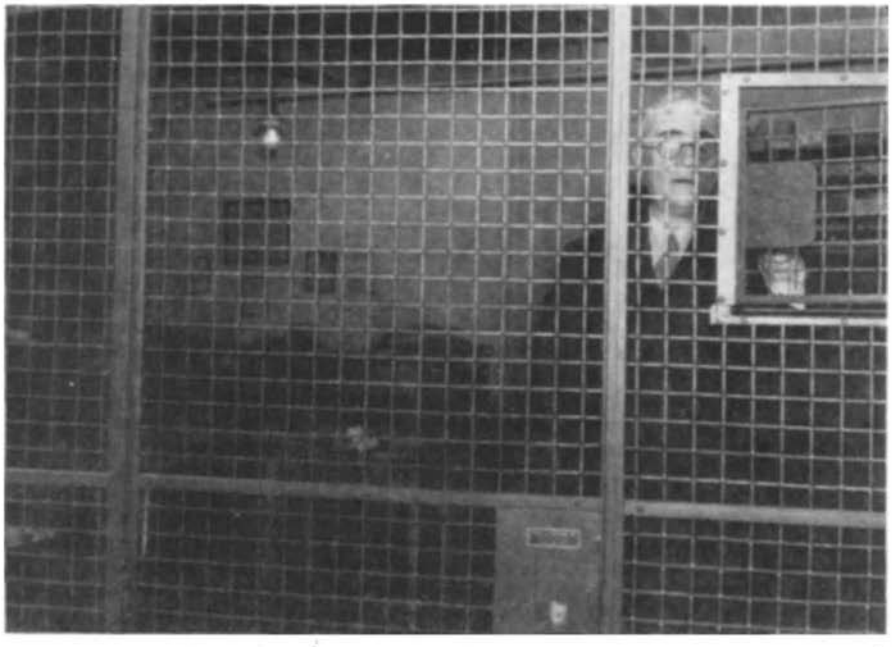
The close-up of the much-highlighted subject, actually the surface of a sheet of sandpaper taken at extremely close range with the light shooting from one side to show texture and bright highlights, is an example of the kind of thing that is often attempted with the short focus lens.

In pictorial photography, the foreshortening effect possible with the wide-angle lens is employed to good advantage in such subjects as that of the park walk illustrating this article. Reverting again to the extreme depth of field characteristic of the wide-angle lens, it may be mentioned that this particular shot was made from the hand with the lens stopped down only to F:11 and with an exposure of 1/25th second. Notice the satisfactory sharpness that prevails from the nearest to the farthest distance, with the exception of the narrow strip nearest the lens.

While it is not advisable to follow the procedure of the news cameramen in employing a short focus lens as normal equipment, the advantages and usefulness of having such a lens "on tap" for the out-of-the-ordinary occasions are self-evident.

## Theme Competition

HERE is a second opportunity for the readers of this department to win prizes by competing in a fascinating phase of the art of photography. Each month there is given a definite assignment in interpretive photography, to be fulfilled according to each individual photographer's own imagination or artistic ability. Prints submitted in these monthly competitions will be judged on the interpretation of a theme, as well as



Taken in close quarters with a wide-angle lens

on pictorial appeal and technical excellence. Each month two cash prizes—$10 for the first prize and $5 for second prize—will be awarded, and there will be two honorable mentions, each to be a year's new or extension subscription to Scientific American.

The simple rules of the contest are as follows: (1) All prints submitted must be mounted, the over-all size *of the mounting* not to exceed 11 by 14 inches. Prints may be any size from 3¼ by 4¼ inches up to the maximum area of the mount. (2) Not more than one print may be submitted by each contestant, it being left up to him to judge his own work, and to select the one which, in his opinion, best portrays the theme of the assignment. (3) Prints may be forwarded by any means desired but each must be accompanied by the required return postage. (4) No names or titles are to be placed on the face of the photograph; on the back of the mounting must be given the contestant's name and address, together with the name of the camera and of the film employed. (5) The competition will be judged by the conductor of this column and the editorial staff of Scientific American. 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. Prize-winning photographs will become the property of Scientific American to be used in any manner at the discretion of the publisher. (6) No entries will be considered from professional photographers. (7) Prints may be black-and-white or toned; no color prints will be considered. (8) All entries in the second Scientific American Theme Competition (May, 1938) must be in the hands of the judges by June 1, 1938. The results will be announced in our issue dated August 1938. (9) This competition is open to all amateur photographers who are not in the employ of Scientific American.

**MAY COMPETITION THEME: "HAPPINESS"**

The assignment for the second competition is "Happiness." In this case, the interpretation of the theme might involve the arrival of a check by mail, a group of children playing, a scene on lovers' lane, a workman at his chosen task, and so on to the limit of your resourcefulness. These hints are thrown out at random and are not necessarily to be considered as definite suggestions.

Address all entries: "Happiness" Competition, Photograph Editor, Scientific American, 24 West 40th Street, New York, N. Y.

Here is something well worth shooting at, both to test your sense of photographic interpretation in competition with others, and because of the prizes involved. Go to it!

*Watch for the third assignment next month.*

## Latitude of Kodabrom

THE latitude of the new Eastman Kodabrom enlarging paper was illustrated in a panel at the recent Kodak International Exhibit for 1938. The exhibit included more than 200 photographs on varied subjects selected from about 1000 submitted by amateur photographers in 19 countries.

The Kodabrom panel displayed six enlargements made from the same negative, and although the time of exposure in making the enlargement and the duration of the developing time was varied in each case, all six prints were identical in result. All six

enlargements were developed in D-72 of the same strength, with the exposure and developing time (in seconds) varied as follows:

| | Exposure | Developing Time |
|---|---|---|
| Print No. 1 | 7 | 120 |
| Print No. 2 | 10 | 90 |
| Print No. 3 | 14 | 60 |
| Print No. 4 | 18 | 40 |
| Print No. 5 | 23 | 35 |
| Print No. 6 | 30 | 30 |

## Flower Photography

INDOOR flower photography by artificial light makes a pleasant indoor exercise when "housebound" for one reason or another. While the lighting of a flower subject is not the easiest thing in the world (nor is the arrangement, for that matter), the way can be made much easier by the realization that the two principal features to look for are the display of texture and the representation of the flower's form. "Daffodil," for example, does, we believe, fulfill these two requirements, for the texture of the flower is revealed by light passing through the petals, and form is revealed by a suitable disposition of light and shadow. Two lights were used, one coming from the side, the other (a weaker light) from the top.

"Daffodil"

## Filing Prints

YOU can take it or leave it, of course, but here's an idea that may help somebody. You are familiar with the "expanding" envelopes that constitute a sort of portable filing case. These may be had in different styles of heavy material and in different colors, but this feature is immaterial. The point is: The pockets are separated one from another and each one is tabbed A to Z, 1 to 31, or whatever. That does not matter either. Sort your pictures out according to subjects, paste labels over the tabs, print in the name of the subject, such as Landscapes, Baby Portraits, and so on, and store your prints under the various headings.

## Film Kink for Leica Fans

IF ever you are obliged to use in a Leica camera the Contax "daylight loading" type spool, which is furnished with a perforated paper trailer at each end, here is the way to do it: attach the end of the paper trailer to the Leica take-up spool and insert

take-up and Contax spools in the usual manner of loading film, making sure, as under normal circumstances, that the perforations engage the sprockets. Close the cover and start turning the winding key, clicking off 14 or 15 "exposures." This will unwind the paper completely as well as two or three film sections for the usual precaution, bringing your first film section into place. When the complete roll has been exposed, it is not necessary to rewind into the original Contax spool; continue winding until the take-up winding knob no longer revolves. This will indicate that the paper trailer at the other end has been wound off the spool onto the take-up spool and you are ready to uncover the camera and remove the spool for development.

## WHAT'S NEW
### In Photographic Equipment

### MODEL C ARGUS

ENCOURAGED by the phenomenal success of the inexpensive Argus 35-mm camera, the manufacturers have now brought out a new model which, though costing double the price of the original Argus, incorporates many remarkable features for a camera of such low price. The new Argus ($25.00) includes the following: A built-in range finder of the split image, sextant type; a speedier lens—F:3.5 Cintar anastigmat; shutter speeds from 1/5th of a second to 1/300th; optical glass view finder; mount providing for quick interchange of lenses; film winder with automatic exposure counter. A complete line of accessories is available for this camera.

### PYREX GRADUATE

KITCHEN technique has invaded the photographic darkroom with the introduction by Willoughby's of the new 32-ounce Pyrex graduate ($1.00) for photographic use. This graduate has the advantage of permanent red graduations fused into the glass, facilitating easy reading. Its features include resistance to breakage from hot or cold liquids, no sharp edges, smooth inside and outside, wide top opening for easy cleaning and convenient stirring.

### AGFA FILM LOADINGS

TWO new Agfa film loadings have recently been made available, according to an announcement by the Agfa Ansco Corporation. One is the 30-exposure spool ($1.00) especially designed for the Robot camera and carrying duplex paper leaders and trailers. This is available only in Agfa Superpan. The other film is Agfa Hypan Reversible motion picture film, which is now made available on special order in 50-foot cassettes ($3.50) for the Siemens Halske 16-mm movie camera.

### FALCON CAMERAS

CHARACTERIZED as "a camera that is so simple to operate that no special knowledge is required, no complications to master," the miniature model Falcon camera ($3.98) has recently appeared on the market.

Also included in the Falcon line of Amer-

ican-made cameras is the candid camera model, equipped with the Wollensak F:3.5 lens ($21.50) or F:4.5 ($17.50), as desired, and taking standard Kodak 127 or Agfa A8 film to turn out 16 pictures to the roll. The camera has a built-in "spyglass" view finder, the case is of Neilite in ebony black, and all exposed metal fittings are attractively finished in brush satin chrome.

## Enlarger with Interchangeable Lenses

EXTREME ease of operation and unlimited scope, the latter due to the easy interchangeability of lenses, is claimed for the Exakt enlarger, an importation of Henry Herbert, of New York City. The Exakt is said to have all the conveniences of an automatic enlarger with the added attraction of an additional hairline adjustment that assures critical focusing.

Several models of the Exakt enlarger are available ($55.00 to $290.00), some with one lens and others with two or three, thus making it possible for the photographer to adapt his enlarger to the exact requirements of the job in hand.

## Negative Viewer

THE Mico Negative Viewer and Marker for 35-mm. negatives is announced by Mimosa American Corporation, priced at $6.50. The negatives are viewed greatly enlarged, permitting comfortable examination of 35-mm. negative strips in the preliminary routine of determining which negatives are to be enlarged and which are to be ignored. Negatives selected for enlargement are nicked with a notching punch for later identification. For even illumination over the entire magnified field an adjustable light diffuser (75 cents) is available for attachment to the viewer.

## The Dakko Enlarger

INCORPORATING many unusual features, the American-made Dakko enlarger is creating a widespread interest. Handsomely designed and easily manipulated, the Dakko ($69.50) is featured by a microscope-type elevator for quick adjustment of the height of the lamp housing; a micro-vernier adjustment is provided within the hood for perfect instantaneous focus. An intense and clear field of white light is assured by a small GE bulb, in combination with a diffusing lens. The bulb, 100-watt, has a life of 50 hours and is readily replaceable.

Another feature of the Dakko is the fact that the housing may be swung to stay in position at any point within an arc of 360 degrees, making it useful for enlarging to any size, up to photomurals. Ventilation is provided in the housing by an aero-syphon ventilator, which sprays the bulb with a constant stream of cool air. This syphon is equipped with heat dissipating fins.

Two methods of accommodating the lens are provided in the Dakko. One is an 18-

leaf metal diaphragm, perfectly light-tight and accepting any lens from ¾ to 3 inches in diameter without injury to the thread. Also, a lens plate is provided taking the regular Leica lens or capable of being adapted to receive the Wollensak lens, which is optional equipment with the Dakko.

A variable opening mask, finished in optical black and felt stripped to prevent any scratching in the negative, permits the use of negatives from the standard 35 mm up to 2¼ by 3¼ inches. A wing on the side of the housing holds the negative roll.

The Dakko has a 16 by 20-inch easel. This new enlarging camera, by means of a few simple adjustments, may also be employed as a copying camera to copy pictures, tracings, and so on.

## PHOTOFLASH

THE new Mazda Photoflash No. 7 will appeal to those news and amateur photographers who desire a longer flash and minimum bulb size. The small bulb is filled with finely-drawn aluminum wire and also contains a small piece of aluminum foil. The flash is so timed as to require no change in synchronizers adjusted for Mazda Photoflash Lamp No. 20. Its relatively long duration of flash will be welcomed also by users of curtain shutter types of miniature cameras, particularly for properly synchronized, high-speed shots.

## THE AGFA CLIPPER

EXTREMELY inexpensive, simple in operation and compact in design, the Agfa PD16 Clipper camera ($5.00) is receiving serious consideration from would-be amateur photographers who want to "feel their way" in photography before venturing the higher outlay demanded by the general run of modern miniature cameras.

The Clipper is made of pressed steel and features a new "pull-out" front. The camera uses PD16 film (same as 616), taking 2⅛ by 2½-inch pictures. The lens is a new type universal focus ("Unifo") model, while the shutter is the self-capping type giving both instantaneous or bulb exposures. Other features: hinged back and film spool guides that simplify the loading operation, and a built-in shutter release guard that prevents exposures from being made when the camera front is in closed position. The Clipper is finished with a grained black covering that is waterproof; exposed metal surfaces are finished in nickel and black enamel. Available accessories include color filter, portrait attachment, and leather carrying case.

## COMPLETE RETOUCHING SET

PURCHASING an outfit complete saves a fellow a lot of headaches. Usually he can buy the complete outfit more cheaply as a "piece" than if he were to purchase the individual items separately. Also, items are included which he would not have thought of purchasing but which prove mighty handy nevertheless. The Trojan Retouching Outfit, distributed by the Central

Camera Company, and priced at $3.00, is an example of what we mean.

"With the help of this new set," the distributors claim, "any picture can be improved and salon prints can be produced from apparently hopeless negatives."

An instruction book explaining the technique accompanies the set, which includes: 3 drawing pencils; 1 dram of Mercurochrome intensifier; ½ ounce of alcohol; ½ ounce of spirits of turpentine; 3 artists' brushes (No. 00, No. 1 and No. 3); one 6-inch metal-edged ruler; ½ ounce ammonia; ½ ounce pumice; ½ ounce varnish; 1 etching knife; 1 dram India ink; 1 dram white ink; 1 dram sepia ink; 1 art gum; 1 pencil eraser; 1 stump pencil. The outfit is packed in a metal box with a built-in mixing palette, the shipping weight being 5 pounds.

## Federal Enlarger

SINCE the process of enlarging miniature negatives has become practically as essential as the actual picture-taking itself, it is natural that some manufacturers are giving their closest attention to the perfection of enlargers for amateur use.

Advance announcement has been made by the Federal Stamping & Engineering Company of the introduction of their new Model No. 120 Photo Enlarger ($17.95). Among its many features is found the fact that it will take negatives from miniatures up to 2¼ by 3¼ inches. It has a Raynar 3-inch Anastigmat lens and will make enlargements up to seven times, linear. Other features include: an efficient and well ventilated illuminating system; calibrated easel; 16- by 18-inch baseboard; hinged type border maker and paper holder attached to baseboard bracket; four negative masks; 125-watt projector lamp; double diffusing plates for intensified illumination; built-in diaphragm with red filter; approved type control switch, cord, and plug.

## Darkroom Kit

INTRODUCED as a suitable developing and printing outfit "for every beginning amateur who wants an outfit that will serve as the nucleus of his darkroom equipment," the Agfa Darkroom Outfit No. 2 ($4.95) has been made available by the Agfa Ansco Corporation. The outfit includes three 5 by 7 steel trays covered with white acid-resisting enamel, a stainless-steel tray thermometer, two stainless-steel film clips, an 8-ounce glass graduate, one glass stirring rod, one 4 by 6 inch printing frame, a six-watt selenium safelight bulb, five M-Q developer tubes, ½ gallon size container of acid hypo and an instruction book.

# CAMERA ANGLES ROUND TABLE

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

***Q.* Is there any way of avoiding the labor of making test strips in enlarging? Could not some density meter measure negatives for exposure beforehand? —S. E. L.**

*A.* In the miniature field the Cargille Negative Integrator offers a generally accurate guide to printing exposure, while for these and other negatives, the Dremmeter Print Exposure Gauge has been found eminently suitable.

***Q.* Is it true that the larger the dimensions of the negative employed, the more critical becomes the factor of exposure? Little inequalities of lighting in small negatives are not so apparent, but in large negatives become glaring defects. In other words, does the larger camera require more skill in this respect than does the small one?—L. E. S.**

*A.* Poor lighting is poor lighting, no matter what the size of the negative; a poor exposure in either case is to be avoided as much as possible. Suitable lighting and adequate exposure are the essentials of all good negatives, whether 35 mm or 8 by 10.

***Q.* What is the longest telephoto lens one can use for hand-held exposures, without magnification shake in the negative?—J. K.**

*A.* Telephoto lenses of moderate focal length are often used in the hand without any trouble in this regard, although, generally speaking, it is best not to hazard a shutter speed slower than 1/100th of a second. In the main, the use of telephoto lenses in hand-held exposures depends on the ability of the individual to hold the camera steady during the exposure interval. When using lenses of extreme focal length it would seem the better part of wisdom to mount the camera—or lens mount—on some steady support.

***Q.* I find that the principal drawback in using the ferrotype process of drying glossy prints is the long delay in drying. Can you recommend a faster method than merely setting up the tins against a wall in a warm room?—E. C.**

*A.* An inexpensive electrically heated device similar in general principle to those used by professional photo finishers is available. Another method is to use the Quik-Heat electric fan, which dries glossy prints and makes them drop off the tins within 15 to 20 minutes when the fan is placed at a distance of about three feet from the tins. One amateur finds that he gets satisfactory results by holding the tin in suspension over a lighted gas ring. In any case, the best results are obtainable by thorough squeegeeing through a photographic blotter which absorbs a lot of the moisture and leaves the prints lying absolutely flat against the tin.

***Q.* I use D-72 developer in enlarging on bromide papers and make up a quart each time I mix a new supply of stock solution. I understand that in order to prevent oxidation of the developer it is necessary to fill the bottle to the top. Can you suggest a method of storing a quart of stock solution so that this danger of oxidation may be avoided after some of the developer has been used up?—C. S.**

*A.* D-72 is mixed 1 to 4 in bromide work, as you know. A good working solution is about 40 ounces for 8 by 10 or 11 by 14 enlargements. For smaller enlargements in a suitably smaller tray, 20 ounces of working developer may be sufficient, provided only a small number of prints are to be made. Coming to your particular problem, let us say that you make 8 by 10 or 11 by 14 bromides. Instead of using a single 32-ounce bottle, buy four eight-ounce bottles or eight four-ounce bottles and distribute the 32 ounces of stock solution in the four or eight bottles, as the case may be. Thus, every time you open a bottle of stock solution you will empty it completely. This will solve your oxidation problem; it will also save measuring out the required stock solution each time you mix new developer.

***Q.* How can I overcome the nuisance of vibration when taking pictures at home of still lifes, or other pictures requiring relatively long exposures?—H. F.**

*A.* Your question seems to imply that you have recently been experiencing some trouble in this regard and that your carefully made negatives have "come out" with evidences of camera shake, although you thought you had taken every precaution to avoid this. Floor shake is doubtless your principal trouble, so our best suggestion is that when you undertake any photography

of this sort at home, you do so after the family has gone to bed and street activities are relatively at a stand-still. With no one moving about the house to disturb a shaky floor and with yourself seated during the course of the exposure, operating the release with a long cable release, you should have no further trouble.

***Q.* What do you recommend as the most suitable wood to use for making a grid for a darkroom sink?—N. H.**

*A.* Redwood 1 by 2 inches has been found completely satisfactory. It is inexpensive and will stand up for a long time without warping.

***Q.* In developing miniature negatives do you think it is sufficient to test the temperature of the solution in the storage bottle and then pour it directly into the developing tank?—G. A.**

*A.* There is sometimes a real difference between the temperature of a developing solution while in the storage bottle and what it becomes when poured into a developing tank. It is suggested that the better method is to test the temperature in the storage bottle and, after bringing it to the point where it should be, pour it into the developing tank, where the temperature should again be tested. If it is then under or over the required temperature it should be brought up or down as required. When the temperature is just right, turn out the darkroom light, roll the film strip onto the reel in total darkness, immerse the loaded reel, cover the tank, and there you are.

***Q.* I'd give my hat to learn how to avoid forgetting to buy essential chemicals and other items when they have run out. Can you suggest something?—A. H. W.**

*A.* Let's have the hat. Simply have a pad handy in the darkroom, preferably hanging on a wall, with a pencil dangling close by, and write down your requirements whenever a particular supply is getting low. Make it a point to replenish that supply the same or the very next day.

***Q.* How can one overcome the illusion created by a brilliant, colorful ground-glass image in reflex cameras so that compositional values are not distorted by depth and color that do not appear in monochrome rendering?—J. L.**

*A.* This ordinarily comes with experience, for most reflex camera users eventually learn to disregard the colors and consider only the compositional and tonal values. In the meanwhile, you will probably find it useful to cover your lens with a blue filter when composing your subject, being sure to remove the filter before making the exposure unless, of course, the blue filter is required.

***Q.* Is it inadvisable to use an exposure meter constantly? Must it be considered a crutch for a cripple to lean upon and to discard as soon as possible?—S. E. L.**

*A.* You can take pictures without an exposure meter, to be sure, but you can do a better job with one. The more experienced the photographer, the less need he has for the constant use of a meter. Nevertheless, a meter is today being used even by men of long experience, for light intensities are often very deceiving and even the best find it useful to check up on their guesses before making important shots. The exposure meter is far from a crutch; it more closely resembles the friendly presence of a wise companion who invites you to listen to his counsel, at the same time encouraging you to do your own thinking. The more experienced you become in judging exposures the less you will need the constant use of the meter, but if you are wise you will never discard it, for when in doubt the meter will make it possible for you to say: "I know it is so" rather than "I guess."

***Q.* I seem to find it difficult to wipe dirt and dust off my enlarging camera after a period of neglect in this regard. What do you recommend?—K. B.**

*A.* Cheese-cloth and a dose of 3-in-1 oil is one of the best cures we know in this case. Not only does a good wiping with this oil clean the dirt from the housing, pillar, and so on, of your enlarger, but it imparts a pleasant, bright appearance that will surprise you. If, after once cleaning the enlarger properly with this treatment, you take a minute or so every time you use the equipment to wipe it off with a clean, dry, lintless cloth, you will find that the finish will remain clean and bright for a considerable length of time.

***Q.* What does one do about drinking water in the darkroom where every container may be spattered with developer or hypo spots?—R. M.**

*A.* A glass turned upside down on a clean shelf will always provide a clean receptacle. Or you can provide a peg set in the wall at an upward angle, over which the inverted glass is placed, out of the way and protected from spattering or dust.

***Q.* What is the difference between single weight and double weight paper?—D. K.**

*A.* Only the weight—and the price, the cost of the double weight being considerably higher than that of the single weight. The emulsion is the same. Some papers are available only in double weight and in that case, of course, there is no choice, but most papers may be had in either weight.

***Q.* When working steadily in the darkroom for a considerable period it sometimes happens that I run out of dry toweling. Possibly you have, too. What has been your experience?—W. J. A.**

*A.* The same, and here's the cure: Paper toweling on a rack. It is cheap, wonderfully absorbent, and singly detachable from the towel roll with one hand.

***Q.* Do you know of some effective method of imparting density to a thin negative without the bother of intensification?—R. S.**

*A.* While nothing can really take the place of a good intensifier, some workers have occasionally found that a fairly workable substitute in emergencies is the use of a light yellow filter capped over the enlarger lens. This prolongs the exposure, of course, though this disadvantage usually can be overcome to some extent through the use of a large diaphragm opening.

# TELESCOPTICS

## A Monthly Department for the Amateur Telescope Maker

### Conducted by ALBERT G. INGALLS

TUBES for telescopes afford opening for individuality of design, and those shown in Figures 1 and 3 are worth study for ideas. Figure 1 represents a 10″, *f*/8 reflector made by C. I. Mitchell, a dealer in sporting goods at Temple, Texas, and its tube rotates efficiently within the retaining bands on ball-bearing roller-skate wheels. It also rotates

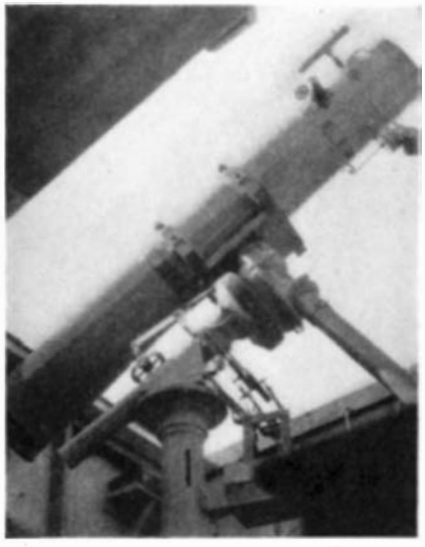


***Figure 1:*** **Mitchell, of Texas**

automatically when the tube is swung to new positions, because there is a low-hung weight near the upper end of the tube which keeps the eyepiece in a horizontal position. In the old days of sail many a sea-captain had just such an arrangement on his bunk, to keep it level. The polar axis is a differential housing with roller bearings, and the brake to make the telescope stay put when set on an object is applied to a brake drum attached near this housing. The declination axis is 3″ steel tubing—a generous allowance for rigidity. Weight of telescope, 700 pounds. There is a flea-power electric drive which works through a V-belt with idler. The finder was made from a 5.50-diopter spectacle lens plus the lens from a pocket magnifier, and the maker states that he found a sighting post inside the tube superior to cross-hairs. The telescope is mounted above a level garage roof, on a heavy wooden structure of posts, which does not touch the building, and there is a run-off roof over it. "Fifteen months of my spare time were spent to build this 'scope," Mitchell writes. He states that he would like to correspond with other amateurs.

FIGURE 2 shows the observatory and Figure 3 the telescope owned by Mrs. Marion Grant Bowen, of Carson City, Nevada, who was helped in the construction by a brother. The ground floor of the 16′ by 22′ observatory literally has the comforts of home—a foyer, dressing room, bathroom, and library. Many a mere man dreams of such a retreat, well out of shouting distance from domestic appeals for help and, as Ellison put the expression, "with a lock on the door and the key in his pocket." Access to the 11′ dome is by way of a hatch that opens outdoors, thus shunting warmed air away from the instrument. The telescope (Figure 3) is an *f*/6.9, 10″ reflector with unusually clean tube, built of cast aluminum rings held on Shelby tubing by opposing nuts. Internal diameter, 12″. Setting circles read to 5′ in R.A. and 1° in declination. There is a slip ring. Cell carries a 9-point floatation system. Altitude at Carson City is 4650 feet, with probably enviable seeing conditions. These data were furnished by Robert Blackmore, 132 N. Arlington Ave., East Orange, N. J.

AMATEURS who sometimes complain of disadvantageous working conditions may take renewed courage after studying Figure 4, which shows the sky-hole in the level roof of a typical Brooklyn residence, with the hatch cover off. William S. von Arx, 573 Monroe St., Brooklyn, N. Y., the author of the chapter on "Stellar Photography," in ATMA, nightly sits on a temporary cross-board at ceiling level 18″ below this roof and operates the equipment shown, getting

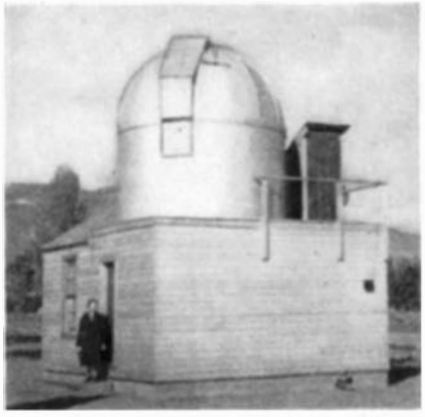


***Figure 2:*** **Mrs. Bowen, of Nevada**

excellent results despite the strong sky-glare of the great city. He describes this equipment as follows:

"THE photographic equatorial shown carries a 508-mm (20″) focus, *f*/6 Eastman Aerial objective, 3.3″ aperture which just covers a quarter plate nicely. The area of sky included per plate is about 11° by 14°, of which 10° square yields excellent definition—scale: 1 mm=400 seconds. The guide telescope mounted on the camera is a 72-mm triplet of 21.5 focus, provided with the usual reticle and a ¼″ eyepiece. The 'carbureter' attached to the lower end of the camera is a small clock which beats four times per second, permitting the observer to count seconds with more precision than 'one-chimpanzee-two-chimpanzee-three-chim . . .' and also relieves him of the necessity of removing his attention from the guide star in order to know how far the exposure has progressed. Near the clock is a thumbscrew for moving the plate holder in R. A.—multiple exposure plates. The rubber bulb and hose operates the 4″ Packard-Ideal shutter (square panel over the lens), which works with a reassuring clatter but without noticeable vibration. Exposures as short as 1/5 sec. can be successfully managed by biting the bulb. This method is often pursued in times of bad seeing. Operating the shutter with the teeth leaves both hands free for guiding; the latter being a busy business at times. More than this, a mental count is kept of the seconds during which the shutter is open.

"Since the mounting is unhoused it was necessary to make it easily demountable. To accomplish this the yoke simply pulls out of the north and south bearings, thus reducing the mounting to three easily handled units. One by one—according to a very rigid sequence—the parts are stowed below the roof level and the hatch cover drawn to. Three sockets were cemented to the roof when the polar axis was considered well set, so that the polar adjustment is identical each time. It has proved to be sufficiently accurate to continue exposures over two or three nights—taking the whole mounting down between times—without perceptible damage to the images even under microscopic examination.

"With the exception of moving parts, the camera and mounting are made entirely of wood finished with lead gray paint, so that it may be more easily seen at night. The camera is made of 1″ by 7″ clear white pine, the yoke and north pier of 2″ by 3″ Douglas fir, and the south pier of 2″ by 6″ clear white pine, all well seasoned, quite rigid and conveniently light in weight. Where necessary the wooden members are reinforced with heavy corner irons and lag screws.

"The clock drive built into the south pier is of somewhat unconventional design. Suitable worms being quite expensive, it was decided to use a friction drive instead. A smooth, accurate motion in R. A. is secured by a small round-belt pulley bearing directly

***Figure 3:*** **The Bowen reflector**

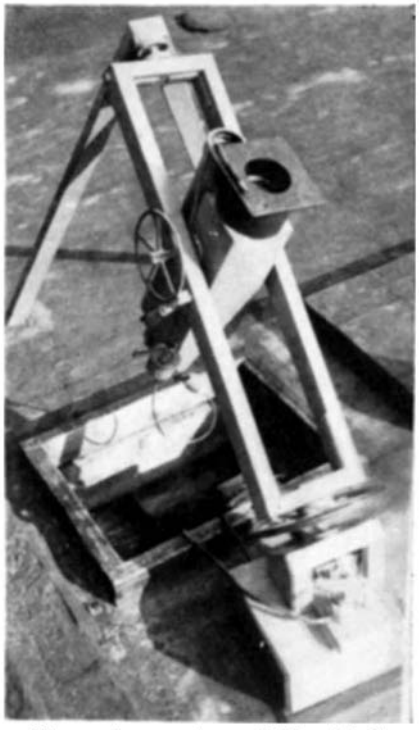


*Figure 4:* von Arx, of New York

on a large (12″) "V"-belt pulley having a length of 5/8″ o.d. high-pressure cord rubber tubing cemented in the groove. The small pulley is driven by a train of worms and gears originating in an electric phonograph motor. The ratio is such that the motor runs at about 40 percent top speed and 80 percent standard speed. For adjusting the rate of the clock a hand screw (on the right of the S. pier) which has a fine metric thread bears down on the speed control of the governor. On the left, next to the main switch, is a hand control which accelerates the motor any amount over the sidereal rate and holds it there—for widening objective prism spectra known amounts. On the north side of the pier is a third control within easy reach from the eyepiece, for momentary acceleration as needed in guiding. A switch on a length of cable 'cuts the gun' as necessary. With the second control down and this switch in hand, a star image can be made to commute between two lines in the reticle at a uniform rate as many times as is necessary to build up an image of a star's spectrum. With the switch 'on,' the image advances. When it reaches the end of its prescribed course the switch is thrown 'off' and the diurnal motion of the earth carries it back to its starting point. The objective prism spectrograph ($f$/4.5, 10.5-cm. focus, with a 60° crown prism) clamps on the east trunion of the Dec. axis at an angle of median deviation, which permits the guide telescope to be used on the star under observation.

"The camera is also equipped with a 15° crown objective prism, a 'normal' grating ($0.99\triangle m$) and a 90° prism for photographing the North Polar Sequence since it is in the blind spot of the mounting. This blind spot is a very definite disadvantage but, pound for pound, few mounting designs equal the stability of the double yoke. Then, too, as those who work with the Hooker telescope solemnly affirm, 'There is nothing interesting north of plus 67 anyway!' "

LEST new readers of the magazine now run away with the idea that, in order to

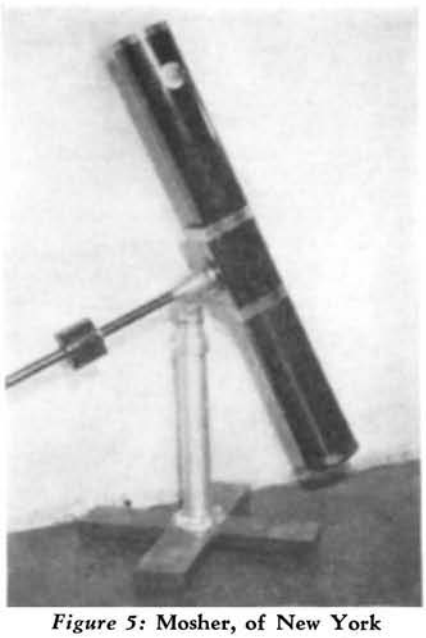


*Figure 5:* Mosher, of New York

be an amateur telescope maker one must be able to concoct creations like those just described, Figure 5 is inserted in order to show a more typical maiden effort such as those who successfully finish instruments of a more ambitious kind have themselves begun on. This is a 6″ reflector made by John J. Mosher, 26 Lansdale St., Rochester, N. Y., and the parts of the mounting are made up of pipe fittings—a reducing T, a short nipple, a 45° elbow, another short nip, and other standard fittings for the upright. As such fittings often have some looseness and shake, setscrews in tapped holes take this up. No blueprints for specific telescopes such as this are available, each instrument being the original design of the maker, based on general principles explained in "Amateur Telescope Making." Generally the beginner thinks his first telescope will be his only creation but the bug gets into his blood stream and he discovers he wants a new and more ambitious one about as often as his wife wants a new hat. Well, it will cost him something *less* than he would otherwise spend in the same time burning up gas on the road, overeating in restaurants, or making whoopee with some well-upholstered platinum or excelsior blonde in night clubs.

*Figure 6:* Hansen, of Massachusetts

WHILE a 6″ diameter is the optimum size for the beginner, a very few make 4″ or 5″ sizes and Figure 6 shows a 4″ "Baby Grand" made several years ago by J. P. Hansen, Framingham, Mass., who says it "works great," and cost "around $25." The stand is from an old drawing board, the patterns were homemade and the castings were made in a local foundry, while others were cast in aluminum in the home basement, using metal melted in the furnace, the molds being of plaster of Paris. Hansen wisely mentions that such molds must be thoroughly dried. He says he was over-anxious to get the mounting finished, poured the metal into wet molds and "the whole business blew up to the ceiling." This is an unusually trim little telescope with excellent, rugged design and attractive appearance and, though it is small, it has a much better mounting than the average beginner's No. 1 job usually is or even needs to be.

*Figure 7:* Wilson, of West Virginia

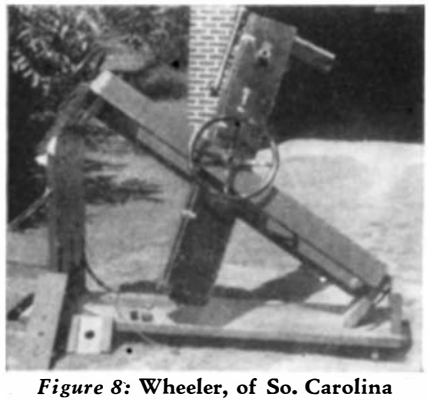


*Figure 8:* Wheeler, of So. Carolina

ANOTHER simple telescope—a maiden effort—is shown in Figure 7, this time an 8″ but with simpler mounting than the previous one. H. C. Wilson, 877 Chester Road, Charleston, W. Va., is the maker. Tube, galvanized iron with heavy wire rolled into the top for stiffening. Mounting, 4″ pipe fitting plus an old tree stump—very solid. Cost, $27.50.

SQUARE tubes for telescopes function as well as round ones and are much easier to make. Figure 8 shows how Paul Mowbray

Wheeler, Professor of English at Winthrop College, Rock Hill, S. C., converted a cypress box into a tube, adding scantlings in the form of a rectangle within which this tube, with its 7″ mirror, was pivoted. There are bearings at top and bottom ends of the rectangle ("double yoke" is the technical term for this) and the whole is a thoroughly efficient and rigid kind of mounting, simple to make, easy to take to pieces or erect, inexpensive. The world's largest telescope, the 100″ reflector at the Mt. Wilson Observatory, is mounted similarly. The large steering wheels on the two axes are the maker's idea, being used for turning the tube in declination, the astronomer's equivalent of latitude, and in right ascension, the equivalent of longitude.

ANOTHER double yoke mounting appears in Figure 9, the photograph having been sent in by R. P. Hassler, of R.F.D. 1, Leverne, Minn. The tube is of metal and the yoke and frame are made of steel channels and an old motor car chassis. This is a 10″ telescope—rather beyond beginner size.

"IF paint is applied to galvanized iron or zinc, it will peel off after a time, but the following treatment will make it stay on," according to Lawrence A. Cox, 47 Upper Green East, Mitcham, Surrey, England.

*Figure 9:* **Hassler, of Minnesota**

"Add ½ oz. dilute sulfuric acid to one pint of saturated solution of copper sulfate. If this solution is swabbed on to the metal liberally, it will immediately blacken the surface. It should not be wiped off but allowed to dry on, and the surface then given a coat of gold size. Afterward it can be dead-blacked or painted otherwise as necessary."

WHEN well-meaning friends insist on labeling you, even in public print, an "astronomer," often to your embarrassment, or where they do not realize what a real astronomer is and what an amateur astronomer isn't, the following quotation taken from an account of the life of the late Ambrose Swasey, the famous professional telescope builder, by Prof. J. J. Nassau and published in the *Journal of Applied Physics* (New York) might be read to them: "When once Mr. W. H. Crocker of San Francisco remarked, 'Why, Mr. Swasey, you are an astronomer,' he replied, 'When I was a boy, my father kept a great number of sheep and when working around the barn and with the sheep, some of the wool rubbed off on me, but that didn't make a sheep of me.'"

# CURRENT BULLETIN BRIEFS

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

DEATH BEGINS AT FORTY is a pictorialized record of the automobile accident problem in the United States during 1937. A number of interesting charts and diagrams show graphically what may happen to you if you are not "a safe driver." *The Travelers Insurance Company, Hartford, Connecticut. —Gratis.*

HASTELLOY—HIGH-STRENGTH ALLOYS FOR CORROSION RESISTANCE is a 36-page booklet that presents complete information on four alloys which have been developed to withstand certain severe conditions of chemical corrosion. Complete details are given regarding chemical and physical properties, available forms, methods of fabrication, and typical successful applications. *Write for Bulletin 538A to Scientific American, 24 West 40th Street, New York.—3 cents.*

PETROLEUM FACTS AND FIGURES, Fifth Edition, 1937, contains about 250 pages and is the first to be published by the petroleum industry trade association since 1931. Effort has been made to incorporate all pertinent data available regarding the industry, and much of the statistical data is presented in pictorial graphs and charts. The subject matter covers utilization, production, transformation of raw materials, transportation, markets and prices, and so on, covering the entire field of petroleum products. All information published in the first four editions is included in this one volume, with all data modernized. *American Petroleum Institute, 50 West 50th Street, New York City.—75 cents.*

KOPPERS SPECIFICATIONS is a booklet of particular interest to architects and engineers. It gives data regarding standard roofing specifications, including spray pond roofs which permit the re-use of water in air-conditioning systems and water-cooled roofs to insulate the upper floors of buildings. *Write for Bulletin 538B to Scientific American, 24 West 40th Street, New York City.—3 cents.*

THE WORKER IN GENERAL MOTORS, by Alfred P. Sloan, Jr., tells the story of employment in General Motors plants, particularly as concerns wages, hours of employment per year, and living conditions available. *General Motors Corporation, Detroit, Michigan.—Gratis.*

SAVINGS AND AMERICAN PROGRESS is a discussion of the relation of wealth-creating enterprises to employment and the American standard of living. Illustrated with a series of simplified charts. *Write for Bulletin 538C to Scientific American, 24 West 40th Street, New York City.—3 cents.*

AMERICAN PLANNING AND CIVIC ANNUAL is a 404-page book, stiff covers, presenting the best thoughts of specialists in civic planning and giving accounts of recent events which have taken place in the broad field of national, state, and community park and building programs. The price of the volume includes membership in the American Planning and Civic Association. Illustrated with a number of photographs. *American Planning and Civic Association, 901 Union Trust Building, Washington, D. C.—$3.00.*

EXPLOSIVES FOR FIELD CLEARING gives a description of practical methods of blasting stumps and boulders. The proper methods for placing the explosive charges for different types of stumps and boulders are described and illustrated with diagrams. Instructions are given for the protection of buildings. *Write for Bulletin 538D to Scientific American, 24 West 40th Street, New York City.—3 cents.*

VIVID PORTRAITS gives complete and specific directions for taking portraits with ordinary cameras. It tells how to avoid stereotyped treatment. *American Photographic Publishing Co., 428 Newbury Street, Boston, Massachusetts.—50 cents.*

AIR CONDITIONING, REFRIGERATION, HEATING is a compact catalogue describing equipment for these purposes in the home as well as in offices and industrial plants. Descriptive and dimensional data are included.—*Write for Bulletin 538E to Scientific American, 24 West 40th Street, New York City.—3 cents.*

BOAT AND MOTOR SELECTOR is a cardboard "slide rule" which tells at a glance just exactly what types of outboard motors can be used on certain types of boats. *Evinrude Motors, Milwaukee, Wisconsin.—Gratis.*

AN EXPERIMENTAL STUDY OF THE PROBLEM OF MITOGENETIC RADIATION, by Alexander Hollaender and Walter D. Claus, is the detailed account of careful, two-year experiments which seem to demonstrate that the famous Gurwitsch rays, often called "onion rays," concerning which as many as 600 scientific papers have been published, never existed! *National Research Council of the National Academy of Sciences, Washington, D. C.—$1.00.*

BULLETIN OF THE TEXAS ARCHEOLOGICAL AND PALEONTOLOGICAL SOCIETY, Volume 9, is a 244-page, illustrated annual containing a dozen papers describing archeological research in the western states. *Dr. Otto O. Watts, Hardin-Simmons Building, Abilene, Texas.—$3.00.*

INDUSTRIAL ADVANTAGES OF A PATERSON LOCATION is a survey of basic conditions in that New Jersey industrial center. It covers briefly the convenience of Paterson to markets, its proximity to auxiliary industries, transportation available, fuel and power costs, water supply, labor supply, and so on. *The Industrial Commission, Paterson, New Jersey.—Gratis.*

# LEGAL HIGH-LIGHTS

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

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

### Light but Strong

A RATHER important patent for an inside frosted electric light bulb was recently held to be valid and infringed, by the Circuit Court of Appeals for the Second Circuit. The patent, numbered 1,687,510, relates to an electric light bulb in which the interior surface is frosted in such a manner that the bulb is strong enough for commercial purposes. The Court found that many attempts had been made to provide inside frosted electric light bulbs prior to the patent in suit. Bulbs frosted in this manner, however, were so fragile that they would break when subjected to ordinary usage.

The inner surface of an electric light bulb is ordinarily frosted by subjecting it to a sand blast or to an acid etching bath. This results in a multitude of tiny pits or depressions in the surface of the glass. The inventor of the patent in suit discovered that it was the sharpness of the pits and depressions that was responsible for the weakness of the bulbs. He found that if he subjected the frosted surface to an additional weak acid bath for a short period of time the sharp angular pits and depressions were converted into rounded crevices and the strength of the bulb was greatly increased. As a result of this invention, inside frosted electric light bulbs became practical and went into extensive commercial use.

Prior to the patent in suit, focusing screens for cameras had been treated in a similar manner to obtain certain optical effects. No one appreciated, however, that the strength of an inside coated electric light bulb could be increased in this simple but effective manner. The Court accordingly came to the conclusion that the solution of the problem in this manner amounted to invention, and it sustained the validity of the patent. With regard to the apparent simplicity of the invention the Court stated:

"Like all problems when solved, it may be argued to be simple, but where, as here, it appears that the accomplishment had eluded the search of those interested in finding its solution until this inventor's contribution, he should be accorded the fruits of a patent for his accomplishment."

### Reversal

ON this page of the April, 1938, issue of Scientific American under the heading "Price Cutting," we discussed a rather important suit decided by the New York State Supreme Court regarding the so-called Fair Trade Act.

The Fair Trade Act permits a producer or distributor to fix by contract the resale price at which merchandise bearing his trade mark name or brand may be sold. The Act also provides that knowingly selling merchandise below the price fixed in the contract constitutes unfair competition. Similar Acts have been passed by many of the States and an Act providing for contracts in interstate commerce has been passed by Congress.

In the case decided by the New York State Supreme Court a retailer sought to take advantage of the provisions of the Act and brought suit against a competitor for selling merchandise below the price fixed by the manufacturer or distributor. The Supreme Court decided that the Act provided for vertical, as distinguished from horizontal, price maintenance and held that a suit for unfair competition under the Act could only be brought by the distributor or manufacturer.

An appeal was taken by the retailer to the Appellate Division of the Supreme Court and the decision of the lower court has now been reversed. The Appellate Division points out that the statute provides that an action for unfair competition may be brought "at the suit of any person damaged thereby." The court then concludes that the retailer was damaged by the price cutting of his competitor and accordingly under the express wording of the statute was entitled to maintain the suit.

In all probability an appeal will be taken to the Court of Appeals of the State of New York and the question of who may maintain a suit for unfair competition under the Fair Trade Act in New York State will not be definitely decided until the decision of the Court of Appeals is handed down.

### Incubation

THE Circuit Court of Appeals for the 6th Circuit has recently decided a suit of more than ordinary importance involving a patent for the method of incubating eggs. The Court held that the sale of an incubator capable of being used in accordance with the patented method, coupled with the distribution of catalogs and advertising matter teaching the use of the incubator in accordance with the patented method, constituted contributory patent infringement.

The patent in suit taught the method of incubating eggs whereby the eggs are maintained at a constant temperature throughout the incubating and hatching period. During the incubating period the air surrounding the eggs is maintained at a relatively low humidity while during the hatching period the air is maintained at a relatively high humidity.

The defendant sold an incubator which was capable of being operated in the manner described and claimed in the patent, and distributed catalogs to its customers describing the patented process. The Court found that this action on the part of the defendant constituted contributory infringement and enjoined the sale of any incubators "capable of being used to practise the patented method and directly or indirectly represented as being capable of such use."

This case is of importance because, even though the patent in suit related only to the method of incubation, the Court enjoined the sale of the incubator *per se*. Another interesting point was involved in this case. One of the defenses was that the method had been in public use more than two years prior to the application date for the patent and that therefore the patent was invalid. The Court found that whatever public use there was took place in Canada and accordingly rejected this defense because the defense of prior public use must be based upon use in the United States.

### Valid

IT is well established that in a suit for patent infringement brought by the purchaser of a patent against the seller of the patent, the seller cannot defend the suit on the grounds that the patent is invalid. The reason for this rule is to be found in equity and good conscience. Certainly a person who induces another person to purchase a patent should not be permitted later to assert that what he sold the second person was actually of no value.

In a recent suit for patent infringement decided by the Circuit Court of Appeals for the Ninth Circuit, one of the patents in suit had been sold by the defendant to the plaintiff, and as to this patent the Court stated:

"As to patent 1,511,699 it is clear that appellant by his assignment to appellee is estopped to deny the validity of the patent."

The defendant argued that this rule was not applicable to the present case, on the rather interesting theory that he actually did not have any interest in the patent at the time that he purported to sell it to the plaintiff. The Court correctly overruled this contention, however, and pointed out that the defendant agreed to assign, and purported to assign, whatever title he had to the patent and that this action gave rise to an estoppel to deny the patent's validity.

### Diaper Doll

THE popular dolls, which have been sold extensively throughout the country, which wear diapers, drink from bottles, and simulate some of the normal biological functions of a baby, have recently been involved in a suit for unfair competition. The plaintiff in the suit sold his doll under the name "Q-T Baby Doll," and its carton bore the following legend: "Drinks its bottle, wets its diaper."

The defendant sold its doll under the name "Beauty Doll Baby," and the Court found that it sold its doll in a carton similar to the plaintiff's, and that the carton bore a similar legend. The Court concluded that the defendant's conduct constituted unfair competition, pointing out that the name "Beauty" was similar in sound to "Q-T", and that the use of the same legend and style of package was likely to cause confusion.

# Books SELECTED BY THE EDITORS

## THROUGH SCIENCE TO PHILOSOPHY

*By Herbert Dingle, Asst. Prof. Astrophysics, Imperial College of Science and Technology*

AN outstanding book by a noted astrophysicist, who is equally noted for his incursions into the philosophy of science, and especially for his attacks on what he calls the "paralysis of the reason with intoxication of the fancy" of men such as Eddington, Milne, and Dirac, because of their tendency to arrive at irrational conclusions as a result of starting with convenient assumptions not based on actual observation or experiment. In this work he is also critical of Jeans. "I am frequently amazed," he writes, "at the easy assurance with which writers speak of the latest gropings of physics as though they were eternal verities." The average reader of the present book on science and common sense, the scientific method, time, causality, indeterminacy, free will, and current philosophies, will not find it light going, since it is "deep stuff." (363 pages, 5¼ by 9 inches, 18 illustrations.)—$5.20 postpaid.—*A. G. I.*

## THE MODERN CONJURER

*By C. Lang Neil*

ALL phases of modern magic are treated in the pages of this book, from the simple manipulation of cards through card tricks, tricks with coins, billiard balls, handkerchiefs, and so on, to parlor tricks and puzzles requiring no particular skill. The first chapters are devoted to the mannerisms and gestures of the performer, his clothing as it can best be adapted to his work of trickery, his wand, and the conjuring tables that are of such great assistance in modern magic. (386 pages, 5½ by 8½, profusely illustrated with photographs.)—$2.15 postpaid.—*A. P. P.*

## BRITTANY PATROL

*By H. Wickliffe Rose*

THIS is the sort of story which verifies the threadbare old saying that truth is stranger than fiction. It is an intimate account of the operations of the so-called "Suicide Fleet" which patrolled the waters of the coast of France to guard against submarines during the World War. (367 pages, 6 by 8¾ inches, 43 photographic plates.)—$3.70 postpaid.—*F. D. M.*

## THE ART AND SCIENCE OF MARRIAGE

*By Esther B. Tietz, M.D., Ph.D. and Charles K. Weichert, Ph.D.*

THE two authors are, respectively, resident physician at Longview State Hospital in Cincinnati and Associate Professor of Zoology at the University of Cincinnati, and the book has an introduction by Dr. Morris Fishbein, Editor of the *Journal of the American Medical Association.* Dr. Fishbein states that, while there have been numerous books on the same general subject written by psychologists, ministers, sexologists, and others, there has usually been overemphasis on some one aspect of it; the present authors' presentation is well balanced. Eighty percent of the text describes the body and its functions, including the reproductive system. The 20 percent by Dr. Tietz covers courtship and marriage and is so to the point and so practical that it could hardly be more so, since it does not mince even a word. Recommended, not to children or easily shockable elders, but to engaged couples. (269 pages, 8¼ by 5½ inches, unillustrated.)—$2.65 postpaid.—*A. G. I.*

## MANAGING YOURSELF

*By Milton Wright*

BOOTSTRAP book. Read it, do what it tells you and you will have succeeded in elevating yourself by your own bootstraps into a better personality—more able, more likable, therefore more successful. How to concentrate, strengthening your memory, also diagnosing that tired feeling and finding mental energy, organizing yourself, using your imagination, establishing confidence, acquiring physical fitness, learning to think straight, and, finally, managing other people—this is its scope. It is most readable, intensely human, practical, and applicable in our battles with everyday life to most of us who aren't entirely hopeless. It is suitable for self-analysis, is not just another inspirational book full of sweet sentiments, and ought to help almost anyone to improve himself. (319 pages, 5½ by 8 inches, unillustrated.)—$2.65 postpaid.—*A. G. I.*

## CHEMISTRY, MATTER AND LIFE

*By Stephen Miall and Lawrence Mackenzie Miall*

"WE have tried to describe in language that any educated person can understand some of the main principles of chemistry, the nature of matter, and some of the chemical changes that take place in living plants and animals," say the authors. The result is a very condensed summary—one to be suggested to those who are *reviewing* facts already studied. (292 pages, 7½ by 5 inches, 8 illustrations.)—$2.50 postpaid.—*B. M. N.*

## MOTION PICTURES IN EDUCATION

*By Edgar Dale, Fannie W. Dunn, Charles F. Hoban, Jr., Etta Schneider*

TEACHERS and administrators in various branches of education will find here a summary of the literature which has grown up around the motion picture as an aid in education. Such a background will assist these workers to evaluate what has been done in this field and to proceed to plan what can be done in the future with this modern educational medium. The book is divided into six parts: The Administration of Visual Aids; Teaching with the Motion Picture and other Visual Aids; Selecting Instructional Materials; Film Production in Schools; Experimental Research in Instructional Films; Teacher Preparation in Visual Education. (472 pages, 6 by 9 inches, unillustrated.)—$2.70 postpaid.—*A. P. P.*

## DICTIONARY AND MANUAL OF FIREWORKS

*By George W. Weingart*

SEVERAL years ago we had occasion to dig up a book on pyrotechnics for one of our readers and discovered at that time that they are scarcer than the proverbial hen's teeth. This little volume seems to be the first discussion of the subject which has been published in many years. It is useful primarily to those who have charge of fireworks displays at fairs, celebrations, and the like, for it gives instructions in the safe and most effective use of explosive types of fireworks, flames, and flares. There are also included quite a number of formulas for making colored flares, fusees, torches, and some other of the less dangerous display fireworks. An explanation of many of the chemicals used leads off the book and information is given as to where they may be obtained and the approximate price. This is a small volume, but is packed with information. (170 pages, 6 by 9 inches, illustrated with many drawings and several colored plates.)—$3.15 postpaid.—*F. D. M.*

## RETROSPECT

*By T. A. Rickard*

THE autobiography of a noted mining engineer and editor of mining journals of first rank. Replete with incident and color, travel and the romance that go with it. Inspiration for the youthful reader to go and do likewise—that is, to succeed—and for the older who read vicariously. Of vast interest to mining men. (402 pages, 6 by 9 inches, 4 illustrations.)—$3.15 postpaid.—*A. G. I.*

## OFF WITH THEIR HEADS

*By Victor Wolfgang Von Hagen*

A NARRATIVE of adventure among the head-hunters of the Upper Amazon. Woven in with the account are many anthropological sidelights on the food, dress, housing, superstitions, and customs of these people. (220 pages, 5½ by 8½ inches, 15 illustrations, map.)—$3.20 postpaid.—*A. G. I.*

## THE MODEL RAILROADER, VOLUME FOUR

*Edited by A. C. Kalmbach*

AS in years past, this volume comprises the complete series of issues of the magazine which is published for that large group of fans who delight in the intricacies of model trains and railroads. It is an attractive collection of data on the construction of locomotives and all the general equipment for model railroads. It is well illustrated with pictures and diagrams and

carries numerous advertisements of dealers in all the parts and equipment that may be needed. (480 pages, 10½ by 7 inches.) —$3.20 postpaid.—*F. D. M.*

### TELEVISION CYCLOPEDIA

*By Alfred T. Witts, A.M.I.E.E.*

DEVELOPMENT of the television art has brought with it a nomenclature peculiar to itself. In this volume the author lists those words and phrases, an understanding of which is necessary to an understanding of television in all its ramifications. An attempt has been made to provide concise knowledge, as distinct from mere definitions of words and phrases, and the attempt has been admirably successful. (152 pages, 6 by 9 inches, illustrated with drawings.)—$2.40 postpaid.—*A. P. P.*

### SCIENTIFIC METHOD

*By F. W. Westaway*

A MOST comprehensive thick chunk of a volume is this one—with a content affording prolonged and serious study. This omnibus of the scientific method is for those who wish to learn to think straight—the true "scientific method" we hear so much about and something that is most difficult to hold fast to even if the desire is present. Words and their elusiveness, the function of logic, induction, general principles of investigation, observation and experiment, the analysis of phenomena, hypothesis, probability, error—these are the subject matter of some of the chapters. Numerous others explain the systems of thinking of most of the great philosophers; still others quote long examples of good scientific thinking by great scientists and thinkers of the past and present. The author has a special flair for making difficult things as clear as possible. The serious "graduate" from this book will rightly feel that he has "been to college" and had his thinking processes melted down and recast. (588 pages, 5 by 8 inches, 35 illustrations.)—$3.95 postpaid.—*A. G. I.*

### OUR RHEUMATISM

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A SIMPLE and easily understood explanation of rheumatism and its allied conditions, written by a British author and physician who has himself been rheumatic. It also includes descriptions of some of the newer methods of treatment, such as the ultra-short wave, octazone gas and the traction couch. (106 pages, 5½ by 9 inches, 14 illustrations.)—$2.00 postpaid.—*A. G. I.*

### THE STORY OF TUNNELS

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### EXPERIMENTAL RADIO

*By R. R. Ramsey*

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### AIR CONDITIONING IN SUMMER AND WINTER

*By Richard E. Holmes*

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