APES BRED FOR SCIENCE

SCIENTIFIC AMERICAN

FEBRUARY
1939

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A DIGEST OF
SCIENCE & INDUSTRY
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AMATEUR PHOTOGRAPHY
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The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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NINETY-FIFTH YEAR • ORSON D. MUNN, Editor

CONTENTS • FEBRUARY • 1939

TWO of the apes, both females, of the colony of pedigreed "apes of science" described in the opening article of this month's number are shown on our front cover. One has a young baby at her breast and each is grooming the other. Momentarily, however, the chimpanzee at the right is distracted by the photographer. These and other apes are being bred to be used by psychologists, biologists, and anthropologists because apes are man's nearest animal relatives.

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OUR POINT OF VIEW

Astrology

A STATEMENT on this page last month explained why this journal does not conduct the scientific investigation of water witching or dowsing for underground water which is often urged by readers. Its editors are still more frequently urged to investigate and disprove astrology. This question has been given some thought.

As is made clear by the science of logic, any argument between two persons or sides on a given question must be based in final analysis on a premise which both sides accept in common. If there is none, there is no real meeting between the minds of the contestants—they never come to actual grips at all. The logic that flows on and on may be wholly flawless, yet, being based on differing premises, it merely agitates the atoms of the atmosphere. Most of the superheated arguments which we human beings get into (and enjoy, anyway!) are instances of this unobserved error.

Reduced to nakedness it seems to us that the argument about astrology falls in the same category: the scientifically minded and the occult minded cannot agree on premises in common. True, when cornered, the astrologer asserts: "You believe in the distant influence of gravitation between planets, don't you? Well, then. . . ." This, however, turns out to be a sort of pseudo-premise.

To us it seems unlikely that any kind of direct attack will knock out astrology, in the useful sense that it will succeed in knocking astrology out of the people who follow it. We scientific people might "disprove" it up to the hilt (if necessary) but still our disproof would not have the hoped-for effects. A surer though slower process seems more likely to be the constantly improving standards of general education.—*A. G. I.*

Sociological

NOT quite five years ago, the legislative experiment known as Prohibition came to an end. Preceding its demise by almost a year, an editorial in the June, 1932, Scientific American urged that quick action be taken by the government in concurrence with the rapidly growing sentiment of the people in favor of repeal. Our reasons were three-fold. First, we were aghast at the federal deficit of $903,000,000 that had piled up during the fiscal year 1931 and the prospect of another totalling two billions in 1932; and we predicted a government revenue, to use against these deficits, of a billion dollars a year from legalized control of liquor. There was also to be saved a large part of the enormous prohibition-enforcement outlay. Second, repeal would promote temperance! Third, the underworld would have, in repeal, amputation of its very great source of income—an income with which it had financed an unprecedented wave of crime and had seduced "the law" itself.

What, then, has happened in five years? Just this: all three of our predictions have been fulfilled. From liquor, the government realized revenues totalling a billion dollars in 1937. Temperance has made such headway that, in 1937, the American people drank just over a gallon of spirits per capita compared with two gallons in the normal, pre-war year 1916. Moreover, on this point, statements have recently been made to the effect that less liquor is being consumed in public and more in the calm atmosphere of the home. As to bootlegging, little need be said. Gone is the rum row that used to lie off each of our coasts; speakeasies have been reduced almost to the vanishing point; and still seizures have come down from 25,000 in 1930 to 11,407 in 1937. Bootlegging has, in fact, been demoted from the ranks of big business, and the few remaining "big shots" of crime have been forced to fall back into less lucrative, more easily detected rackets.

Sociologically, this experience should have a meaning for all those who think they know what is best for the American people and presume to translate their personal opinions into laws. It should show, for one thing, that our people are a pretty level-headed and dependable lot. Given personal freedom of action in regard to liquor, they have more than come up to scratch and shown their self control and temperance. Give them more chances to express their individuality, where this is now denied them by fiat, and they will without doubt show such evidence of temperate judgment and action as will redound to the benefit of all.—*F. D. M.*

Canals

FIFTY years ago the Panama Canal was still under construction and seemingly insurmountable obstacles loomed ahead. Regular readers of our feature "Fifty Years Ago In Scientific American" have caught glimpses of the troubles that beset de Lesseps and of the sentiment which, at that time, was growing strongly in favor of a Nicaraguan canal. We cannot here go into the political and financial machinations that made possible the final completion of the Panama Canal, but recent developments have once more opened the whole subject of marine transportation between the Atlantic and Pacific, particularly for our naval vessels and auxiliaries.

Pleas have been made for bomb-proofing the Panama Canal; agitation has been renewed for a second canal across Nicaragua, partly to relieve pressure on the Panama Canal in time of stress and partly to provide a second avenue for merchant and naval vessels in case of damage to the existing waterway. Such damage, particularly in time of war, would be disastrous since it would force our warships, troop-ships, and those carrying needed supplies and food to travel the extra thousands of miles around the Horn. Bomb-proofing the Canal is a large order, but it is obvious that every precaution must be taken to prevent disaster at any one of the many strategic points along its course.

On the other hand, a second waterway would be of great value in times of peace as well as in the event of war. It would go far to insure that marine traffic would be uninterrupted by any cause and would make doubly difficult the destruction of our invaluable link between the two oceans. The way is open for the construction of a canal across Nicaragua. This country holds a 99-year lease on the right-of-way. Experience in the construction and operation of the Panama Canal has taught many valuable lessons that could be applied in the work on another canal. As shown by a note on the "Fifty Years Ago" page in this number, the surveys of the Nicaraguan canal route had even then been carried out with great care and foresight "in marked contrast with those previously made for the Panama Canal."

With such a background, and with the advantages of Lake Nicaragua as a part of the proposed canal, there should be no untoward difficulties in pressing the work to completion. The way is open. The end is a desirable one. Our merchant vessels and our battle fleets must be assured of a safe passageway between oceans. And the route through the proposed canal would be some thousand miles shorter than the present course through the Panama Canal. The advantages of two canals are obvious. May the powers-that-be see with a clear eye and do their utmost to bring to completion a project that will be of tremendous value to the United States as well as to the commerce of the entire world.—*A. P. P.*

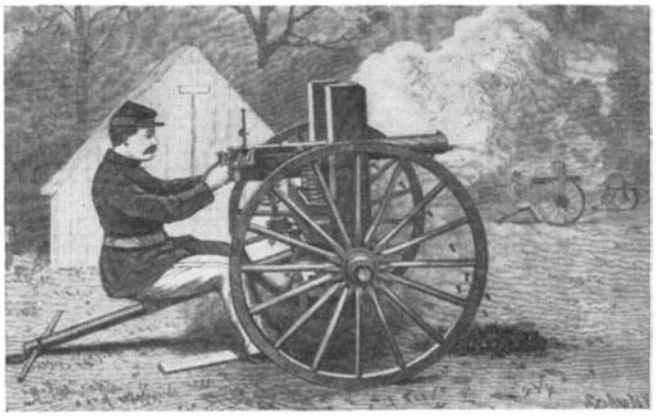
50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of February, 1889)

CANAL—"Every discouraging report, for the past year or two, touching the probability of the completion of the Panama Canal, commenced by M. de Lesseps, has caused public attention to be yet more earnestly attracted to the Nicaragua Ship Canal project. The great difficulty and the enormous cost of the work thus far done at Panama have compelled those interested in the Nicaragua route to be extremely thorough and careful in their surveys and estimates, which have been completed with a detail that is in marked contrast with those previously made for the Panama Canal."

MACHINE GUN—"The Maxim gun . . . has met with marked success, and has been adopted by nearly all the European powers, including England, France, Germany, Italy, Switzerland, Austria, and Russia. The gun is soon to be tested at the proving grounds at Annapolis, with a view to procuring its adoption by the United States government. The speed of fire of the rifle caliber gun using the American cartridge is very high, being 700 per minute. The one



pounder will discharge 400 shots per minute. A six pounder adapted to fire shrapnel and grape canister will discharge at the rate of 150 per minute. . . . The Maxim automatic mitrailleuse is so constructed that, on firing a single shot to start the gun, the force of the recoil is utilized for extracting the empty cartridge case and for effecting the various operations necessary in reloading and again firing the arm."

EXHIBITION—"The first impression one receives on a general survey of the Paris exhibition buildings is an exceedingly favorable one. There is a something about them that is pleasantly impressive, and this feeling augments as one passes through the various departments. . . . It is reported . . . that Edison proposes to span the machinery department with a rainbow of incandescent electric lights, which would, without doubt, be a most effective exhibit."

ALLIGATORS—"The alligator of the South, like the buffalo of the West, is likely soon to become extinct. The slaughter of the alligator for its hide, like the slaughter of buffaloes for their hides, has been so great that it may be only a few years before the lonely lagoon of Florida will have lost its last survivor."

SMALLPOX—"In Paris, where the law requiring vaccination is feebly enforced, the mortality from smallpox ranges from 1.36 to 10.0 to the 100,000 inhabitants, while in the principal German cities, where the vaccination laws are rigidly enforced, the death rate is but 1.44 to the 100,000 inhabitants. London, under compulsory vaccination, has a death rate from smallpox of but 0.6 to the 100,000 inhabitants."

PIPED WIRES—"The Consolidated Gas Light Co., of this city, some years ago, in laying a gas main, took advantage of the opportunity to introduce a telephone line in it, suspending it from insulators within the main. Excellent results were attained. On recently opening the main the wire was found to be coated with naphthalene, but the line as such was intact."

CIGARS—"There are 1,800 cigar factories in New York City. Of these the great majority employ from one to fifty hands each. Large factories, of which there are 350, employ from 50 to 500 hands, while the largest class of factories, of which there are only ten, employ from 500 to 1,000 hands."

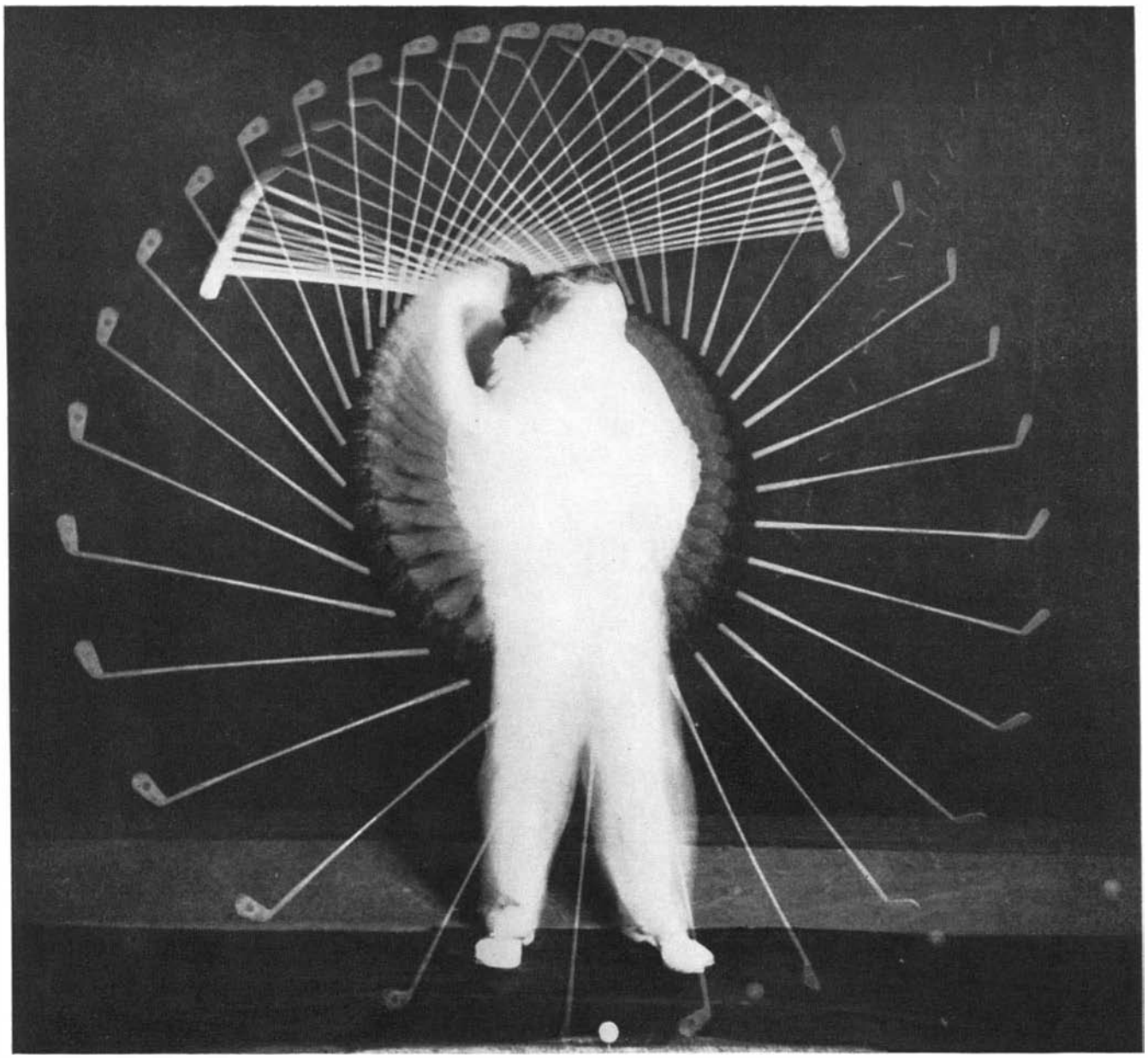
VERSATILE—"A well recently bored for gas at Pittsburgh delivers fresh water, salt water, and gas at same time. There are two casings, one within the other; the outer one, 100 ft. down, taps a fresh water stratum, while the inner pipe reaches the salt water and gas at 200 feet down."

TALL—"The Eiffel Tower in Paris had reached a height of 761 feet on January 9, 1889—the highest structure upon the globe."

WIRELESS—"When we contrast the present state of electric science . . . with its condition a year ago, we are struck with the remarkable advances that have been made. . . . The most important experiments bearing on the theory of electricity have been those of Hertz on the propagation of electrical disturbances. . . . Hertz has obtained electric oscillations of a very short period—several hundred millions in a second—and he has shown that electro-magnet waves caused by them are propagated in the surrounding space, and are reflected and interfere with one another as do waves of light."

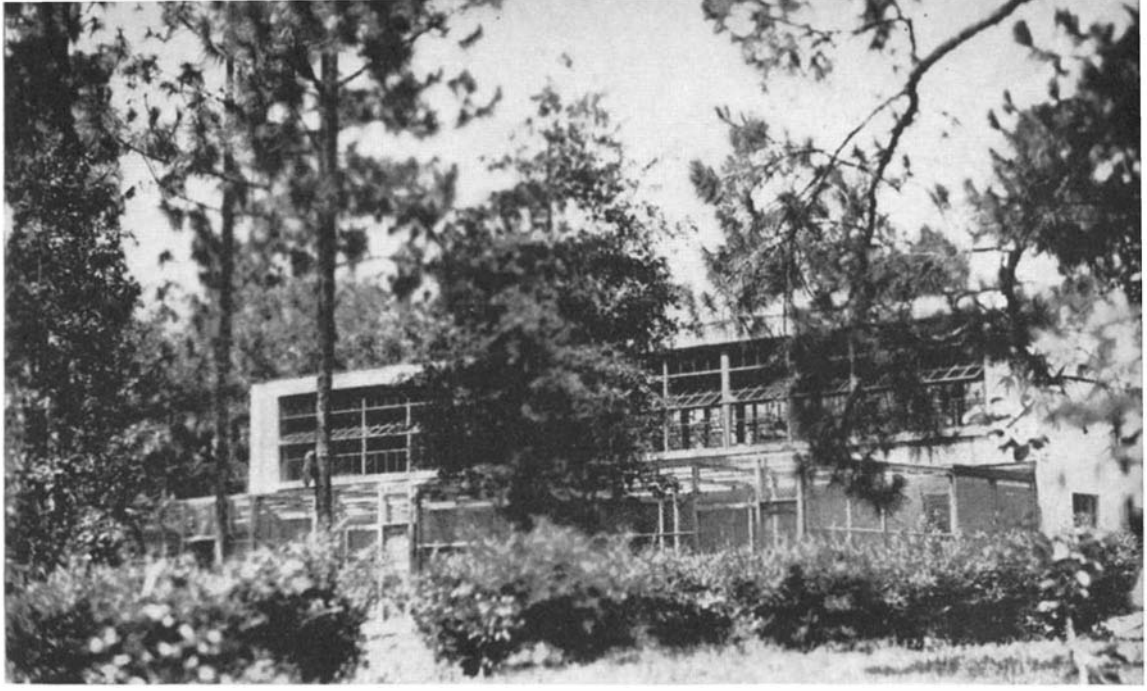
REFRIGERATION—"The refrigerator cars in which meat is brought from Western stock yards to Eastern markets are 29 feet long inside, 8 feet 2 inches wide inside, and 7 feet 2 inches from the floor to the cross beams to which the hooks are fastened, above which is a space of 14 inches to the roof. At each end are galvanized iron tanks filled with a mixture of pounded ice and coarse salt. . . . The cars are iced the day before shipping, refilled just before loading, and are iced again every twenty-four hours at regular stations on the route."

CLAY—"Electricity is being more and more used for the purification of kaolin and other porcelain clays. The clay is sifted on to a rapidly revolving horizontal plate, which is surrounded with powerful electro-magnets, which retain the particles of iron. . . . The process is said to be comparatively cheap and very rapid, and since its introduction many clays hitherto rejected as containing too much iron have become of value for the manufacture of pottery."



PATTERN OF A GOLFER— BY PHOTOGRAPHY

MORE and more industrial problems are being solved by the ultra-speed photography process developed by Dr. Harold Edgerton at Massachusetts Institute of Technology. To the manufacturer of golf balls and clubs, for example, the above photograph from the newly established Research Department of A. G. Spalding & Bros. has an important story to tell. In making it, the camera shutter was opened and, as the golfer started his swing, an intense light started flashing so that each flash caught the club in a different position. Here, each exposure was made at a speed of 1/100,000 of a second. The teed ball, of course, was registered on the film with every flash during the downward stroke. The golfer did hit it—and the ball flies off to the right. Note the upward flight of the tee. as well as the angle of the club face and the fact that the golfer lifted his head!



The Laboratory Building of Yale Laboratories of Primate Biology, Orange Park, Florida. Here in cleanly cages chimpanzees are being bred for the uses of science, as experiments made on the apes may be of greater value to biologists, anthropologists, and psychologists than those in which dogs, rats, guinea-pigs, monkeys, and other animals more distantly related to human beings are employed

DATED CHIMPANZEES

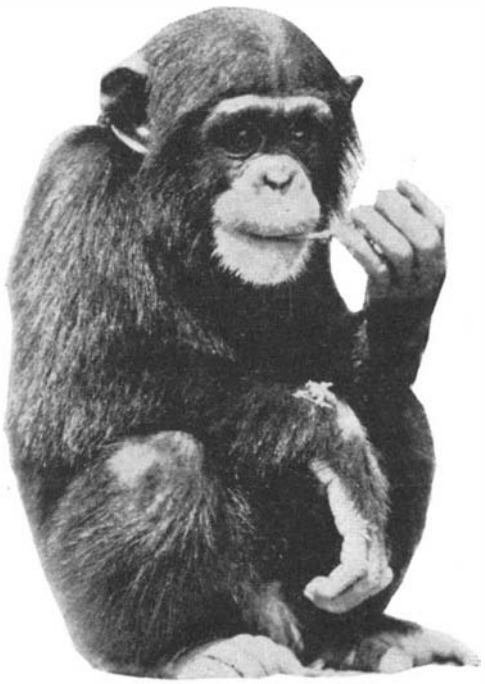
Yale's Ape Colony, in Florida, is a Laboratory in Which Discoveries Directly Applicable to Man are Being Made on Man's Closest Relative, the Ape

FLORIDA boasts the world's strangest colony—dated chimpanzees. In the salubrious atmosphere of subtropical Orange Park, there jabber, leap, climb, shriek, mutter, and multiply dozens of pedigreed anthropoid apes.

And, incredibly enough, in this flourishing colony, these startlingly man-like creatures are to be bred—or rather, manufactured—to specification. A standardized, all-purpose ape is the ideal laid down in the blueprints. Nowhere else in creation is there such a laboratory.

If, some fine day, you should drive through the balmy and luxuriant northern Florida countryside, and at last reach the low and spreading buildings of this great laboratory—for great laboratory it is, and not a zoo—you would readily single out cage after cage of squat, dark, hairy figures—babies, youngsters, and adults—loafing in the shade or waddling clumsily about in the sunshine. Coming closer, you could not help noting how bright-eyed, healthy, and clean is this animal colony. And you would observe no scratching of fleas. Indeed, each cage is well-kept.

Perhaps with astonishment, as you watched the attendants going about with food, apparatus, and notebooks, you would absorb the significant fact that human beings rarely get more careful consideration or more individual attention. Indeed, the colony was founded because these apes are among the most manlike of all creatures—and because an eminent scientist had the fortunate idea that the more like human beings these animals are treated, the more the discoveries directly applicable to human problems.



The chimpanzee who showed where his gums ached. Moos in his fifth year

"A single chimpanzee wisely used may be worth more than thousands of guinea-pigs," says the moving force and guiding genius behind this unique undertaking, Robert M. Yerkes, a distinguished professor of biology at Yale University. "The primary intent of the administration is to produce chimpanzee subjects which by type, breeding, rearing, and general adaptation shall be pre-eminently suitable for research purposes in lieu of human subjects." The laboratories are under the auspices of Yale University and have been supported financially by the Rockefeller Foundation.

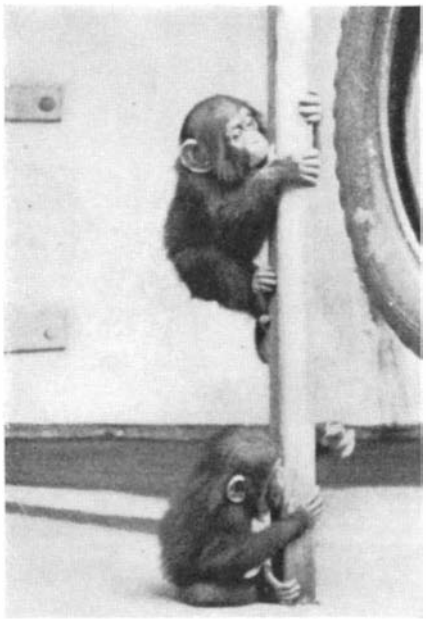
There are countless human problems of utmost importance which are vitally in need of solution but upon which research simply cannot be carried out with human subjects. Such experimentation must deal with dire diseases, including syphilis, and with the brain and problems of behavior, as well as with the more intimate aspects of glands, sex, and reproduction. The ape must come to the rescue of man.

How strikingly human the chimpanzee is at heart—especially after his confidence in investigators and their good will has been brought to a high point over a period of years—has astounded even Dr. Yerkes. He relates an actual incident to drive the fact home.

Moos, a young male, had been ill, and was convalescing. But he was evidently still in pain and would refuse all solid food. Moos had already been given repeated close examinations. His attendant, however, determined to find the source of his pain. Refusing solid food suggested a toothache. The investigator went into the cage to

By BARCLAY MOON NEWMAN

look Moos over once more. The young chimpanzee greeted him cordially, and calmly, even hopefully, submitted to the new examination. Yet the investigator could see no evidence of dental difficulty. Shrugging, he turned away to open the door and leave. Moos thereupon reached over and plucked the attendant's coat, drawing him back. Then he poked up his upper lip with a finger of one hand, and with a finger of the other hand pointed to a spot on his upper gum. Peering in-



The twins—only chimpanzee twins known—enjoying a playing spell

tently, the attendant was at last able to discern a swelling. A new tooth was about to break through. And Moos thus solved his own difficulty.

Perhaps still more remarkable, the chimpanzees soon learn that no harm is meant them even during uncomfortable experimenting and, like Moos, will eagerly try to help the investigation along. When Fifi has several times been made to sit down at a table and has been afterward trussed up with complicated apparatus, from which stimuli may mysteriously come, one day she rises to the occasion in true ladylike fashion. Upon being introduced into the experimental chamber, she walks to the table, seats herself in the little chair, placidly folds her arms and waits for the investigators to truss her up and perhaps shock her with electric currents.

Also, with almost human intelligence, they learn to obey spoken commands, gestures, and gentle shoves. Often it is feasible merely to go through the motions of what is expected of the ape, and he or she will react by imitation of the investigators' actions. Of course, when Fifi, Moos, and Mimi do their chores admirably, they are rewarded suitably with a banana or an orange. Next time, their confidence increasing, they are successfully encouraged to do more difficult tasks.

In fact, affection, and ludicrously even deep sentiment, may spring up in the maturing chimpanzee's heart and the eager creature will attempt to outdo himself. Further, sentiment may go so far as to prove decidedly embarrassing—hugging and kissing and little love-taps are demonstrations of the surging emotion within. On the scientists' part, the chimpanzee youngsters are treated like so many children.

Under this regime of extraordinary care and sympathy, and of research into the manifold difficulties and unknowns incident to undertaking the production of apes, the colony has indeed flourished. At the start, in 1925, there were only two chimpanzees, of opposite sex. Today, the population is approaching three score.

So, for more than a decade, increasing numbers of chimpanzees have been maintained alive and healthy in captivity. Their handling and rearing have been so successful that they have multiplied rapidly. This demonstrates how scientifically and painstakingly the enterprise has been developed.

THE chimpanzees are subjected to a rigid routine—so that they have enough exercise, a diet making for health, and sufficient repose. Their diet has been given intensive study—perhaps more study than any other factor. Not only are the calories measured, but each essential nutrient—carbohydrate, fat, protein, mineral, and vitamin—is provided. Few groups of human beings are better nourished.

Strict hygienic measures are unbreakable law. Well-groomed are these apes, and quite free from vermin. Mental hygiene, too, is not neglected. No chimpanzee is ever teased or otherwise unnecessarily annoyed. Over-excitement of these charges is avoided. And throughout its entire life, every creature is kindly treated.

At present, and for a long time to come, practically all these thoughtful procedures on the part of the apes' supervisors are directed toward the eventual mass production of a standardized chimpanzee. The ideal called for in the blueprints has its features as carefully detailed as those in any set of plans for a new model car. The records of every series of experiments carried out with the aid of any given ape are analyzed laboriously in the light of this ideal.

"The ideal chimpanzee must be small and robust," states Dr. Yerkes, who then adds a multitude of other characteristics to be established by careful breeding and selection. The ape must be disease resistant—"preferably with varied specific immunities" to diseases. Reproduction must be rapid. And he must not take too long to grow up and reach maturity.

Intelligence is important. Furthermore, Mr. and Miss Chimpanzee must understand how to behave himself or herself though shifted from one environment to another. He and she must be active, yet not destructive; co-operative, emotionally stable, dependable, and kindly disposed towards the world in general. On the whole, the ideal ape is easy to handle, being ever calm but capable of warm friendship.

Finally, the ideal race not only is to breed true to type (or standard) generation after generation, but also is to be a producer of twins.

Why twins? In twins are hidden untold treasures for the searchers after the secrets of heredity and of the environment's influence in modifying heredity. In human twins, the vast and almost immeasurable hereditary differences between human beings are reduced to a minimum. The study of a pair of twins, particularly if reared in different environments, tells scientists a great deal about what traits and talents are fixed by heredity and what influence a poor or a good home or education or group of contacts may have upon inborn character. Such studies have already transformed the science of criminology as well as many another important social investigation. So, chimpanzees being remarkably similar to men, chimpanzee twins can be expected to carry on the profitable work.

Thus far, only one pair of twins has blessed the colony. But this pair marks

Chimpanzee family, mother holding the baby as in playful display

an important beginning. The capacity for producing twins may run in families. Hence these twins, properly mated later with other twins, may give rise to apes given to twinning.

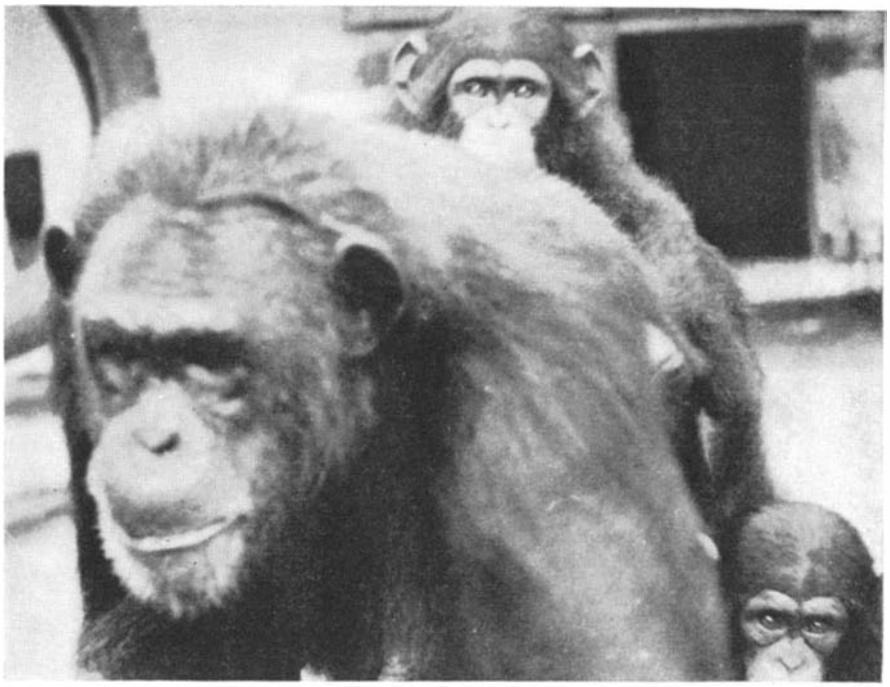
Along other lines, significant discoveries applicable to man have already been made by using chimpanzees. The staff of investigators has contributed many new facts concerning the processes of learning, the development of intelligence with increasing age, and the power to adapt oneself to changing environments. In most respects human behavior

is not by any means fundamentally different from behavior in higher animals. Moreover, observing animals always gives excellent leads towards the secrets of basic human emotions, attitudes towards new companions and new situations, and personality as a whole.

Observing a steady stream of near-to-human-type births in monkeys and apes is today providing the medical specialists with knowledge concerning birth problems. That such discoveries are being made and are of vital meaning to man is not surprising. Never before have medical experts been able to approach so close to certain features of childbearing or been able to experiment so searchingly in this field.

A great list of experiments has already been drawn up in this early stage of the program. The invaluable investigations should proceed, ever more fruitfully, as the colony continues to increase. After a decade, the success of the colony and of the plans for it have been proved. A major scientific and medical feat is being achieved.

Like all pioneers, Dr. Yerkes has been first a dreamer, and then has found in his dreams inspiration for action.



Mona, the mother, and her boy and girl twins, photographed when one year old

TWO decades ago, while musing upon the search after the secrets of life, and especially human life, he spotted a failure on the part of his fellow scientists. Everywhere biologists, psychologists, and medical investigators were studying the structure, vital chemistry, and diseases of animals—guinea-pigs, rats, monkeys, sometimes (rarely) chimpanzees. With what wonderful precision these investigators were working! How accurate all the vast and delicate modern laboratory equipment! How marvelously keen and sensitive these innumerable gleaming 'scopes!

But just here a startling thought flashed into his mind. Precision instruments were, throughout the scientific world, being used on biological specimens—primarily so that the resultant discoveries could be applied to man. Yet upon what sort of specimens were all these painstaking observations being made? Here was the surprising neglect.

The alley cat, the stray dog, a monkey kidnapped in the jungle, pondered Dr. Yerkes, are the utterly unknown specimens upon which precision measurements are being wasted. Who knows the history of such specimens picked up haphazard—often diseased, of unknown age as a rule, probably often abnormal in ways disastrous to true scientific precision? And as for any of the forms most closely related to man, they are obtainable only with the greatest difficulty—and when obtainable are decidedly the most haphazard of all specimens. All available apes were simply snatched from the jungle or bought from natives.

Strikingly poor specimens make all findings strikingly poor—the highest scientific care comes to nought where thousand-dollar instruments are turned upon ten-cent specimens. And often it is a far cry from the guinea-pig or the albino rat, or even the monkey, to the high estate of man.

"Truly," asserts Dr. Yerkes, "extraordinary risks have been taken." After new drugs are found beneficial in animal maladies, they are tried out on human beings. But who knows to what sort of animal this new drug is really valuable? It may be to an abnormal animal—the exception—or only to some lower creature at most distantly related to man.

Now Dr. Yerkes was, and is, more than a mere biologist. His speciality is that remarkable field, psychobiology, whose grand attempt it is to explore the influence of bodily processes upon mental characteristics and behavior and, at last, problems of society. And in this work, which is so closely bound up with human interests and the entire science of man, he had come to study the ape as a form more like man than any other living thing. The chimpanzee had been his choice—really had to be the anthropoid for his experiments. Gorillas are almost unobtainable. Orang-outans are sluggish and solitary. Besides, the chimpanzee is the ape most tractable, most adaptable to conditions of captivity, the least expensive (though still costly), and is by far the best understood scientifically—as to anatomy, living processes, nutritional needs, reproductive peculiarities, and general personality.

And so, not denying the possible future use and possible peculiar advantages of the gorilla and orang-outan—advantages still to be discovered—Dr. Yerkes looked to the chimpanzee. And the chimpanzee, we see, has not failed him.

Years were spent in planning the program, including methods of keeping the animals alive and healthy, and means of bringing about successful multiplication. The blueprints of the ideal were finally worked out. To these specifications the chimpanzees were eventually to be molded through wise breeding procedures. Northern Florida offered the most favorable climate.

IN 1925, a young male and a young female were bought from a dealer, who had brought them in from Africa. Of course, these creatures—the Adam and Eve of the Florida Eden—being taken in the jungle, had no pedigrees. Still, a start had to be made somewhere. At any rate, Adam and Eve turned out to be fairly satisfactory and quite healthy. Later, several additional apes were purchased. But meanwhile, natural reproduction under the favorable colony conditions commenced. Infants began to appear, not merely healthy but happy and friendly as they developed into chimpanzee children, from birth accustomed to friendly man. Now there have been more than a score of perfect births—including the birth of the twins who may give rise to a dynasty of twinning apes.

The standard, all-purpose chimpanzee, peculiarly fitted for scientific experimentation and perhaps for later (though still uncertain) routine tests in hospitals—to save the lives of countless men—is on the way.

"The aim," Dr. Yerkes tells us, "is to create a breeding colony which shall have only dated individuals of known history and condition."

A Faster Army Rifle

Garand Semi-Automatic Rifle Adopted by U. S. Army . . . Self-Loading . . . Fires Clip of Eight Cartridges . . . More Rapid Fire, Gun Held on Target

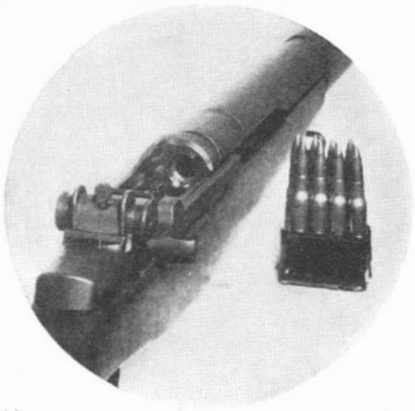
FOR many years the Ordnance Department of the United States Army has devoted an intensive effort toward the development of a satisfactory semi-automatic, or self-loading, rifle. Such a rifle would omit the side bolt of the present Springfield and permit the individual soldier to fire an entire clip of cartridges without once removing the butt from his shoulder. A distinct advantage foreseen would reside in the soldier's ability to hold his rifle on his target without the necessity, as with the Springfield, of dropping the gun to the port position to slide the bolt by hand. It would be necessary for him only to pull the trigger for each shot.

Some years after the World War, the search for such a weapon narrowed down to a caliber .276 rifle. Before a final decision was reached on this weapon, a caliber .30 semi-automatic rifle was completed after many years of work by John C. Garand, a designer in the employ of the Ordnance Department at the Springfield Armory. The results of tests on this weapon were so excellent that the caliber .276 was abandoned and the Garand semi-automatic rifle adopted as the standard weapon for the United States Army. During the next few years, our entire Army will be equipped with this weapon.

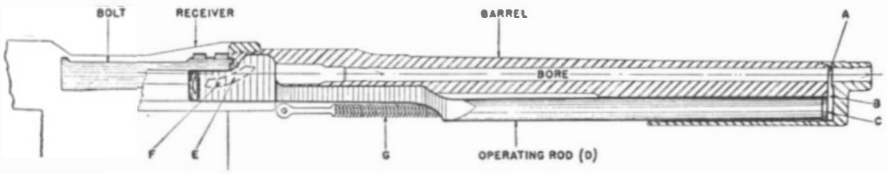
The new M1 rifle is described in *Army Ordnance* by Frank J. Jervey as "a gas-operated, clip-fed, self-loading, shoulder weapon slightly over nine pounds in weight. It fires the same ammunition as the caliber .30, M1903 (Springfield) rifle and all standard U. S. caliber .30 machine guns. The ammunition is supplied in eight-round, reversible, *en bloc* clips which are fed by hand into the magazine of the rifle. Upon being inserted, the clip depresses the follower which in turn releases a catch, allowing the bolt to go forward under the action of a compressed spring, stripping the top cartridge from the clip and chambering it. When the last round in the clip is fired and the empty case is ejected, the clip also is ejected and the bolt is retained in the open position ready for the insertion of the next loaded clip.

"It generally is conceded that for short periods of fire the M1 has the value of approximately three bolt-action rifles. . . . The lack of fatigue after continuous firing and the ease with which the rifle can be held on the target throughout the firing of a complete clip is remarkable for the type of fire. . . . The average rifleman is capable of firing about 40 shots per minute." One case tells of 80 shots at 200 yards in one minute, all hits within the target's "4" ring.

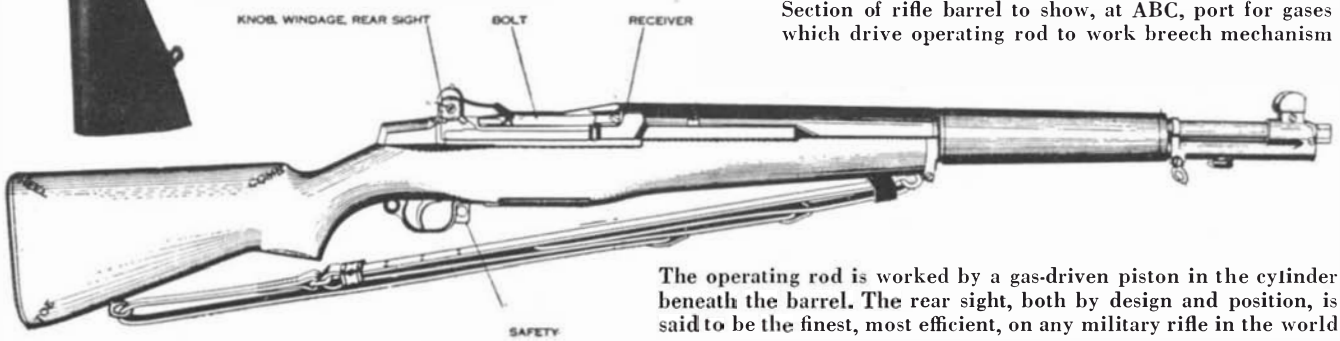
"The rifle shows its greatest superiority over the Springfield in anti-aircraft work. . . . In the M1 (the Garand), the 'kick' is very light, and it is easy to keep the rifle on the target throughout succeeding shots. The advantage of this for defense against high-speed, low-altitude aircraft where the target is present for a fractional period of time can be readily appreciated. Try, for a moment, to visualize a company of soldiers on the march, equipped with semi-automatic rifles. An airplane traveling at a speed of about 200 miles an hour suddenly appears over the top of the trees. Within a split second, each man can bring his rifle to his shoulder and begin firing eight rounds almost as rapidly as he can pull the trigger. Defense of this type certainly should add materially to the protection of marching columns."



The new Garand rifle, at left, is without the side bolt. However, it does have a small operating lever for the initial "cocking," as shown in photograph, at right, of open breech and clip of eight cartridges



Section of rifle barrel to show, at ABC, port for gases which drive operating rod to work breech mechanism



The operating rod is worked by a gas-driven piston in the cylinder beneath the barrel. The rear sight, both by design and position, is said to be the finest, most efficient, on any military rifle in the world

BUBBLES

A Fascinating Little Experiment Reveals a Surprise and Later May Lead to Some Utilitarian Purpose

WHAT shape is a common bubble of air rising through water? Some might answer offhand: "Round." Others with better memory of casual observations might put it: "Spherical, in general, but constantly wobbling." The ultra-slow motion picture series at the right shows what really happens—shapes and antics previously unrealized.

In the top picture a balloon-shaped bubble of air surrounded by water is just leaving an adjustable orifice at the bottom of a vessel 3 inches in depth.

About 1/100 second later it is breaking off and starting to rise—second picture.

In the third picture, approximately 1/1000 second later, the bubble is on its way upward. The elongation at its bottom has contracted and been pulled upward into the bubble. Note the truncation of the bottom thus produced, also the tip of the pulled-in part dimly showing within the bubble.

In the fourth picture, taken about 1/300 second later, the bottom is pulled farther in and the little tip inside has cast off a tiny water droplet.

In the fifth this little drop is rapidly moving toward the top of the bubble.

In the sixth it is about to strike the top.

About 1/600 second later, in the seventh, it has struck the bubble's ceiling, made a neat little "goose-egg" on its head and rebounded downward.

And now see what happens! That little blow from the droplet has set up waves that travel all over the bubble and give it, 1/100 second after the previous picture, the strange shape shown in the eighth picture.

The final picture, taken about 1/400 (.00024) second later, shows the amazing shape a bubble can assume!

To researches such as this there are several well-known types of reaction. The person of limited imagination, who calls himself "practical," scornfully says: "So what?"—and walks away, pitying the poor experimenter. On the other hand, the scientist, all boy, probably remarks that these observations provide a fascinating illustration of Somebody's-law, and that the industrial people probably could find some application of them to industry—leave it to them. The broad-gage industrial man is boy plus scientist plus truly practical, so he says: "Let's play with these bubbles some more, and see if we can find something applicable in them—you never can tell."

The application hasn't yet been hit on, but "the practical applications of the bubbling of gases through liquids are almost universal, and we have no doubt that there will be such," stated Dr. Gustavus J. Esselen, of Boston, Massachusetts, in describing this research before the American Chemical Society. "The processes of flotation of ores, the formation of lather and suds with detergents, the washing of gases both for absorption and for cleaning, the formation of gaseous emulsions, the evaporation of liquids into gases as in carburetion, and numerous other applications of contact between gases and liquids can easily be cataloged," according to Dr. Esselen. "Which of these will be affected and to what extent can at the present moment be only guessed.

"What has been learned so far is that the bubbling of air through water is far more complex than one would anticipate. Instead of rising through the liquid in the spherical or nearly spherical form resulting from the action of surface tension forces, air bubbles assume a variety of forms apparently through the operation of forces hitherto unsuspected.

"A separate set of forces is set in operation by the formation within the air bubble of a tiny globule of liquid water which, given momentum by the force of surface tension which breaks it away from the inner surface of the bubble, bounces up and down within it. These globules of water do not merge with the bubble walls, but possessing high speed, and hence substantial momentum, they bounce off the inner surfaces of the bubbles as if the surface film lining the bubbles were made of rubber and the globules were tiny balls.

"The effects of these collisions between bubble wall and water globule are evident in wave motions imparted to the bubble, which continuously changes its shape as it rises through the liquid. These can be readily seen in motion pictures and in prints of parts taken from them.

"STRIKING, too, is the difference in behavior evident when a wetting agent is added to the water in which the bubbles are formed. The basic effect of the wetting agent is to reduce the surface tension of the water and thus the strength of the film surrounding the bubble. For this reason, the bubbles show a pronounced tendency to merge together and the bouncing of the globule of water can no longer occur because at the first contact with the weakened surface film it is able to penetrate into the surrounding liquid.

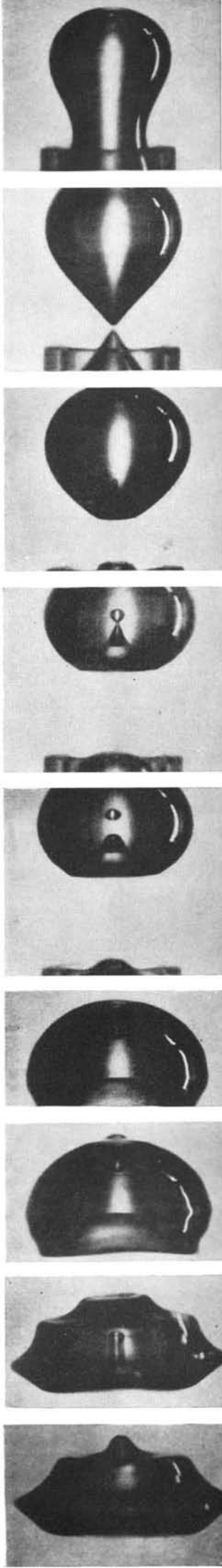
"Quite obviously, the behavior of bubbles in liquids depends upon the character of the liquid and more particularly on the strength of the surface film which it forms around the gas bubble.

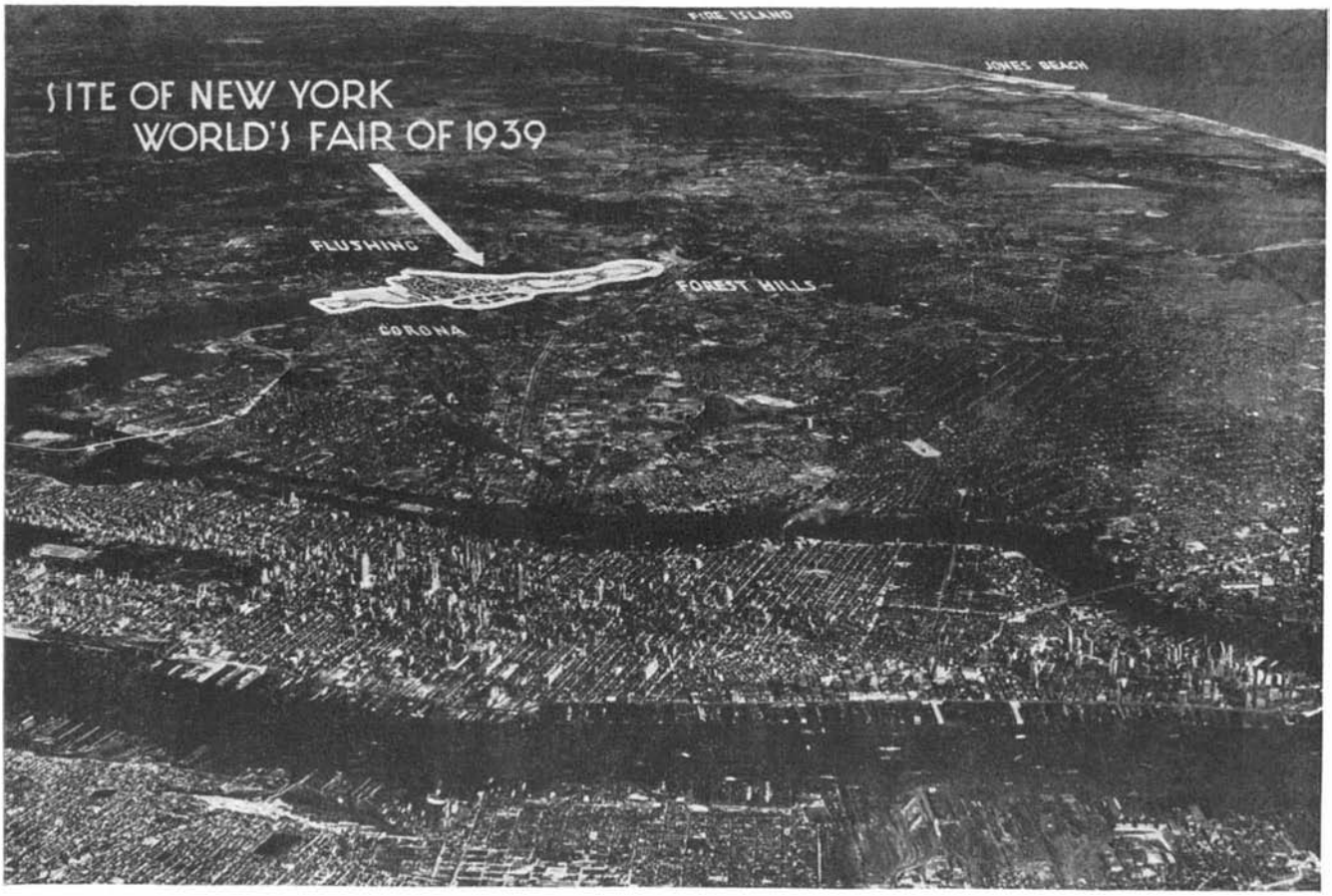
"Throughout our experiments the temperature of the water was maintained at 20 degrees, Centigrade (68 degrees, Fahrenheit). The size of the orifice varied from 0.53 millimeters to 7.5 millimeters, covering a ratio of area of 1:200. Four different air velocities were used—50 cubic centimeters, 150 cubic centimeters, 600 cubic centimeters, and 1200 cubic centimeters per minute. With an air flow of 150 centimeters per minute the tendency for these globules to form decreases as the orifice size increases from 0.53 millimeters to three millimeters diameter. With the three millimeters orifice, no globules are observed with an air flow of 150 cubic centimeters per minute. As the orifice diameter is further increased the globules are again formed. These results are presented in the following table:

Globule Formation Inside Air Bubbles

Air Flow cc. per minute	*Diameter of Orifice* millimeters	*Globule Formation* percent
150	0.53	50
150	2	20
150	3	0
150	4.9	80
150	7.5	100

"The figures presented in the column headed 'Globule Formation' were obtained by counting the number of air bubbles in which the formation of globules was observed and calculating from the total number."





The Fair is directly northeast from the midtown business section of Manhattan in the foreground

Up From the Ashes

New York World's Fair 1939 a Glittering Cinderella . . . Engineering Difficulties of Filling in and Building Upon Ash-Filled Swamp Muck

By JOHN P. HOGAN
Chief Engineer and Director of Construction

GEOGRAPHICALLY, New York has the tremendous advantage of possessing one of the world's finest harbors and a very lengthy landlocked shore-front for waterfront and shipping developments. There are, however, some physical disadvantages in this since, of the five boroughs of the city, four are on islands separated by arms of the sea. The development of the city has, therefore, been largely a question of bridges and tunnels, either for rapid transit or vehicular traffic. Curious backwaters have developed in various portions of the metropolitan area due to absence of these facilities or failure to exploit them.

Near the geographical center of the city, which is also very close to the center of population, there developed in the Borough of Queens one of these backwaters, bounded roughly by Queens Boulevard—which is opposite 59th Street, Manhattan—Flushing River, Flushing Bay, and the East River, and covering an area of about 16 square miles. Because of marshes and deep indentations, the area could not support, financially, the necessary reclamation or improvements, grading, and proper paving.

Many years ago the then city of Brooklyn, needing a place to dispose of its ashes, selected the largest one of these marshes for the purpose at a point where it was about one and one-half miles wide. For a number of years, not only the ashes, but also all the nonperishable debris of an average population of from one to two million people were deposited here. As the ashes were deposited, they sank into the mud to a maximum depth of 40 feet and piled up to a height of nearly 90 feet. Infested with rats, they added to the unattractiveness of the already dreary landscape.

Straddling one of the main entrances to New York, this ugly area formed a blot of the first magnitude. The dumping of ashes was stopped several years ago after about 50,000,000 yards had been placed, but the task of reclamation was thought to be too expensive and too stupendous to be immediately undertaken.

About 1932 things began to happen. The old Triborough Bridge Project was revived. This bridge now connects the three Boroughs of Queens, Bronx, and Manhattan, entering the latter at 125th Street, crossing the East River at Hellgate, and entering Queens at the village of Astoria.

About two years before the opening of the Triborough Bridge, a group of enterprising businessmen of New York decided to hold a World's Fair in New York in 1939 to commemorate the 150th anniversary of the inauguration of George Washington in New York City. In searching for a site that was both

readily accessible to the heart of the city and large enough for the purpose, they found that the desolate marsh fulfilled these requirements better than any other available site. The city plan had always included the rehabilitation of the marsh and dumps to form a grand city park 50 percent larger than Central Park.

Under the stimulus of providing a site for the World's Fair, the city agreed to advance all the necessary items in the general plan for immediate construction and to add thereto the cost of dredging two lakes and leveling the ash dumps over the remaining marsh in order to provide a foundation for the park. The city agreed also to build a permanent park headquarters for use as an exhibit building for the City of New York during the Fair and to use its best efforts to get the state to build as its exhibit a permanent amphitheater seating 12,000 people which could also be utilized during the Fair.

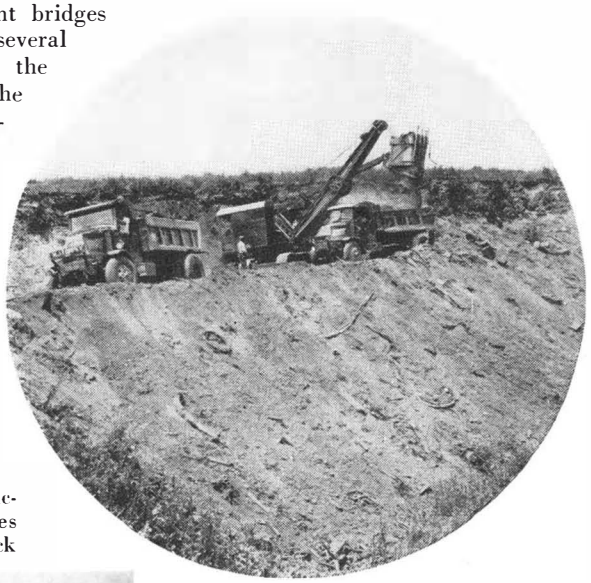
THE Fair Corporation agreed to build four permanent bridges. It agreed further to landscape the site in such a way that the planting done would be useful for later park development; to build several permanent park roads and to leave for the initial stages of the park development all the temporary roads, all bridges across Flushing River, and any other structures built by the Fair Corporation which the city would require. A lease, embodying these terms, was signed on June 29, 1936.

No time was lost. Prior to the determination of the details of the formal agreement, the contract was awarded for leveling the site on June 15, 1936. Although this required dredging of nearly a million yards of material, and transportation of nearly seven million yards of ashes, the work was completed in eight months, or in April, 1937, two years before the date of the opening of the Fair. The vast tributary works, the road and bridge building, sewer construction, and so forth, were put into work as rapidly as detailed plans could be prepared.

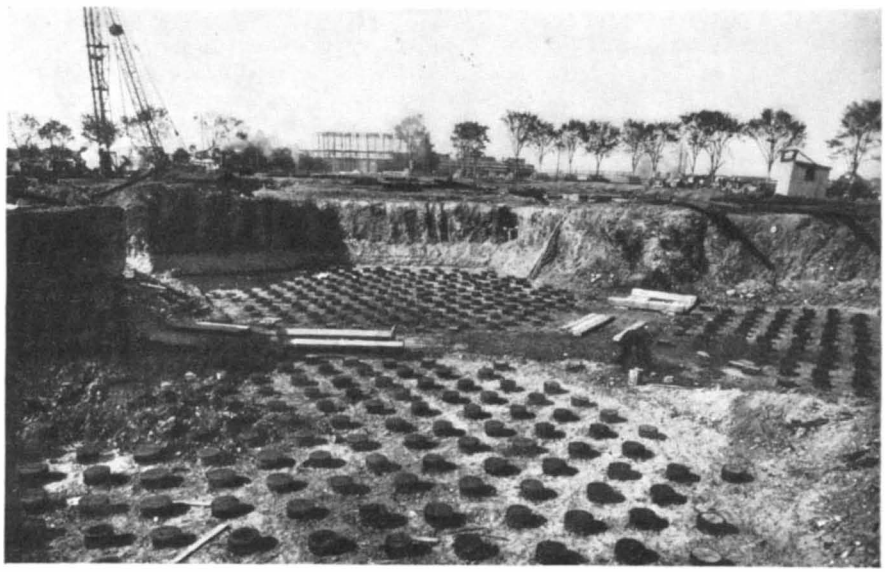
The work done by the Fair Corporation itself is only a fraction of the building program for the exposition. The Fair itself has constructed 20 exhibit buildings, a theater, three large railway stations, and a group of administration and operating buildings. In conjunction with the states, it has constructed 13 buildings to house the exhibits of 37 states; in conjunction with the Federal Government, it has constructed eight buildings to house the official exhibits of foreign nations. The building program of participants is much more impressive. Twenty-three of the 62 foreign nations and 43 industrial corporations will erect their own exhibit buildings, and over 50 buildings and amusement devices will be erected in the Amusement Area. It is expected that the total expenditures on account of the Fair will be in the neighborhood of $150,000,000.

In addition to the exhibit buildings, the Fair Corporation has constructed and will operate utilities, roads, general landscaping—including the planting of 10,000 large trees from 12 to 20 inches in diameter—five permanent bridges and 11 temporary bridges, several large parking fields, and the Theme Center, including the well-known Trylon and Perisphere. Over $10,000,000 of the money spent by the Fair Corporation is underground. Some of the items which helped to make this total are 51 miles of roads and paths; 34 miles of storm drains, sewers, and water mains; 90 miles of electric conduits; and over 500 miles of piling including piles driven by private exhibitors. In this work, and in the development of the foundations, the majority of the engineering problems have been encountered and solved.

The original filling and first stabilization was a delicate operation. The ash dump covered roughly 300 acres of the 1200 acre site. Elsewhere, the site was composed of a peat covering about three feet thick overlying from eight to ten feet of very fine silt with a very high water content. Rock was about 400 feet deep below the surface, and therefore out of economic range for foundations. Underneath the liquid mud, however, was a bed of very fine sand covering the entire area and formed like a trough with the axis of principal depth three and one-half miles long approximately in the middle of the site. This sand has a supporting capacity of about two tons to the foot, which indicated that it would support piles loaded with about 18 tons. On most portions of the site where large amounts of ashes had been dumped, the natural surface would support a concentration of about 1500 pounds to the square foot. It was therefore evident that the direct weight of the buildings could be supported on the site.



Early work on the site, showing one of the huge ash dumps with its variety of large-city refuse



For some of the larger structures a veritable forest of piles had to be driven into the muck

The main danger, however, was that of lateral movement either during the filling operation or during the construction of the foundations. The original disposal of the ashes had forced them down into the mud, in many cases to a depth of 40 feet. This had been partly compensated for by driving water out of the underlying mud, and partly by the rise of a series of mud waves around

the edge of the dump. In these mud waves, the original peat covering had been forced up in many cases as much as 20 feet above the surface of the swamp and in some cases the underlying mud had flowed through the peat covering. Elsewhere, the peat cover formed a mat upon which to place the ashes excavated from the dump, but it was necessary to place the ashes in three-foot layers and to allow no slopes of more than three feet in 100 to develop, otherwise further flow and additional mud waves might have been created. The bed of the old channel which meandered through the site had to be filled, and this furnished one of the principal problems since it was 15 to 16 feet deep and had no peat cover.

The problem of equilibrium was successfully met. Within certain areas, subsequent settlement continued locally for over one and a half years after the completion of the first filling in April, 1937. The only way in which this local settlement could be met was by a continuance of filling operations. Finally, in the summer of 1938, the last of these local settlements ceased, and today the site is perfectly stable. The process of consolidation was greatly accelerated by the early construction of a large number of storm drains.

In the lower ground along the banks of the new river and the new lakes, it was in many cases necessary to put the sewerage drains and conduits on piles, and where soft spots developed in the new foundations for roads in this area they were corduroyed with three-inch wooden planks recovered from pile butts. Of the total length of 37 miles of road it was necessary to treat only a mile and a half in this manner. One of the aids in stabilization, where the ash cover was thin, was the action of the piles themselves. The underlying silt is so liquid that it is not compressible. Therefore each pile represented the displacement of an equivalent amount of water from the mud. To meet any lateral movement, most of the pile foundations were connected with reinforced concrete struts.

A FLEXIBLE type of pavement was chosen, both because it would be easier to repair after local settlements, or after excessive wear, and because it was the cheapest type which would give good service. The bus routes and main highways consist of a four-inch thickness of crushed stone on which was laid a three-inch layer of cold laid plant-mix bituminous macadam. This is in two courses consisting of a two-inch binder and a one-inch wearing surface. For lighter traffic, a similar plant-mix bituminous macadam is laid directly on the ash fill after proper consolidation. This pavement consists of 2½ inches of binder and a one-inch wearing surface. In courts and gardens, the walks consist of a thinner bituminous mixture laid on a base of cinders.

The most serious foundation problems were encountered at the site of the Trylon and Perisphere, particularly as the Trylon has a maximum wind load equal to about four times its weight. The foundation problem was solved by driving about 1100 creosoted piles from 90 to 95 feet into the underlying sand. These piles were then covered with heavy reinforced concrete and, in the case of the Trylon, these had to be heavy enough to resist the over-turning effect of the wind load. As the Perisphere rests on eight columns, a pile and reinforced concrete foundation was adopted, the whole load of approximately 2500 tons being transmitted through a circular ring girder into the pile foundations.

The Fair itself now promises to be not only the largest of the world's expositions, but one of the most beautiful. Important, too, are the destruction of an eyesore and the promise of a future park, which have started the construction of thousands of apartment houses and dwellings in the neighborhood and thousands more are projected. It has been estimated that a million people will move into the neighborhood within the next ten years.

When Grover A. Whalen, President of the New York World's Fair 1939 Incorporated, opens the Fair to the nations of the world on April 30, 1939, he will have followed to completion a modern miracle—the rise of the New York World's Fair from the ashes!

Even in its far-from-complete condition in October, 1938, the Fair presented a spectacular contrast to the original site

Test Your Soil

Home Gardener or Commercial Grower May Test Soil With Simple Kits, Grow Better Plants

Photographs courtesy Sudbury Soil Testing Laboratory

The small soil testing kit, with complete instructions for using, is about the size of a small book

A GARDEN plot or grain field is a tiny chemical laboratory, is made up of countless soil particles, contains complex and intricate chemical processes, and is never the same from week to week, changing as the crop draws on the plant food resources, modified by weather and seasons. The fertility of the garden or farm is directly dependent on what goes on in that earth zone where feeder roots draw sustenance from the earth.

In the past, soil testing to guide the grower has been largely confined to extensive laboratory processes and out of reach of the average grower. Now, however, there is available a simple field kit with which anyone can make tests of soil and determine from them the fertility of any given plot of ground.

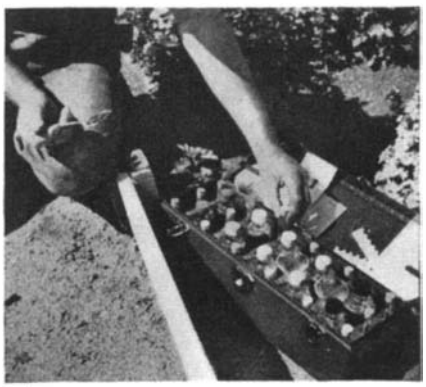
As little as two dollars will secure a field kit of the simplest type. Anyone who can read newspaper English and distinguish colors may, in a matter of minutes, run the four principal tests on a soil sample.

The first and most important determination is whether a soil is neutral, acid or alkaline. Some crops, such as asparagus, alfalfa and heliotrope require a soil definitely alkaline. To put such plants in acid soil is inviting failure. Other plants, such as rhododendrons, cranberries, parsnips, and gardenias will be retarded or destroyed by alkalinity. Every soil test kit contains a pamphlet listing the alkali-acid preferences of plants and the degree of either condition they demand. There are instructions as to how to change a soil from acid to alkali, or the reverse.

The other three primary tests are for nitrogen, phosphorus, and potassium. These are the soil chemicals which are required in large quantity by growing plants. The objective of a soil test is to make certain they are present in sufficient quantity and in the balance required by the crop being produced.

Nitrogen is the element chiefly required in leaf and stem growth. Such crops as cabbage and lettuce and bluegrass lawns draw heavily on the nitrogen in the soil. Phosphorus content of soil is linked with the production of flowers and fruits. Any crop of orchard, flower garden, or grain fields needs adequate phosphorus to "make the crop." Potassium stimulates root growth; such a crop as the lowly potato demands this element in the correct balance in the soil.

Each year gardeners and farmers spend millions for "complete" fertilizers that contain a set ratio of the three principal plant foods—nitrogen, phosphorus, and potassium. This gunshot application of plant foods may not have enough of one or too much of another chemical to supply the needs of the particular crop. The soil test shows what is present and what is lacking, and the grower may buy only those chemicals needed to make his soil highly productive. The possible economy is obvious, for the grower may now be paying out money needlessly for chemicals that are already present in his soil.



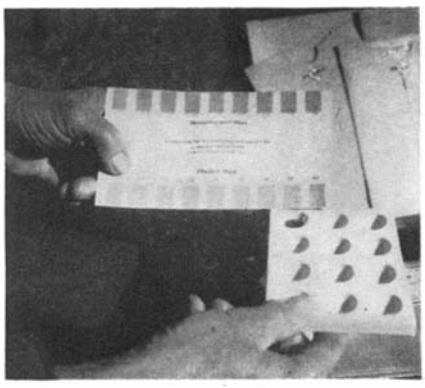
Larger soil testing kits can be used by non-technical market growers

THE technique is simple. With an ordinary spoon, dig two inches under the soil surface and scoop up a soil sample. It should be dry enough not to wad up under pressure. Each tube in the kit has a colored cork; each color is for an individual test and each test is made every time in the tube assigned to it. The test tube is filled one fourth full of soil. The kit contains small bottles of test solutions. Selecting the one designated for the test being made, fill the test tube until it is half full. Cork it, shake it, and set it aside until earth particles settle. The liquid above the soil will take on a color. This color is the key to the test.

There are four color charts in each test kit, one for each test. Match the color of the liquid in the tube with a color shade on the chart for the test being made. The shade or tint on the chart will be designated by a key letter or number. Turning to the pamphlet, one finds the answers all worked out. From the resulting data, one can make up his own fertilizer, "tailor-made," for his particular soil. —*Arthur Hawthorne Carhart.*

All testing operations are as simple as pouring a test solution into a tube

The solutions are filtered in the larger sets, in order to clarify colors



Colors in the solutions are matched against those in key color charts

Powder Metallurgy

Tungsten Filaments Started It . . . Now Superior "Alloys" Made Without Melting . . . Components Retain Identity . . . Can Alloy Metals, Non-Metals

By PHILIP H. SMITH

A NEW process for the manufacture of metal objects is now available to industry. It permits the alloying of metals without the customary melting and casting, while entirely new compositions can be produced from such unrelated materials as metals and abrasives.

This process is called powder metallurgy; and although it has been known and used for more than a quarter century, it is only now coming into its own as a tool of production. In a manner which seems as simple as filling a doctor's prescription (but isn't) it provides your automobile with oil-less bearings, clutch facings, and spark plug inserts. It offers your home and your family radio tube parts, lamp filaments, dental alloys, warming-pad mixtures, and permanent waves, while to science and industry it contributes X-ray targets, welding electrodes, grinding wheels, and other essential products.

The art, which is characterized by the compression of metals in the non-fluid state, seems now to be on the eve of further commercial expansion. Developments begin to issue in a steady flow; promotion and research run neck and neck to get results now and to promise more in the future, yet there remains a vast unexplored domain which makes definitive evaluations premature.

The exact date of powder metallurgy inception cannot be set. If we say that it began as a science around the turn of the century, the statement can be defended. At that time came the production of tungsten filaments from the metal powder, involving all the applications of technique—preparation of the powder, compression, heat treating, and subsequent processing to form—whereas the production of bronze powders which antedated filaments by a half-century required only the first of the several producing steps.

Some of the Products Made Possible or Improved By Powder Metallurgy

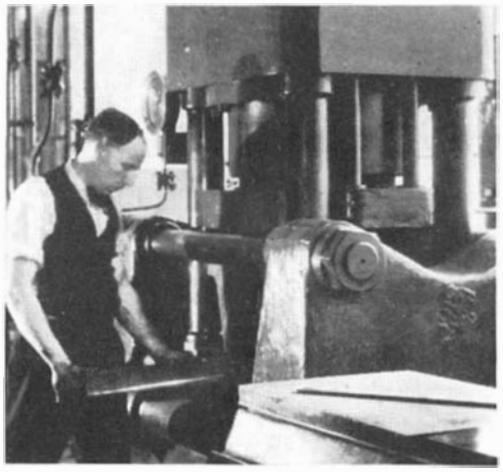
Bushings	Grinding Wheels
Bearings	Resistance Elements
Brushes	Thermostats
Cemented Carbides	Magnets
Clutch Facings	Lamp Filaments
Brake Bands	X-Ray Targets
Contact Points	Brazing Compounds
Medals and Coins	Metal Wire and Sheets
Welding Rods	

The manufacture of tungsten filaments called for the metal in a pure state, in bar form, ready for drawing into fine wire, and since tungsten has a melting point of 6100 degrees, Fahrenheit, there was the problem of getting high enough temperatures to reduce the metal to a fluid state as well as the problem of obtaining refractories that would stand such heat. If, however, tungsten oxides are reduced by hydrogen to leave tungsten in a pure powdered state, then the powder can be compressed into bars, sintered or heat-treated, hot-swaged, and drawn.

The process sounds extremely simple, but at the outset it was highly complex. It was necessary to find a way of eliminating impurities and discover means to control not only the structure of the metal particles but their size and assortment of sizes as well. Then there had to be research to find binders which would be eliminated upon heat treatment; and long study went into determination of the proper pressures to obtain desired densities.

Upon the knowledge acquired by metallurgists in their quest for the best means for producing tungsten filaments, and subsequently molybdenum wire (another high melting point metal), has been reared the new science of powder metallurgy. Today there is hardly a metal known and used by man which is not available in powder form, and used either as a single element or in combination with others.

Developing satisfactory methods for powdering and refining metals to approach some measure of standardization has been a long process and an essential step in the new metallurgy. Out of these labors have come eleven basic processes. These have been listed in the following manner: machining; milling (by ball mills, stamps, attrition mills, and so on); shotting (pouring molten metal in water, air); granulation (by stirring molten metal while solidifying); atomizing (disintegrating by steam, compressed air); condensation of metal vapor; reduction of oxide powders; chemical precipitation; electrolytic deposition; sintering (for the production of alloy powders in friable form); formation of an alloy followed by dissolving or otherwise remov-



Tungsten oxide, placed in long retorts in trays (at left), is heated in an atmosphere of hydrogen until reduced to metallic powder. The powdered metal is then placed in a steel form and pressed into a bar under 14 tons pressure per square inch (right)

ing one of the alloying constituents. The relative importance of these processes cannot be set unless you measure arbitrarily. Importance in volume is one thing; the value of the item produced is another. It is enough to say that the process used in any particular instance is determined by the metal and the use to which its powder is to be put.

The range in processes is very wide, as can be seen by examining a few at random. The grinding process, for example, produces powders by crushing in stamp, ball, or attrition mills, and is quite simple. Brittle and tough metals can be handled in this manner, but malleable metals must be stamped. Powders so produced are flaky in form; a good example is metal paint pigment. Atomizing, on the other hand, requires forcing a thin stream of molten metal through an orifice and then hitting it with a stream of steam or compressed air. This method permits a very close control of powder size and regulation of the size at will. It is employed when powders are to be used in molded products, although copper cannot be so treated. Still another process which permits close control is that of reduction from the compounds, in particular the oxides, chlorides, and hydrides, using temperatures below that which will melt the metal. Tungsten filament, as previously mentioned, is produced in this manner.

CONTEMPORARY with research to develop suitable powders has gone much study in the art of compressing. And here, in this second phase of powder metallurgy, are revealed many of the most striking achievements and more than a hint as to limitations. The production of metal parts or products from powders requires pressures ranging from 15 to 50 tons per square inch. Now these pressures can be obtained, as the presence of parts proves, but the surface area of pieces is very definitely limited at the moment by the mechanical difficulties of building presses which will compress large surface areas economically. Further difficulty is encountered when trying to produce parts having great thickness to be compressed. It requires a pressure ratio of three to one to do a job with proper porosity or density because the average density of the powders is about 30 percent that of the cast metal. The mechanical difficulties are complex enough, but if you try to compress metals of different densities the problem is intensified by physical considerations.

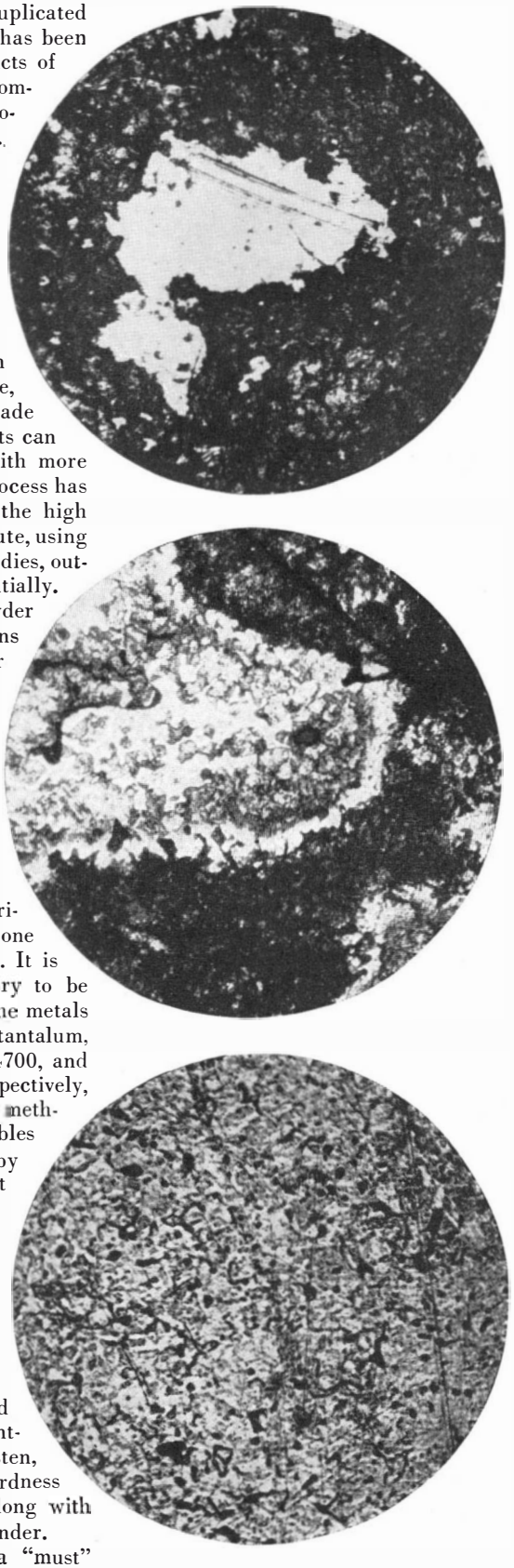
There are authorities who express confidence that these problems will be solved to broaden the field of metal powder application. One specialist has said: "We can't press around a corner yet"; but he declares that striking gains in this direction are soon to be announced. Certainly the intricacies of form achieved with die casting cannot be duplicated with metal powders, yet there has been steady progress and the products of today reveal an advance in complexity of form over those produced only a short time ago.

While experimenters have been trying to discover how to press large objects out of powders, they have been busy also perfecting the process of making small parts. Powders are now being produced commercially on a tonnage basis so that more and more things can be made economically. Likewise, there have been improvements made in dies and presses so that parts can be made more quickly and with more uniformity. The speeding-up process has brought about press work at the high rate of 40 to 120 pieces per minute, using single dies. Now, with multiple dies, output can be increased substantially.

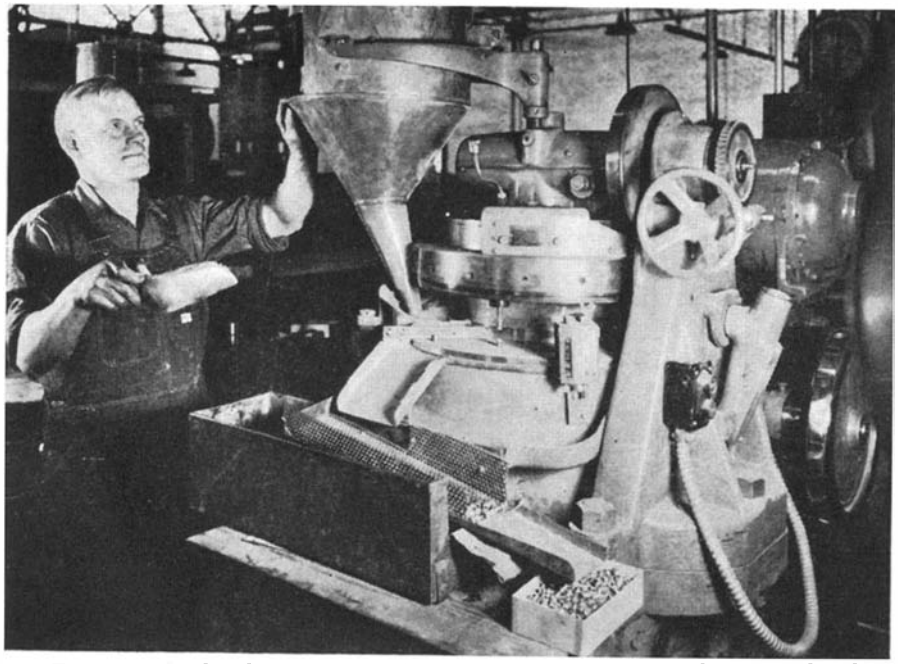
Probing the science of powder metallurgy brings two questions uppermost. Probably the reader has formulated them already. Why employ metal powders anyway? In what particular is the process superior to the older method of combining metals in their fluid state? And the second query is: What makes the particles stick together?

Our résumé of the early experiments with tungsten revealed one reason for employing powders. It is when metals are too refractory to be melted or cast conveniently. The metals of tungsten, molybdenum, and tantalum, with melting points of 6100, 4700, and 5100 degrees, Fahrenheit, respectively, cannot be handled by any other method without incurring grave troubles with equipment and losses by volatilization and oxidation. But this is not the only instance where powder metallurgy makes a unique contribution. If you would make a product out of several components and wish to retain the essential identities of those components, powder metallurgy does the trick. The cemented carbides illustrate this excellently. Whether made with tungsten, tantalum, or titanium, the hardness of the carbides is retained along with the toughness of the cobalt binder.

Metal powders also play a "must" rôle when certain structures are sought. Oil-less bearings, made from powders of copper, tin, and carbon, are given a porous structure by control of pressure, while increased porosity can be obtained by an admix of volatile salts which evaporate upon heat-treating to leave pores for oil absorption. Again, this new metallurgy serves uniquely when it is de-



Three steps in the sintering of a powdered metal bearing containing copper, tin, and graphite. *Top:* After compression, before sintering. Light areas are tin and dark are copper. *Middle:* Partially sintered. Gray areas are bronze formed by interdiffusion of the two metals. *Bottom:* Copper and tin powders completely "alloyed" by diffusion



The three powdered constituents of an automobile bearing metal are mixed and placed in this briquetting press. The resultant solid is the actual formed bearing

sired to combine components which cannot be alloyed because of extreme differences in melting points or because of immiscibility. By surmounting this difficulty, the powder process has furnished superior electrical contact points, bearing and magnet composites, and certain welding electrodes.

THERE are many instances where powder is used by choice rather than necessity in the manufacture of metal products. Permanent magnet alloys, for example, can often be made at less expense and more easily by this process. Then there are products in which usefulness is enhanced by the higher purity possible with powder. Injury which may result from the use of de-oxidizers and de-gasifiers in the melting and casting process, can be avoided with powders.

Still another advantage is the permissibility of taking two or more metals and compressing them in layers of separate elements. By this means, composition effects can be localized. Valve parts provide a practical example.

Powder metallurgy, by its very achievements, has proved where its advantages lie and has marked out the territory for exploitation. But it is still young—too young to have promulgated a water-tight explanation of the mechanism of the bond. There are many theories and each may contain some truth. It is claimed that the clean surfaces of the powder permit a cohesion or adhesion of the particles under the combined action of heat and pressure. It is also thought that there is an interlocking of the metal particles because in many instances the structure of the particle is dentritic, or toothed. The action of pressure is not to be overlooked as significant in the creation of the bond. Under pressure the air between particles is expelled and replaced with particles deformed by that pressure, giving an angularity which perhaps facilitates the union.

It has been suggested recently that the friction during compression may generate a welding heat momentarily where the surfaces are in contact. This theory arises as a result of studies on the action of metallic surfaces in contact and rubbing as occurs in bearings. Here, it developed, the friction produced sufficient heat to create slight molecular diffusion on the surface.

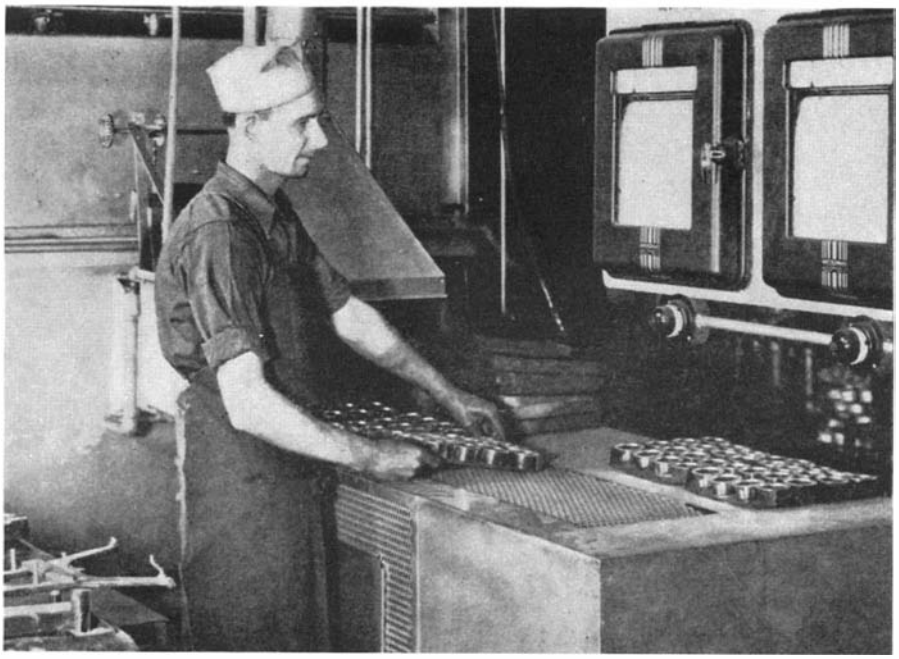
So the answer to the question: what makes the bond?—the greatest problem among many—must be left to the future. There are vast differences between the science of casting fluid metals and this newer one of compressing metals in the non-fluid state. Such factors as re-crystallization and grain growth, for example, are unlike and call for long study before it can be said that powder metallurgy has built a solid backlog of scientific understanding.

Meanwhile events move rapidly. The mystery of the bond isn't holding up commercialization. Only a year ago it was thought impossible to make tool steel or high carbon steel by the powder method. Now the problem is thought to have been solved. Stainless steel, another impossibility, is declared to be a reality, while behind locked doors are other achievements yet to be released. But each and every item which becomes a reality must prove its worth competitively, so judgment as to value must be withheld. What we see happening is mainly significant to us as straws in the wind.

AT the moment, the leading application of powder metallurgy is in production of ductile metal from tungsten, molybdenum, and tantalum, and in making cemented carbide tools, porous structures, electrical contact and electrode materials. But if it is true that a way has been found to get sufficient pressures with economy for large area work, and if the complex dies now in process of development and experimentation prove satisfactory, the way will be open for the manufacture of many more metal parts and products.

Prosperity for this new process seems to be "just pressing around the corner."

Information and photographs courtesy of: General Electric Company, General Motors Corporation, Handy and Harman, Charles Hardy, Westinghouse Electric and Manufacturing Company.



Pressed bearings, made as in picture above, are sintered to cause diffusion of constituents. Here, they pass through a high-temperature furnace on a conveyor

THE AMATEUR'S SEISMOGRAPH

Instructions for Building and Operating in the Owner's Cellar an Instrument which Will Record Quakes from the Most Distant Parts of the Earth

By AUSTIN E. JONES

A SEISMOGRAPH is neither difficult to build nor tedious to operate. Of the many forms, the Bosch-Omori horizontal-pendulum type is probably the easiest to make and maintain. To house it a small separate building is preferable, but if this is too expensive a corner of the basement will be suitable. The corner will have to be walled off to stop convection currents of air, also to preclude accidents to the apparatus. As a foundation, a pier (Figure 1) should be set at least two feet in the earth beneath the floor, or on bed rock. It should have no direct contact with the floor. The zone

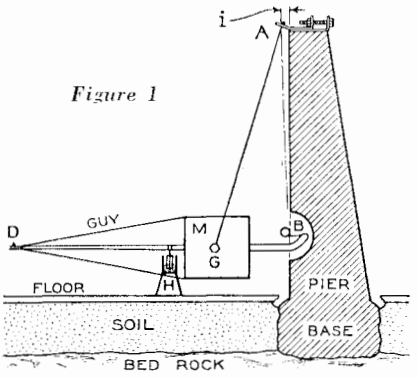


Figure 1

of earth will to some extent insulate the pier from disturbances originating within the building. Concrete walls of basements have also been used to support seismographs, with some success (Figure 2).

For the "heavy mass," on the pendulum, which remains virtually stationary while the earth and apparatus move, a compactly shaped cylindrical piece of metal *G*, weighing more than 50 pounds, will be required and a visit to a junk dealer is quite likely to reveal it already in usable form. However, as a larger mass will prove to be more effective in overcoming friction, the nearer the mass approaches 500 pounds in weight the better. A very effective seismograph can be made with a mass of 200 pounds. The mass need not necessarily be in one piece, as several disks may be bolted together, or a canister filled with shot will answer the purpose.

The mass, represented at *M* in Figures 1 and 2, may have its axis in the boom, as shown, or at right angles to it. The lines formed by the boom *BD* and the piano wire suspension *AG* should pass through the center of gravity of the mass. In the case of a 200-pound mass the distance *BG* should not be much more than one foot, while the distance to the end of the boom may be three to five feet. This will

Improving Circumstances Favor the Amateur

RETURNING from his work, a man is met at the door by that familiar refrain, "Dinner is on the table, so don't delay a single minute." He promises to "be there just as soon as I can wash my hands," and starts toward the bathroom. Then he hesitates, glances furtively backward, ducks suddenly into the cellar doorway and is gone. Time marches on. Some 21¼ minutes later he emerges breathlessly from his little seismological laboratory with a yard of grimy smoked paper, to which he points and announces with gusto to a rather disgusted waiting wife that "there has been a tremendous earthquake today and a long way off." As he eats his chilled meal he talks on and on about big earthquakes and particularly about this one (his wife seems to be listening but is thinking about hats). When he pronounces that the quake was in the Far East those present exchange winks, but tomorrow's papers will say, "Heavy Quake Does Extensive Damage in Java."

The man is an amateur seismologist.[1]

For years past there has been evidence that numbers of amateurs would like to build their own earthquake recording instruments, but until quite recently there has been a lack of literature on the subject, in a form suited to the needs of the beginner. Most professional writings on seismology have been abstruse and mathematical. This situation is changing. Commander N. H. Heck, chief seismologist of the United States Coast and Geodetic Survey, has published an all-around, semi-popular treatise, "Earthquakes." Prof. L. D. Leet, in charge of the Harvard Seismograph Station, has written a detailed semi-scientific treatise on practical seismology, a book which makes available to the amateur who will do a little studying an elementary technical understanding of seismograph and earthquake principles. And now a seismologist who has built seismographs for professional use tells in the accompanying article how to make an instrument that will function for the great world-shaking, distant quakes that are chronicled in the newspapers every few days. At last, therefore, improved circumstances have made it better possible for the amateur to proceed.

The author of the accompanying instructions (see "American Men of Science," the "Who's Who" of American science) did graduate work at the University of California, then was an assistant-scientist with the United States Geological Survey at Mt. Lassen. Later he placed two seismographs in Alaska, and has spent four years as assistant to the widely-known volcanologist, Dr. T. A. Jaggar, Director of the Hawaiian Volcano Observatory of the Department of the Interior, where the study of earthquakes of the peculiar volcanic type is made a specialty. "A fair amount of my time," he states, "has been concerned in devising seismographs from material at hand, as well as constructing cellars for them." So far as is known, no definite instructions for making a seismograph of the quality he describes have ever been published. The professional has always purchased his instruments ready-made, or has himself employed instrument makers to make them, or else made his own, and in each case no definite building instructions were written out because this was unnecessary.

Recently a Committee on Amateur Seismology was formed in the Seismological Society of America, the national organization for professionals and interested amateurs. This society publishes, at Berkeley, California, a monthly journal named the *Bulletin of the Seismological Society of America*, which is not entirely technical and abstruse, many of the articles being readily understandable by the lay reader. Other journals publish occasional articles on seismology.

Readers who construct the apparatus described here are requested to communicate their results to the editors, who are interested.—*A. G. I.*

[1]The first syllable—seis—of this troublesome word rhymes with ice, dice, lice.

be increased by a lever or pen-arm (Figure 5). When properly suspended, this mass will swing about the hinge points *A* and *B* by flexure of the piano wire.

The axis of the hinge *AB* is inclined to the vertical by a small angle *i*, which in a good set-up can be changed by a screw thread at the top of the pier. In place of the pivot-and-socket joint shown in Figure 2, at *B*, a suspension by means of a bolt across the face of the pier, and a short wire attached to the end of the boom, as in Figure 1, will make possible another easy adjustment, but no change in period can be made without changing the angle *i*. For teleseismic, or distant, work the period should be somewhat longer than seven seconds (approximately) per swing and return, but in the neighborhood of 12 seconds the pendulum is likely to become unstable. The purpose of an adjustment at *B* is to correct the slope of the boom; for example, in cases of tilt due to temperature, earth changes, or foundation settling.

A COMPLETE record of a quake, such as the professional usually prefers for exhaustive interpretation, requires three instruments at right angles, each recording its component of waves which arrive from all directions, but any component will suffice for general interest, and in one-component stations the boom is usually placed in a north-south direction. If the experimenter is not exacting at the beginning with regard to the direction which the instrument records, non-adjustable ties may be made at *A* and *G*, and a pivot-and-socket joint made at *B*. It is the intention to suggest that the individual may to a great extent use his own ingenuity as to the type of

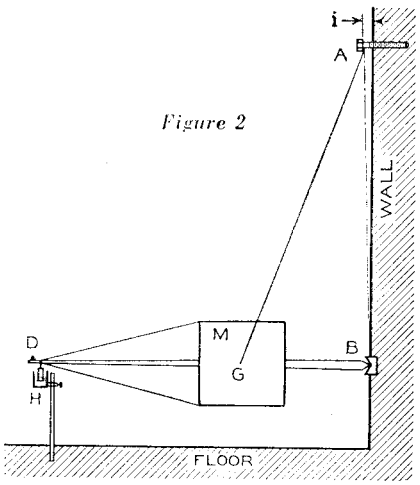


Figure 2

mass, boom, and adjustments. Generally the part *DM* of the boom should be light and rigid, the part *MB* being heavier and more rigid. The friction at *A* and *B* should be negligible. The smaller the mass the greater *MB* should be. However, a small mass—10 or 15 pounds, for example—would not work well unless *MB* were three or four feet long. Then

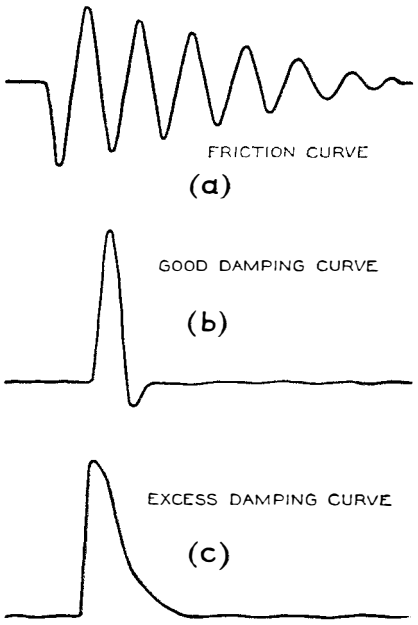


Figure 3: **Some adjustment curves**

DM must be short and the static magnification would be much less than with the heavier mass.

Once the pendulum is started vibrating in an arc of about one half foot, it should continue to vibrate for many minutes. If it will do that, it may be considered ready for the next step. However, while such an undamped pendulum will indicate earth movement, it will continue to move after the earth has stopped, and thus will give an erroneous indication. To stop this free movement, damping is required. Such damping, as described here, will

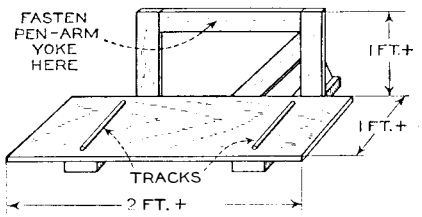


Figure 4: **For recording apparatus**

induce the pendulum to follow earth motions fairly closely. A small amount of damping, *H*, at the end of the boom, as in Figure 2, will equal a larger amount near the mass, as in Figure 1. The choice is the builder's. In Figure 2 the damping would be about two square inches of vane sliding in heavy oil, or in Figure 1 many square inches. It also depends upon the size of the mass. The oil container should be adjustable in height, so that the damping will also be variable. Figure 3 shows how friction and damping affect the seismogram. When the pen is displaced it will write a decay curve, as in *a*. This form is due almost entirely to friction, and if the damping is increased the decay curve will be shortened. The correct damping is attained when the curve becomes similar to *b*, where the first displacement is about five times the second, with no third, and the damping should be adjusted to this type of curve. Too much damping will induce a decay curve that does not recross the zone of rest but merely comes slowly back, as in *c*. However, the final adjustment is not made until the recording apparatus is completed.

To support the recording apparatus a wooden frame (Figure 4) may be used (though the frames of the Hawaiian Type seismograph are built of iron about ¼ inch by two inches). The tracks should be built of metal rod or smoothed hard wood, so that the clock and drum-carrying frame will slide easily under the pen. The purpose of this track arrangement is to facilitate precisely positioning the drum under the delicate pen-arm without injury to it. The dimensions

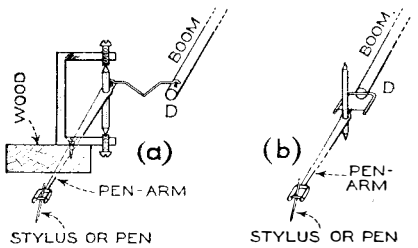


Figure 5: **Two magnifying systems**

shown are only approximate and may be varied. This frame will also accommodate a second pen-arm from a pendulum set up at right angles to the first, if this is later wanted as the amateur gains knowledge of seismology.

The magnifying system is to be attached to the end of the boom, at *D*, Figure 1 or 2. The writer prefers the method of attachment shown in Figure 5, at *a*, consisting of cup-and-needle joints. The connecting link is depressed in the middle, as shown, so that it will remain balanced on the points, and is made of light, thin metal. Buttons may be soldered at the ends, in which the cups are punched. The needle on the pen-arm is placed about ¼ inch from the pen-arm axis. As an alternative, the yoke and cross fiber method of Figue 5, *b*, may be used. Here again, ingenuity may assert itself. In either case the pen-arm axis is pivoted in a yoke fastened to the top of the frame (Figure 4). The magnification of the pen-arm multiplied by the magnification of the boom, *BD/BM*, gives the final static magnification of the seismograph. This is not the dynamic magnification. For illustration, an earth wave of 20-second type records with a different magnification on a 10-second instrument than does a 3-second earth wave.

The pen-arm should be extremely light, yet fairly rigid. It is usually made of thin sheet aluminum rolled into a tapering tube (Figure 6, *a*) or a T-section may be bent, as in *b*. Approximate dimensions are ½ inch wide at the pivot or vertical axis, to ⅛ inch wide at the tip where the stylus is attached. The pen yoke at the tip should be very light—½

inch in greatest dimension—and may be attached to the pen-arm with wax.

The needle or stylus is a piece of fine piano wire—about No. 24 to 30—attached to an arbor from a watch, which is free to turn in dents made in the pen-arm yoke; or the watch bearings may also be used.

The next requirement is the works of a spring drive clock (Figure 7, *a*), or a

Figure 6: Two forms of pen-arm

Telechron motor, to drive a large drum *d* at the rate of one turn per hour. The connecting link *b* is constructed so that the drum axis *cg* will travel endwise on screw threads as it is rotated. This should record the pen motions for a day (or more if preferred), the record line spiralling around the drum once each hour.

THE drum should be large and light, about 6 to 12 inches long and nearly a foot in diameter. The ends may be made of metal disks—cake tins might suffice—and the covering may be of cardboard, light wooden strips, or metal riveted on. The drive end of the shaft is either square or slotted, in order that it may be turned by the clock, while the opposite end is threaded for a foot or more. If the threads extend through the drum this will facilitate fastening its ends by means of nuts and washers. For local work—up to about 600 miles—the threads may be as close as 16 to the inch, but two to the inch is better for teleseisms. The drum should be three or four inches longer than the spiral, in order to allow free swing of the pen during large disturbances. In all, the axis will be about three times the length of the drum. The frame on which the clock and posts are mounted is to slide on the tracks of Figure 4.

For recording, a piece of paper, smoked for each day's run, is placed on the drum. Its width should equal the length

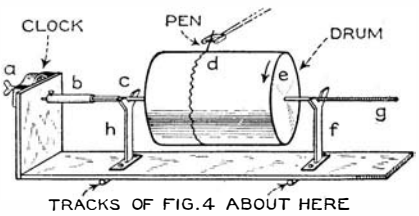
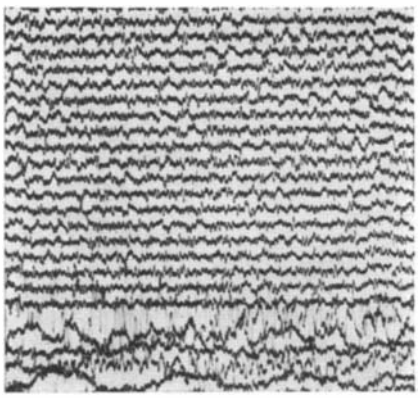


Figure 7: Drive, axis, and drum

of the drum, and it should be about two inches longer than the circumference, so that it may be folded and fastened by a small amount of library paste, as in Figure 8. While any paper will suffice, window-envelope paper has been found best. It is transparent, has a good gliding surface for the stylus, and takes paste just well enough to be easily removed from the drum without destroying its value as a record by mutilating it.



A small local portion of a seismogram showing two things: in its upper part the microseisms that shake the earth lightly but continuously and are due to pounding of the surf on the coasts of the continents, according to the most generally accepted theory, and in its lower part a portion of the record of an earthquake that originated in the Netherlands East Indies, traversed the earth, made the upper curves, was reflected to the other side of the earth and again traveled to this side to make a second record of itself (at the very bottom of the illustration). From Scientific American, Dec. 1938

For convenience in placing and removing the records it is well to have a separate supporting frame similar to the one in Figure 7, or else a wall bracket as in Figure 9, *a*. This frame can also be used for smoking the records. This is done by placing a kerosene lamp under the drum, which is rotated until an even coating of lampblack covers the paper. It is better, however, to build a smoking box (Figure 9, *b*), as a better coating is secured by its use. After the day's run the paper should be carefully removed (leaving on it not more than one or two finger prints!) and laid flat to be pinned on a hanger like the one in Figure 9, *d*. The date and other data are written on it and it is then dipped in the thin shellac mixture in the vat (Figure 9, *c*). This thin shellac mixture should be about one fourth shellac and the rest alcohol. Placing the storage tank lower than the vat or dipping tank will allow the vat to empty through the connecting hose and this will prevent some loss by evaporation.

A defect of the seismograph just described is that no method is shown for

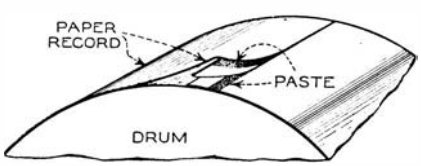


Figure 8: Simple fold for paper

recording time on the paper. This may wait until the amateur is satisfied that the seismograph is working well, for it may require several days before any world-shaking earthquakes occur to be recorded. A good visual test of the sensitivity of the instrument is the waviness of the recording line. These waves are microseisms and their amplitude will increase in stormy weather (typical microseisms are shown in the illustration in the central column of the present page). Traffic may also disturb the record. Microseisms should have periods of from three to five seconds or more, while traffic disturbances are in the neighborhood of one second in period. Sometimes

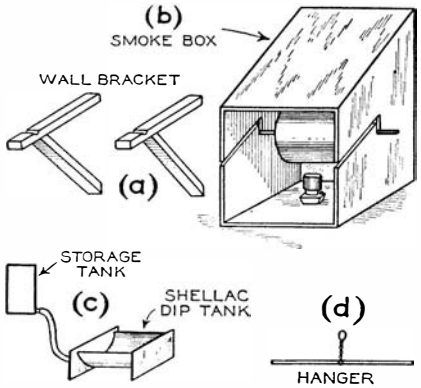


Figure 9: Accessory apparatus

traffic effect is magnified by trembling of the pen-arm, which may have nearly the same period. In such cases a small paper vane on the pen-arm often helps damp out this vibration.

The time control is maintained by a separate clock, since the added load on the drive clock would render its rate too uncertain. The second hand of the clock should be so arranged that an arm fitted on its shaft will close a contact once a minute for a period of about one second (Figure 10). The current from a dry cell will suffice to raise the pen from the paper by means of a small electromagnet

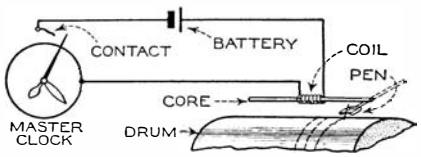
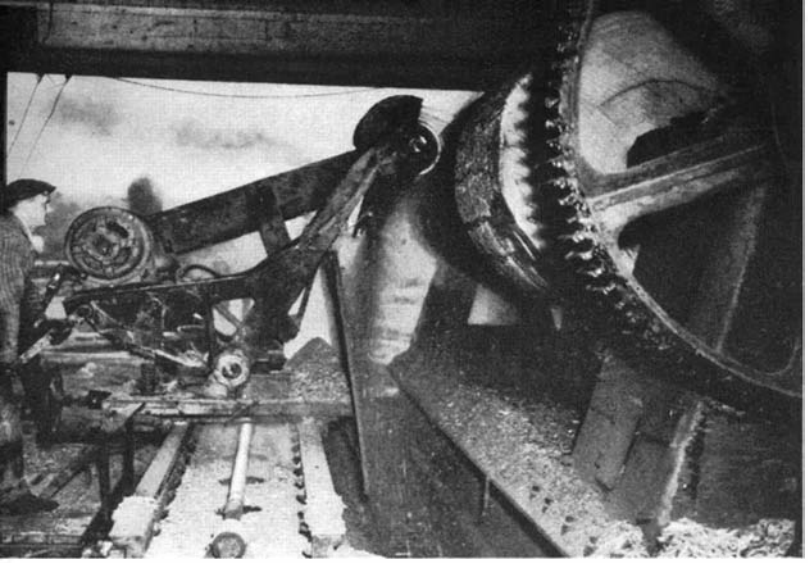


Figure 10: Electric time control

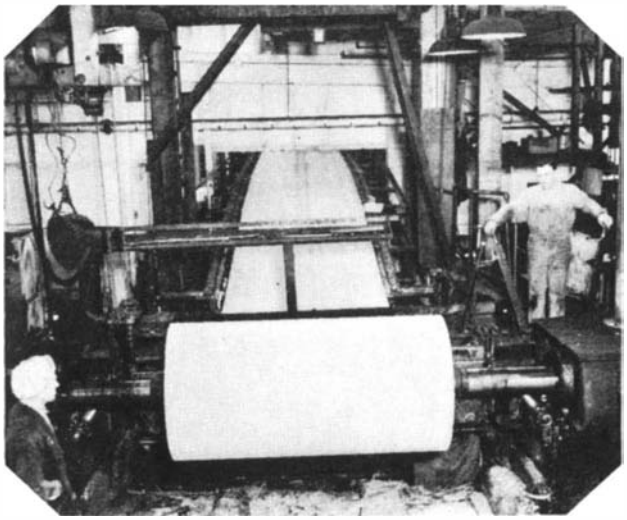
of 100 to 200 turns of magnet wire on a pencil of soft wires. This magnet is suspended above the pen by a rigid arm. The resulting gaps in the line will mark every minute of the day. To make them easier to read, hour marks can be added by contacts taken from the minute hand of the master clock. When the record is removed these latter gaps should be numbered on it with the proper hour. From time to time these marks from the master clock can be compared with radio time signals, thus obtaining for the record the absolute time correction for the beginning of each interval. This in turn will make possible the determination of the times of arrival of earthquake waves.

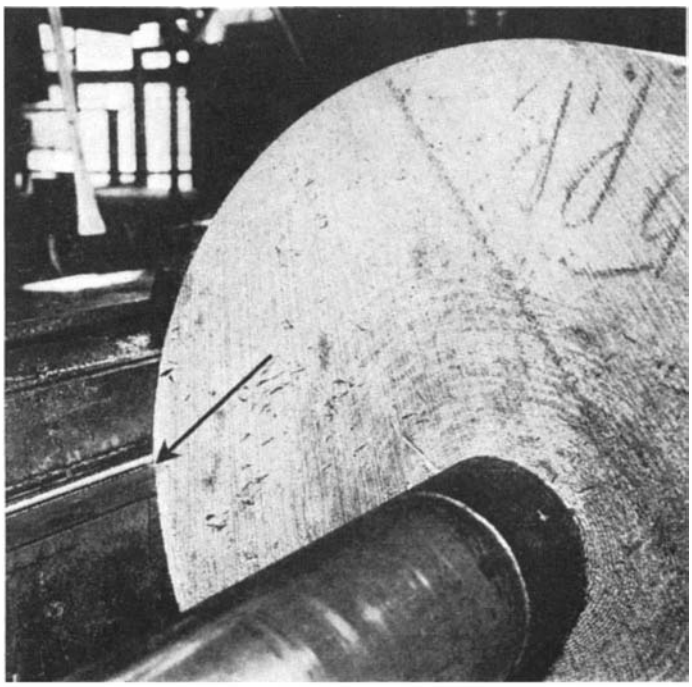
From Logs to Plywood



1 Removing the bark from a Douglas fir log, one of the first steps in the production of a form of plywood that finds wide use as wallboard, for structural purposes, in concrete forms, for subflooring and sheathing. Modern plywood, versatile and economical, is the result of co-operative research by forest product engineers and industrial chemists to produce a strong, light-weight material

2 *Below:* The log is set up in a lathe and the veneer, 1/28 to ⅛ of an inch thick, is cut in a continuous sheet that is delivered to a multi-tier conveyor. Plywood is made up of an odd number of plies bound together with various adhesives, with the grains of adjacent plies at right angles

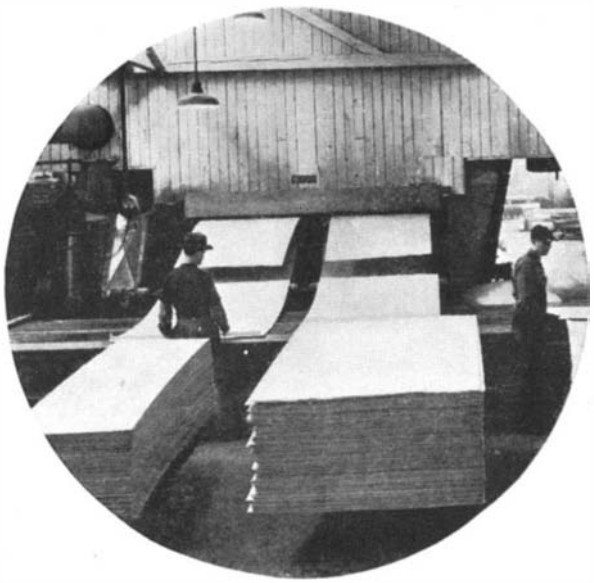




3 Arrow points to aperture between lathe knife and pressure bar through which the cut Douglas fir veneer runs at high speed. In other methods of producing special plywood veneers, the thin sheets may be sliced with a long, heavy knife, or sawn from the log

4 *Below:* Veneer going into mechanical roller driers, 150 feet long. Complete drying requires 15 minutes. Plywood structure is based on the fact that wood is strong with and weak across the grain. By binding together layers of wood with grains properly placed, a composite board is obtained that is uniformly strong

5 *Below:* Veneer emerging from the driers and being placed on sorting tables. The binding force of the transverse plies in plywood practically nullifies the tendency of wood to expand or contract across the grain, thereby reducing the co-efficient of expansion of a plywood panel to little more than 1/10 of 1 percent

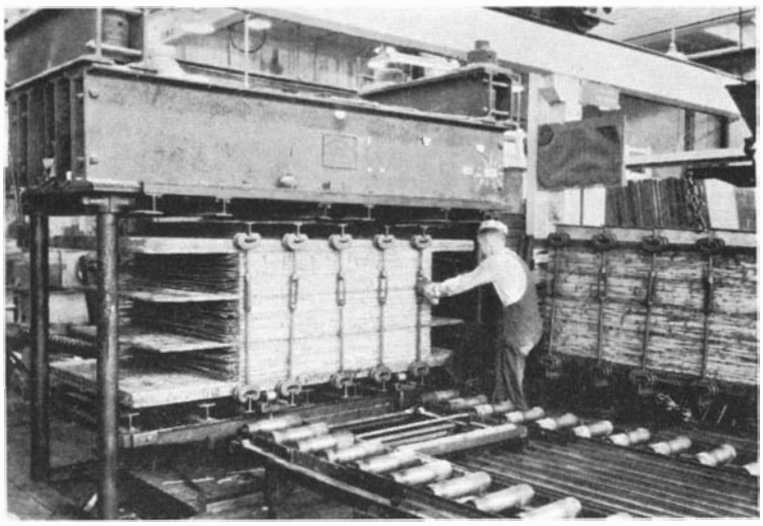


"Unwinding" Trees . . . Stronger Lumber . . . Made Possible by Research . . . Co-operative Efforts

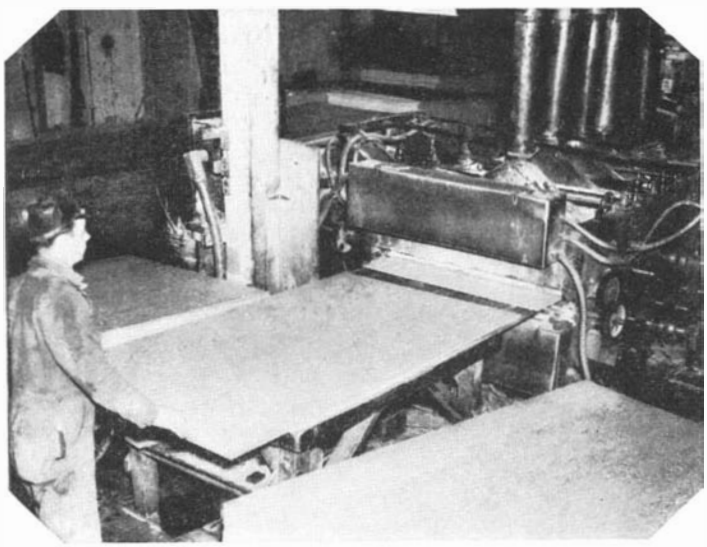
By A. P. PECK

6 Close-up of the glue-spreading operation. Adhesives used are casein, phenolic resins, or soya-bean meal, according to requirements. The soya-bean meal falls into that rare category of products which are at once cheap and good. In plywoods other than Douglas fir, both vegetable and animal base glues are used

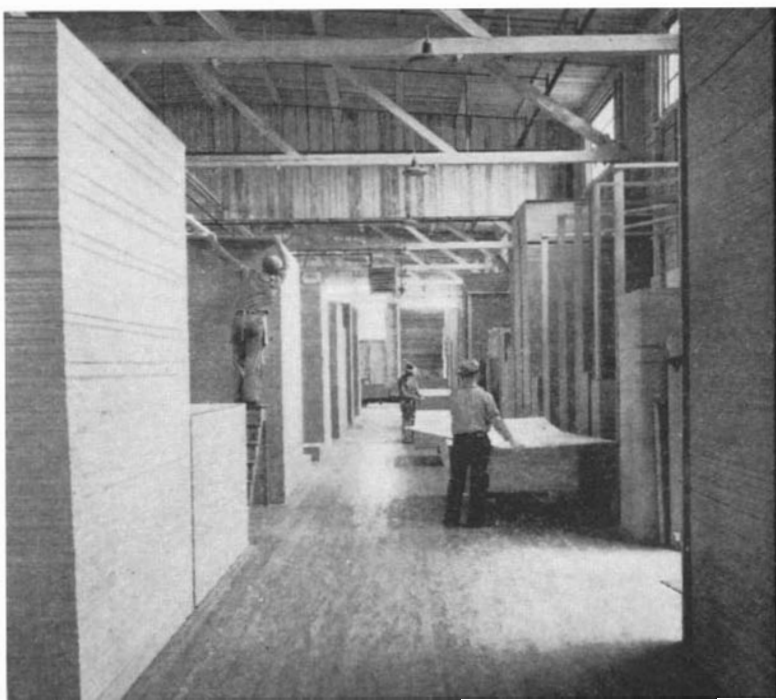
7 A general view of glue spreading showing the glue container at right center, with spreading rolls below. One of the advantages of plywood is its resistance to splitting. Nails may be driven close to the edge of the board without danger of splitting; also, nails hold well, cannot readily be drawn from plywood



8 *Right:* Glued-up plywood is subjected to a pressure of 200 pounds to the square inch, in a hydraulic press. The I beams, rods, and turnbuckles are used to retain the pressure, thus releasing the press for use on the next batch. Note the roller-type conveyor



9 *Left:* Sanding the surface of a finished, trimmed sheet of plywood. The panel passes through eight endless belt sanders, each of which carries a different grade of abrasive paper, the last of which gives a fine, smooth surface



10 *Right:* Finished Douglas fir plywood ready for shipment from the Seattle plant of the Aircraft Division of the United States Plywood Corporation. Trees, "unwound" and glued, are here ready for use in a multitude of applications in a wide variety of fields

SODIUM SKIES

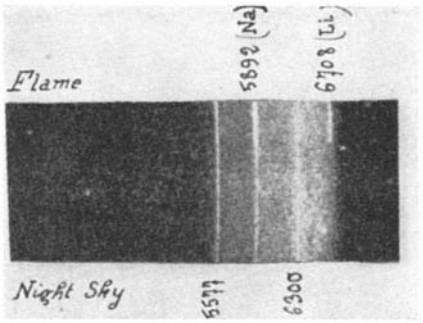
Recent Research Indicates that a Large Part of the Illumination We Commonly Designate as Starlight Originates in the Earth's Upper Atmosphere

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

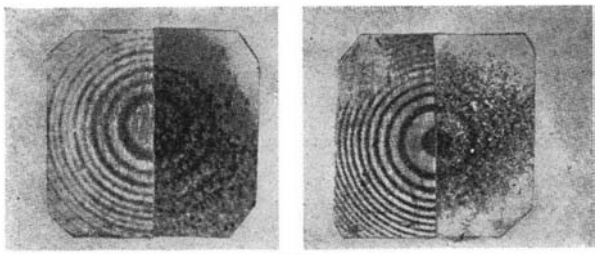
NO clear night is really dark. Only when clouds shut out the sky altogether is there much difficulty in finding one's way in open country, and even when the clouds are heaviest it is possible to see the outline of a building or a tree against them. Impenetrable darkness outdoors is very rare, though it has happened, even at noon, during great volcanic eruptions.

At first thought one would suppose that this faint illumination came from starlight. But photometric measures show that there is too much of it to be thus explained. More light comes from the vast numbers of stars invisible to the unaided eye than from those which we can see separately; but the sum of the two accounts only for about a third of the light of the night sky. A somewhat smaller part comes from the extension, all over the heavens, of the zodiacal light; that is, from sunlight reflected by an exceedingly thin haze of fine dust which extends well beyond the Earth's orbit. But a very considerable part of the whole light originates in the Earth's atmosphere—as is shown by the fact that its strength increases toward the horizon, and so represents something carried round by the Earth's rotation.



Courtesy *Astrophysical Journal*

Figure 1: Spectrum of the night sky



From *Astrophysical Journal*, Sept., 1938

Figure 2: Fringes, 0.15 and 0.30 mm. etalons

This "night sky" light shows a remarkable spectrum, consisting of emission lines and bands. It has long been known that the green line, so conspicuous in the spectrum of the aurora, can always be seen with suitable apparatus in any part of the sky. By using spectrographs of great light-power, many fainter emissions were discovered in the blue and violet; and, in 1929, Slipher found that there were relatively powerful radiations in the yellow and red, which would be conspicuous at a glance if our eyes were as sensitive to these longer waves as they are to the green.

Just as the Sun's first rays at dawn strike the upper air, the emissions become stronger and new ones appear, evidently stimulated by the sunlight.

The origin of this extensive and complex spectrum has not been easy to determine fully. The light, even at best, is faint, and can be photographed only with instruments of small dispersion, so that it is not possible to separate double lines, except very wide pairs, nor to discriminate, in many cases, between individual lines such as are produced by atoms, and complex bands (emitted by molecules), though, with ordinary higher dispersion the distinction is obvious.

Moreover, the conditions of excitation, at the very low density of the outer atmosphere, are so unfamiliar that some of the strongest lines are of the "forbidden" type which it is hard to produce at all in the laboratory. The great green line, and a pair of sharp lines in the red are such forbidden lines, emitted by neutral atoms of oxygen. Many of the bands in the blue and violet arise from neutral molecules of nitrogen. Some of the strongest features in the dawn-flash come from ionized nitrogen molecules—which are doubtless put into condition for their emission by extreme ultraviolet light from the Sun.

Identification of many of the infra-red bands still awaits more complete laboratory studies of gaseous spectra in this region. But there is a pretty strong line in the yellow which has till recently been a great puzzle. Laboratory spectra in this region are well known; but, for a reliable comparison we must have an accurate wavelength of the line. On low-dispersion plates it is very hard to secure this. The measures of several good observers, between 1929 and 1935, gave values ranging from 5885 to 5892 Angstrom units.

This immediately suggests the well known yellow sodium lines at 5889.98 and 5895.94. The spectrographs which were employed had not dispersion enough to separate the pair, and the recorded wavelength should be an average. This agrees well with the measures of Slipher, the discoverer, in 1929, but the later values are discordant. A strong helium line is nearby, at 5875.62, but the measures do not admit of identification with this.

To settle the question, more precise measurements were required, and these have been made by a group of French observers—MM. Cabannes, Dufay, and Gauzit, of Paris and Lyon—whose recent paper clears up the question most satisfactorily.

A new spectrograph, with a camera of the remarkably high focal ratio 0.7 (that is, with focal length only 70 percent of the diameter of the lens!) made it possible to photograph the yellow line with a half hour's exposure. The dispersion in the yellow is 500 A per millimeter. The line on the plates is 1/50 mm. wide, corresponding to 10 Angstroms (enough to include both sodium lines, while the helium line, if present, would have been clearly separated). Ten good plates gave an average wavelength of 5894 ± 1 A—almost in the middle between the sodium lines.

FIGURE 1 shows one of these plates, with the green and red oxygen lines, and the yellow line. At the top the spectrum of a Bunsen flame is superposed on that of the sky. The sodium line produced by the flame agrees with the atmospheric line very closely indeed. The line at 6708 is produced by lithium in

the flame and does not appear in the sky.

The critical question, however, is whether the night sky line is double. On the plates it is distinctly wider than the oxygen lines at 5577 and 6300, which are known to be sharp. Moreover, Dufay, in 1932, observed with a wide slit having a fine wire stretched lengthwise along the middle. With monochromatic radiation such as the oxygen lines, this gives a wide image on the plate with the narrow shadow of the wire down the middle; with the yellow line this shadow was less sharp.

This made it probable that the atmospheric yellow line was double, but fell short of proof. By making a spectrograph like the other, but two or three times larger in all dimensions, it should be possible to obtain spectra of greater linear dispersion, and find the line double on the photographs. But such an instrument would have been very expensive; and the analysis can be made with less costly apparatus.

The Fabry-Perot interferometer (itself a French invention) consists of two plates of glass with surfaces worked as accurately plane and parallel as possible, and set up with their inner surfaces parallel, and at a fixed distance apart. These surfaces are thinly silvered, so that they reflect back a part of the light and transmit the rest.

IF monochromatic light falls squarely upon such an apparatus, part of the light will be transmitted by both plates. Another part will be reflected from the second back to the first, again by this, and then pass through. The light-path will be longer by just twice the distance between the plates. If this double distance is an exact number of wavelengths of light, the two wave-trains will reinforce one another—as will also all the beams resulting from repeated reflections—and a great deal of the light will get through. But, if the double distance is half a wavelength greater, the waves of the second train will interfere with those of the first—and very little energy will pass through.

Now suppose that such an interferometer is set up in front of a camera, and pointed at a large luminous area which gives off light of a sharply definite wavelength. The same principle will apply; but the double distance for oblique rays must clearly be measured between the plates at the proper slant, and so will be greater, the greater the inclination. Hence, for light coming at different angles from the central axis of the plates, the device will alternately be nearly transparent and almost opaque, and our photograph will show bright and dark rings such as are exhibited in Figure 2, left, which is a negative on which the bright rings show dark.

Near the axis it takes a greater change in obliquity of the rays to increase the path by a given amount than farther away; hence the outer rings are more closely spaced.

If two radiations of slightly different wavelengths are present, there will be two sets of rings, of different sizes. If the double distance of the plates is such that one set of light-waves gets ahead of the other by a whole wave, in traversing it, the two systems of rings will be

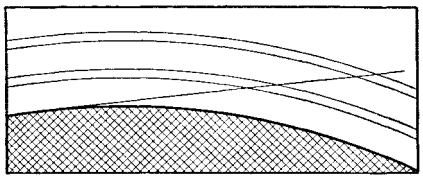


Figure 3: **Upper cut is less oblique**

superposed; but if the gain of one set of waves on the other is half a wave (or 1½, 2½, etc.), the second system of rings will lie half-way between those of the first.

For sodium light the second situation occurs if the plates are 0.15 mm. apart, and the first if their distance is 0.30 mm.

Figures 2, left and right, show the results obtained with these plate separations. The left-hand halves represent rings obtained with sodium light in the laboratory, and the faint right-hand parts those with the night sky.

The latter show the coarse grain inevitable (with present technology) in very fast plates, but it is evident that the ring systems are essentially just the same in both cases. When the two ring-systems are seen separately (Figure 2, left), those of one set are fainter than the other, both in the sky and the laboratory —corresponding to the fact that λ5890 is stronger than λ5896.

The agreement of the photographs makes it quite certain that the yellow radiation of the night sky actually comes from sodium.

To obtain these interferometer photographs was a real *tour de force*. The light of other lines in the night sky spectrum had to be got rid of. The green line was cut out by an orange filter; the red line by using plates not sensitive in this region. To obtain clear photographs from the night sky exposures had to be made on two or three successive nights. At the beginning of dawn (or at a corresponding hour in the evening) the radiations are much stronger, and exposures of half an hour suffice. Figure 2 represents photographs taken in this light. The longer exposures during the night gave substantially the same result. The intensity of the yellow lines is greater at low altitudes in the sky than near the zenith, obviously because we are looking through a greater thickness of faintly luminous atmosphere in the second case. If radiation comes from a fairly thin layer at a definite height above the ground, this effect will be greater, the less the height. It is obvious from Figure 3 that the line of sight cuts the upper layer less obliquely.

From measures made by Garrigue, our authors conclude that the height of the luminescent layer is about 130 kilometers, or 80 miles.

This beautiful piece of work shows conclusively that sodium *atoms* are present in the upper regions of the Earth's atmosphere in sufficient abundance to give out their characteristic radiation. This is a very extraordinary fact, for there are also oxygen atoms up there, as well as molecules, and a free sodium atom would seem to have little better chance of long life than Billy Sunday's famous "celluloid dog chasing an asbestos cat through Hell." At present we can only say that they evidently *do* last long enough to do a good bit of shining. In the regions exposed to sunlight these free atoms cannot help absorbing energy from sunlight, and unloading it again, giving the characteristic "resonance emissions." The sunlight which they are absorbing is represented by the centers of the observed sodium lines, and is much weakened, but still pretty strong, so that it is easy to see why these lines show so strongly at dawn. In the middle of the night they may be excited by impacts of electrons or ions—which are known to be present at this height.

BUT how do the sodium atoms get there? It is imaginable that some minute amount of salt dust derived from ocean spray may get a few miles up, but if it did get 80 miles high, we would have molecules of NaCl, and no known way of decomposing them.

Our authors think it probable that the sodium comes from meteorites, which certainly contain sodium and are volatilized, in great numbers, at about this height. While the meteor is luminous it is very hot; and it is reasonable enough to suppose that free sodium atoms may escape from the turmoil.

If this explanation is correct, there should be free calcium atoms present, too,—and our French colleagues note that a faint line in the night sky spectrum at λ4226 coincides, within the errors of measurement, with the resonance line of calcium. The meteorites should also liberate atoms of aluminum, potassium, iron, magnesium and silicon; but the resonance lines of the last two are out of reach in the ultra-violet—obscured by ozone absorption. Those of iron and aluminum are in the accessible portion of the ultra-violet, and therefore might be detected by observation in this region. The potassium lines are in the deep red, and might be disentangled from the strong bands there. Further studies which are being made in this promising field will be of great interest.—*Princeton University Observatory, December 5, 1938.*

American Archeologists

Recent Results of the Excavation of the Agora, Market Place and Civic Center of Ancient Athens, Have Exceeded All the Previous Expectations

EIGHT years of excavation in the Agora of Athens, conducted by the American School of Classical Studies, have resulted in uncovering the greater part of the ancient market place. Where 360 modern houses stood in 1931, and narrow streets were teeming with thousands of local residents, there now appear the public buildings and the broad streets which were frequented for hundreds of years by Athenians of the classical period. Since the level of the terrain of that age lies between 10 and 15 feet below the modern level it has been necessary to remove 190,000 tons of earth, which have been carted to the outskirts of the city where low land required to be filled.

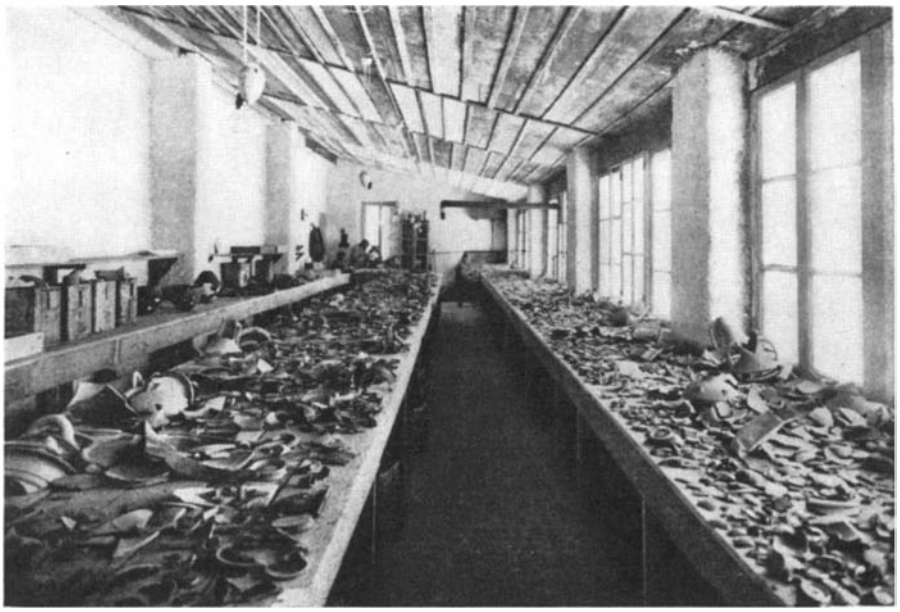
Athens was subjected several times in its history to thorough devastation by invading armies: by the Persians in 480 B.C., by the Romans under Sulla in 86 B.C., by the Herulians in 267 A.D., and by the Goths under Alaric in 396 A.D. Moreover, the site of the city has been almost continuously occupied from ancient to modern times. The result is that the remains of the ancient buildings exist for the most part only in foundations, but in the débris from the various destructions lying about the foundations so many architectural pieces from the superstructures of the buildings have been recovered as to make it possible to reconstruct the buildings on paper with practical certainty.

The identifications of the public buildings are based on references to them by ancient writers, among whom the most valuable is Pausanias, a traveler who visited Athens about the middle of the second century after Christ. Although Pausanias did not aim to write a guide book, his description is so lucid that the excavated buildings can be exactly equated with those listed seriatim in his itinerary. We can thus follow in the visitor's footsteps along the street bordering the west side of the market and see the Portico of Zeus, where occurred the diverting colloquy on feminine beauty between Socrates and Ischomachos, the small Ionic temple of Apollo, the Temple of the Mother of the Gods, where the archives of the city were filed and in the court of which the cask of Diogenes lay, the Senate House, and finally the Tholos, a circular building where the officers of the Council were boarded and distinguished foreigners were entertained. Towering on a hillock above these ruins is the best preserved of

At left: A fraction of the excavations; Temple of Hephaestus. *Below, left to right:* Tholos, Temple of the Mother of the Gods, behind it the roof of the Senate House, a stair leading to Temple of Hephaestus, the Temple of Apollo, the Stoa of Zeus Eleutherius

IN ANCIENT ATHENS

By T. LESLIE SHEAR
Professor of Classical Archeology at Princeton University
Field Director of the American School of Classical Studies



The vase mending room mentioned in the text, with thousands of potsherds, or fragments of broken vessels, spread out on the tables in systematic order

Vase of late 6th Century, found in a well in center of the Tholos

all Greek temples, which has now been proved to have been dedicated to Hephaestus, the God of the forge.

Still following the route of Pausanias we then pass to the Temple of Ares, north of which is the Altar of the Twelve Gods, the most sacred altar in the market place; in the center of the area is the Odeum, in the southwest corner the main fountain house of the city and along the east side runs a broad street, 30 feet wide, which for centuries was the chief thoroughfare from the Agora to the Acropolis, providing an easy ascent for the great Panathenaic procession which regularly paused half up the slope at the site of the Eleusinion.

Thus the topography of the market place, as it appeared in the classical period, has been almost completely revealed, but in addition to that the excavations have uncovered earlier buildings and monuments which were unknown to the classical Greeks and have brought to light a long series of subsequent settlements. Substantial remains have been found of continuous occupation of the site extending with little interruption from the late neolithic age, about 3000 B.C., down to modern times. In order to determine the relative ages of successive deposits the utmost care must be exercised in the observation and excavation of numerous superimposed strata, and the objects found in them, by which the chronology is fixed, must be accurately identified and precisely recorded. To this end a group of expert excavators has been developed in the Agora work and an elaborate system of recording has been established by which any one of the 38,000 catalogued objects from any designated square meter of the site at any stated level is immediately available.

BEFORE the beginning of these excavations it had been generally prophesied that, because of the thorough devastation of the area, little of other than topographical and historical interest would be found except inscribed records which, being on stone, would not have been coveted by invading conquerors. The epigraphical harvest has, in fact, exceeded all expectations. The 5500 inscriptions so far found include part of the law code of Solon, the official list of the confiscated property of Alcibiades, other important legal documents, dedicatory inscriptions of various kinds, among which the most important are the epigrams of Simonides and Aeschylus in honor of the Athenians who fell at Marathon, and the epigram by Simonides written on the base of the statues of the Tyrannicides. Many honorary decrees which carry their date of issue have furnished much information in regard to names and dates of the archons of Athens, so that important additions and corrections have been made to our knowledge of the Attic calendar. Not the least important of the inscribed documents is the collection of 289 ostraka, the ballots cast against citizens whom their fellows wished to drive into exile. The list includes the first and last men ostracized, Hipparchos, son of Charmos, in 487 B.C. and Hyperbolos, son of Antiphanes, in 417. The man on the list with the largest number of ballots (99) is Themistocles, and next to him comes Aristeides, "the Just," with 49 votes. These ballots are contemporary documents and, apart from their historical value, are of interest in illustrating the orthography of the average Athenian of the time.

A surprising result of the excavations is the discovery of sculptured works of both Greek and Roman periods and of quantities of vases, many of which are preserved in perfect condition. The unexpected sources of this material are early graves and wells, which were filled from time to time with débris, usually due to the clearance of the site after some disaster to the city. Since burials were not permitted within the city limits the graves antedate the period when the market place was here located. Scattered graves have been found with their contents intact which date from the late neolithic period, about 3000 B.C., from the Mycenaean, 1200 B.C., and from the protogeometric age, 900 B.C. Besides these a family burial plot, located just south of the later Tholos, was uncovered which dates from late geometric times (8th Century B.C.). The plot contained shaft graves for adults and urn burials for infants; its homogeneous nature was indicated by the proximity of the burials and by the fact that the area was surrounded by a circuit wall. Moreover, a detailed anthropological investigation of the skeletal material revealed a strong

family resemblance among the occupants of the graves. The graves, which were intact with their stone covers in place, yielded many handsome complete vases of the period, one burial, that of a young girl, containing no less than 28 objects. This plot had been completely covered by the beginning of the 5th Century and its existence was presumably then unknown. It is evident that these

Vase of early 6th Century found in a well, showing oriental influence

graves have been preserved only by accident and that many other burials in the area were destroyed when the rock was cleared for the massive foundations of later buildings.

The most fertile source for individual objects has been the deposit in wells. These are invariably cut in the soft bedrock and extend down to varying depths, the deepest so far cleared having a depth of about 120 feet. A few of the wells have been used continuously to modern times, but most of them are filled to the top with earth and débris. In some cases the ancient diggers failed to strike water and abandoned the project, but usually water is encountered after a few yards of upper filling has been removed, and several times the inflow of water has been so great that a 24-hour schedule of bailing has been necessary in order to make possible the removal of the deposit. Some wells have been opened on the northern slope of the Acropolis and in the Agora itself but most of them served small houses and shops in the areas adjacent to the market place.

THE clearance of a well is a difficult technical problem since the diameter of the shaft rarely exceeds a yard and is often less, and great care must be exercised in order to avoid breakage of fragile objects. A skilled workman of small size works in the shaft, using only his hands for digging when small objects are numerous in the earth. The water and earth are removed by metal buckets operated by a windlass, and the deposit is recorded at 50 centimeter levels, the strictest watch being kept for evidence of stratification. All earth from wells is passed through a sieve at least once; that from the well containing the ivory statuette of Apollo Lykeios was sifted three times.

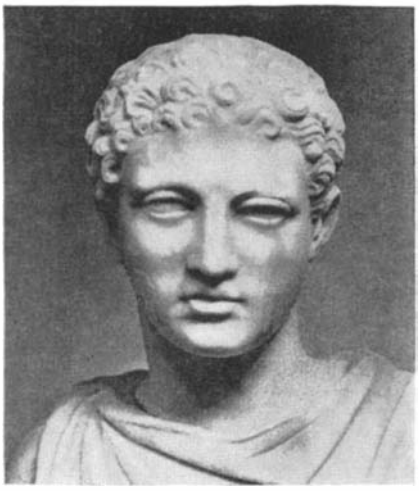
The wells were filled up at different periods, usually in connection with some devastation of the city, such as the Persian invasion or the sack of Sulla. It may have been fear of pollution that led surviving inhabitants to fill existing wells with débris and hew in the solid rock with considerable effort new ones nearby. Where wells have been in actual use complete vases, usually of undecorated household ware, are invariably found at the bottom where they have fallen from the hands of careless housemaids. But for the most part the pottery in the filling deposits is broken and these potsherds, sometimes exceeding a hundred baskets in quantity, are taken to the workrooms where, arranged in sequence of depth from the top to the bottom of the well, they are spread out on long tables. Then

Staff members and technicians mending vases in the workrooms

members of the staff and the Greek technicians sort pieces belonging to individual vases which are put together, with restorations in plaster of any missing pieces.

Since the dates of the construction and of the filling of a well can usually be closely fixed by the pottery, lamps or coins on the respective levels, it is evident that invaluable chronological data are provided for other associated objects of which the exact period was previously unknown. If, for example, a piece of sculpture is found in a well which contains nothing later than the sack of Sulla, as occurred last season, that sculpture cannot be interpreted as a Roman copy of a Greek work. Similarly, in the case of undecorated household pottery and kitchen ware, which has been largely disregarded in the past, deposits of fixed date acquaint us with the domestic habits of the Athenians throughout the ages. A considerable amount of this plain pottery was secured in the last campaign from a well in the center of the later Tholos, which was constructed in the third quarter of the 6th Century and went out of use in 480. It was associated with handsome black-figured vases of the late 6th Century. This was the table ware which was undoubtedly used in connection with the service of meals in the Tholos to the officers of the Council.

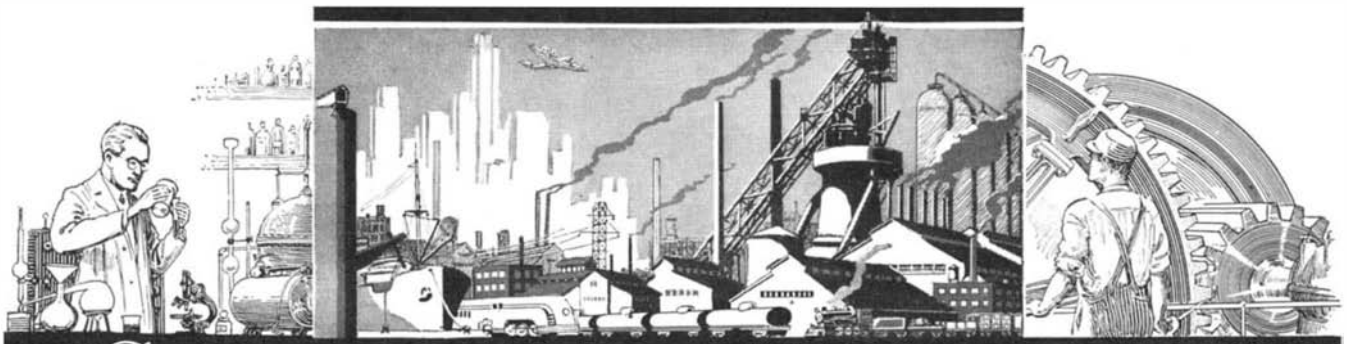
NOT a few pieces of sculpture have been secured from wells and in several cases where the pieces fit together to form complete statues it is clear that the objects were deliberately broken at the time they were thrown away. The most sensational discovery in the field was that of the unique ivory statuette of Apollo Lykeios which has been put together from 275 small pieces. A marble statue of a Faun was found broken in 73 pieces, and during the past season a statue of Hermes (see below) proved to be intact except for the right hand, after seven pieces had been cemented together. Occasionally the despoilers dumped an object into a well without taking the trouble to mar it, and then the excavators are cheered by the discovery of a handsome work such as the marble head of the bearded Hermes of archaic type, found also in the last campaign. This is a beautiful replica of the Hermes of Alcamenes, a sculptor who was active about the middle of the 5th Century B.C. Bronzes as well as marbles were tossed into the wells but, with several notable exceptions, they have suffered serious damage from the corrosive action of the water. The wells thus served as convenient dumping places for refuse, cast-offs, and any ob-



The head of the statue of Hermes which was found in a well in 1938

jects of which contemporary inhabitants wished to be rid, human nature being the same then as now; they have proved to be exhaustless mines of treasure to the excavators.

All the objects from the excavations are housed in a temporary museum on the site which will be replaced by a permanent Agora Museum, the construction of which will be begun in the immediate future. Full reports on the progress of the work and on the many discoveries are published in preliminary form in *Hesperia*, the Journal of the American School at Athens.



SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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

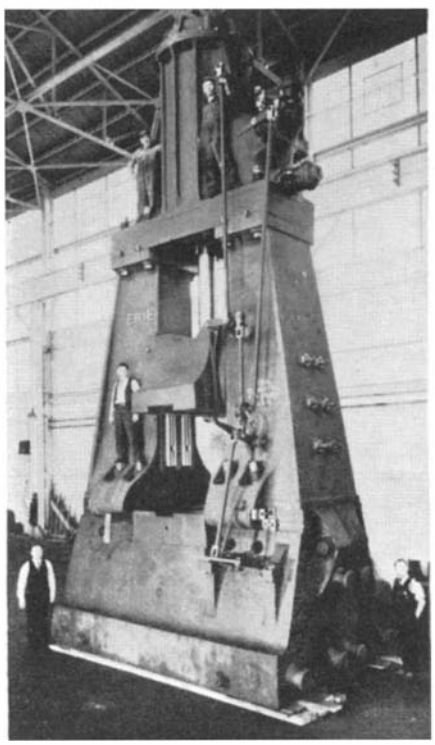
D. H. KILLEFFER
Chemical Engineer

Largest Steam Hammer

RAISING its steam cylinder-head higher than the average dwelling house, the largest steam drop hammer ever built has been shipped to England from the Erie Foundry Company. This hammer will be used in the forging of airplane engine crankcases and airplane propellers for British aircraft of all types.

So light is the control that the ram may be brought within the smallest fraction of an inch of the dies at full speed and stopped there. The cushion effect of steam control was a marvelous sight to watch as the hammer underwent its preliminary test before being dismantled for shipment.

After installation, the hammer will be 27 feet in height, from the floor line to the top of the cylinder. Beneath the floor, extending 12 feet 9½ inches into the ground and resting upon its own foundation anchored to bedrock, extends the sub-anvil structure. This is in two pieces, each of which weighs approximately 234,000 pounds. The super-anvil, above the floor line and supporting the gigantic frames, is in two pieces, each of which weighs approximately 200,000 pounds.



From floor to top—27 feet

The weight of the ram, piston rod, and piston is 50,000 pounds, and with the top die included, the reciprocating weight increases to more than 70,000 pounds. The diameter of the cylinder is 39 inches and the stroke of the piston is 72 inches. The piston rod diameter is 11½ inches. The space between the guides is 50 inches and the ram is 80 inches front to back.

Wine from Milk

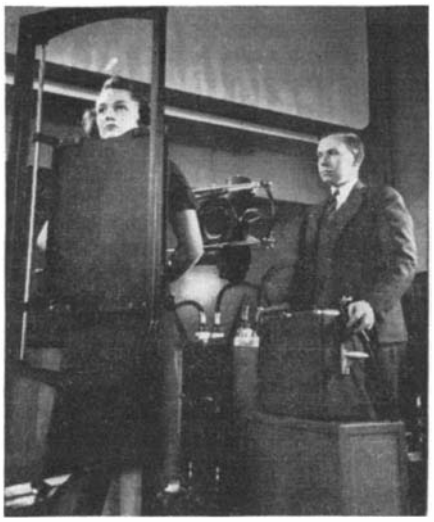
BECAUSE the great dairy industry in Denmark has whey as a by-product of its operations, earnest efforts have been made to find uses for the quantities of this liquid wasted. One of the latest results of these researches is the manufacture of an excellent "wine" from whey. So far only in the large-scale experimental stage, the process may yield as much as a million and a half Danish kroner annually, if results as proved to date can be realized on a nation-wide scale.—*D. H. K.*

X-Ray "Candid Camera" Snaps Human Chest

A SMALL glass "trigger tube," no larger than a 65-watt lamp, puts ordinary house current to work snapping a candid-camera picture of a human chest in less than a hundredth of a second.

This tube controls the flow of 110-volt power from a light-socket to a bank of condensers. Eight seconds later, at the press of a button, it releases this stored-up power as an 89,000-volt maximum discharge through an X-ray tube.

The resultant invisible X rays are shot out from the large tube and through the chest of a model standing four feet from the portable machine. Clicking faster than a heart beat, this latest development in candid picture-making recorded a chest radiograph free from distortions which the movements of the heart sometimes cause in conventional X-ray pictures.



Taking an X-ray snapshot

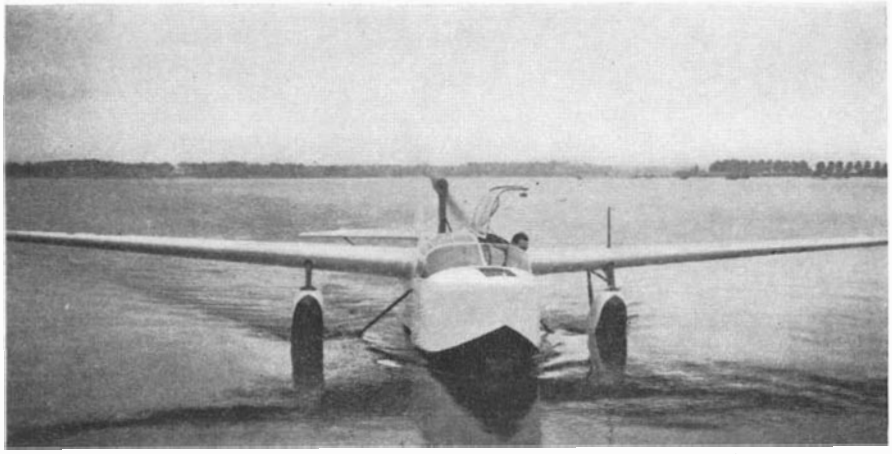
Dr. Victor E. Hicks, director of the industrial division of the Westinghouse X-Ray Company, recently explained that the new condenser discharge dynex had been developed primarily for the study of chests in medical practice and listed its outstanding features as "the elimination of mechanical time switches, plus the uniformity of the chest films produced regardless of the chest thickness or line voltage variations."

The "trigger tube," Dr. Hicks continued, is a vacuum tube containing electric coils, which permits the power to flow from the electric outlet to the condensers and then when the coils become heated permits the condensers to discharge their accumulated power to make the X-ray exposure.

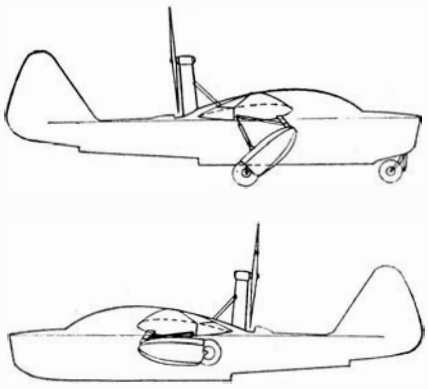
Tinted Insulation Board

THE insulation board industry, whose first products were strictly utilitarian, has long been seeking to make its products decorative as well. The boards made of wood fibers, first a deep brown, have steadily been lightened in color, and are now available in a light tan.

One of the most spectacular advances,



Above: The Spencer-Larsen amphibian. *Below:* Drawings showing how the stabilizing floats and landing wheels are combined and pivoted so the wheels may be retracted



however, has come in recent months with the perfecting, by Fir-Tex engineers, of a tinting process. Fir-Tex "Colorkote" panels now are offered in ivory, sky blue, apple green, apricot, and shell pink. They provide interior wall finish, and insulation, in one application. Eliminated are lath, plaster, wallpaper, and calcimine.

The basic board is made of interlaced wood fibers. The manufacturing process utilizes the by-products of Pacific Northwest lumbering—clean, inside wood which, for ordinary building purposes, is the wrong size or shape. The special Colorkote preparation, containing the desired tint, is mechanically painted on the board. In a battery of dry kilns, the tint preparation is baked in. A calendering operation then produces a glazed surface.

Since the coloring material is insoluble in water, the Colorkote panels are washable. The home owner may change the color scheme at any time. Any decorating treatment may be used, and no sizing is required. For novelty effects, the panels may be grooved to reveal the natural tan color beneath.

A Novel Amphibian

THE Spencer-Larsen Amphibian, which has been undergoing extensive tests on Long Island, has many novel and logical features in its design.

In a pusher flying boat, the propeller thrust line must be well above the top of the hull, and so the heavy engine is likewise placed high above the hull. The center of gravity is high accordingly. But for stability in the water, the center of gravity should be low. The designers of the new amphibian have reconciled these divergent requirements by putting the engine in the hull and driving the propeller through a gear transmission unit, using two vertical shafts. If the well-designed transmission system proves entirely serviceable, positioning the engine within the hull will bring other advantages such as the elimination of a drag-producing nacelle and greater efficiency of the propeller, which will be free of interferences. Of course the cooling of the internally placed engine must be carefully taken care of and suitable air scoops must be provided.

In former years, plywood was regarded with suspicion when employed in the hull. In the Spencer-Larsen machine, however, phenolic bonded plywood, internally protected with Bakelite varnish and externally with synthetic enamel, has resulted in a seaworthy hull which is easier and cheaper to build in limited production than a metal hull.

The amphibian characteristics have been attained by making the two stabilizing floats and the landing gear into single units. When the front end of each float is pivoted upward, the main wheels are in contact with the ground, and the nose wheel is let down. The boat is then provided with a perfectly serviceable landing gear. But when the nose of each float is depressed, the wheels are raised simultaneously and are faired in behind the floats. The photograph shows the general lines of the amphibian; the sketches illustrate the functioning of the combined water and land alighting gear.

With a four cylinder Menasco engine developing 125 horsepower, two occupants, and a useful load of 600 pounds, a respectable cruising speed is obtained. A small, not too expensive amphibian is not available on the market at the present time, and intelligent efforts to fill the gap will be welcomed by the aviation fraternity.—*A. K.*

Chairman of the C. A. A.

PERSONAL contact with Edward J. Noble, Chairman of the Civil Aeronautics Authority convinces us that here is the right man for an important job. Mr. Noble is not a career bureaucrat, not an over-zealous reformer, but a quiet, capable business man, with the most sincere desire to advance American aviation. He is modestly studying every phase of the many problems facing the Authority and coming to careful, well-thought-out decisions. Every announcement coming from the Authority in Washington bears out this view. Thus the solution of the vexing problem of a real airport for the capital of the country, and the elimination of the terrible flight hazards at the Washington airport, are both in sight. Plans are under way for a 750-acre airport at Gravelly Point on the Potomac River, only three and a half miles from the Washington Post Office. Four runways of at least 5000 feet each, good approaches, freedom from danger of flooding, and excellent navigational facilities are all to be provided. Again, the Civil Aeronautics Authority is not rushing into a program of airport construction for the whole country, but is undertaking a careful and comprehensive rational survey first of all.—*A. K.*

Automatic Direction Finder

AFTER several months of intensive flight testing in scheduled service with an American Air Lines Douglas transport plane, the Sperry Gyroscope Company has made public announcement of its new automatic direction finder. Since November, 1937, air regulations have required that all transport planes should be equipped with a shielded loop antenna and a direction finder to help locate the airplane and to secure positive radio reception of the airway beams under adverse weather conditions. Many excellent devices have been put into service and have proved of great utility.

The only drawback to these devices has been that they require close attention by the pilot, already burdened with other duties. The new direction finder not only achieves what previous devices have achieved, but functions automatically and continuously, to the great relief of the airman.

With the automatic direction finder, the pilot is only required to tune to a station. The pointer on the dial of the instrument indicates the exact bearing of the station and continues to give the bearing even up to the point of passing over the station. Another valuable feature of the device is that it immediately shows the pilot when he has passed over a station, to confirm the "cone

The indicator of the automatic direction finder is conveniently located

of silence" which he may have noted when flying on the regular radio beam. The cone of silence is recognized as a somewhat negative aid, since, as the term implies, there is a momentary absence of any signal.

Another advantage of the new apparatus is that it provides a method of determining the

drift or "crab" angle at any time. The pilot can tune in on a station toward which he is flying and observe whether or not the heading of the airplane is constantly changing. If he then turns the airplane to right or left until the bearing is no longer changing, he can determine, by a simple arithmetical process, the angle of drift or "crab" that the plane must take to make allowance for the wind.

Still another advantage is that bearings can now be obtained when static conditions are so bad that it is virtually impossible to obtain a "null" signal if operating the ordinary type of hand-operated loop.

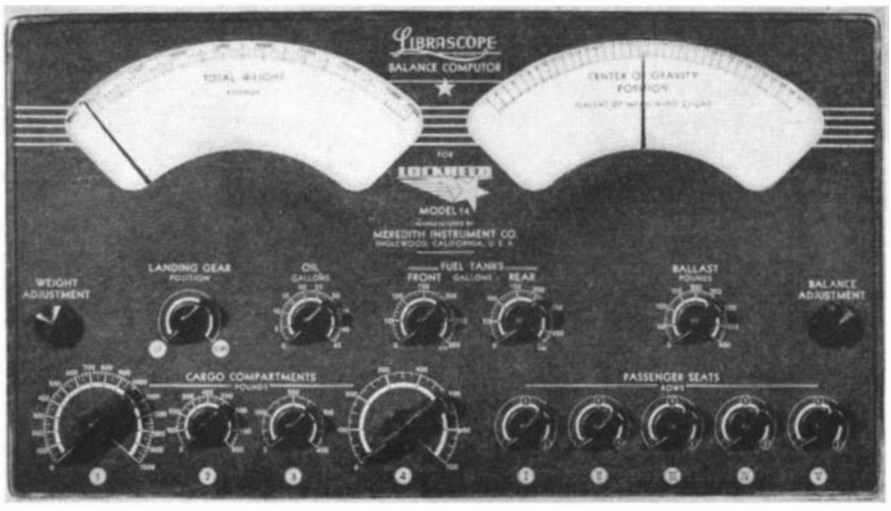
The instrument is so mounted as to have considerable appeal from the point of view of convenience. As our photograph indicates, the centrally located automatic direction finder is mounted in a horizontal plane. Following the pointer, the pilot can readily imagine what his course and bearings are over the earth below.

Some marvellous things have been done in demonstration. For example, the Douglas plane was able to locate a carefully hidden truck which was acting as a temporary transmitting station.—*A. K.*

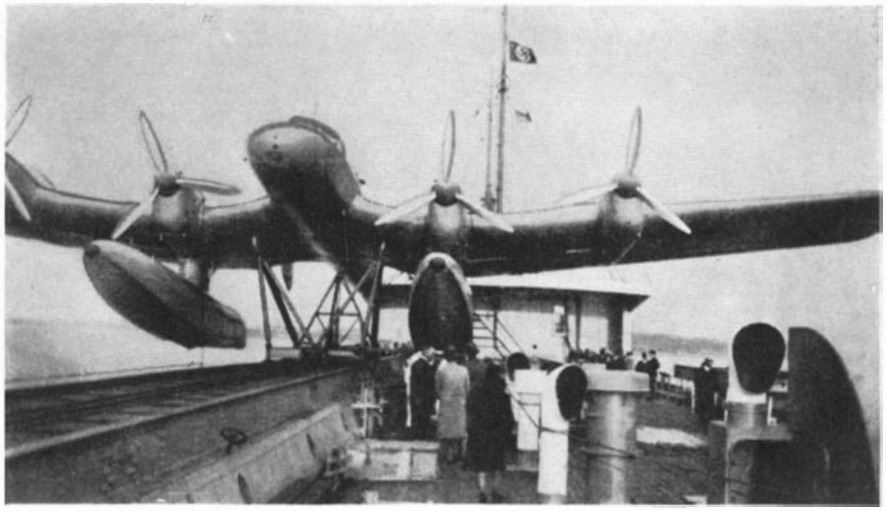
The Librascope

ONE of the most important points in airplane operation is the correct balance or trim of the craft. Yet changes in cargo, consumption of fuel, changes in position of the passengers, all introduce changes in the trim. Minor variations in the center of gravity position may be taken care of by the use of tabs or trimmers placed at the rear edges of the elevators. But the tabs must not be asked to do too much or else both efficiency and control power are lost. Also, it is far better to know the location of the center of gravity at all times, so that necessary adjustments in weight position can be readily made. Formerly the operating personnel was provided with elaborate loading charts, and had to carry out complex computations.

Now the job has been taken over by the Librascope, made by the Meredith Instrument Company, which has no friction devices or springs to wear or deteriorate and carries on its lower face a number of dials which indicate (as our photograph shows) landing gear position, the amount of oil and fuel in the tanks, ballast, passenger loads in various seats, cargo load, and so on. By moving the various knobs appropriately, and setting the weight adjustment to work, the operator can read the total weight on the scale at the upper left hand corner. A change over to "balance adjustment" indicates the center of gravity position on the right upper scale. We have operated the instrument ourselves at Newark Airport, and have been satisfied that here is a simple, entirely practical, and highly useful device.—*A. K.*



Panel view of the Librascope, described above



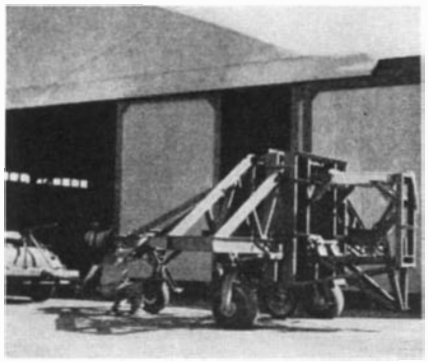
A seaplane on the *Friesenland's* catapult

Catapulting a Large Seaplane

THERE are many plans for commercial operation across the North Atlantic: the composite seaplane; the construction of a seadrome in mid-Atlantic; the use of a very fast, very clean landplane; the utilization of large flying boats with stopping places at the Bermudas or the Azores; the catapulting of heavily loaded seaplanes. We believe that the final solution will be in the construction of very large flying boats which will be able to fly non-stop from New York to London, while carrying a commercial payload. But in the intermediate stage, the catapulting of a large seaplane from a mother surface vessel, as practiced by the Deutsche Lufthansa, is an effective and successful method of operation. Recently the writer of these notes had the privilege of visiting the *Friesenland*, a surface vessel which is employed in catapulting the Lufthansa's seaplanes, and of observing the launching process. German engineers have worked out the catapulting system in good fashion. An air compressor, electrically driven, supplies air to huge cylinders with slow moving pistons. The irresistible power of the pistons, acting through sheaves and cables, sets the carriage into rapid motion without perceptible effort. The plane moves over the onlooker's head and in a couple of seconds the huge seaplane is aloft and away. Even the most blasé spectator gets a thrill when witnessing this triumph of the mechanical engineer's art.—*A. K.*

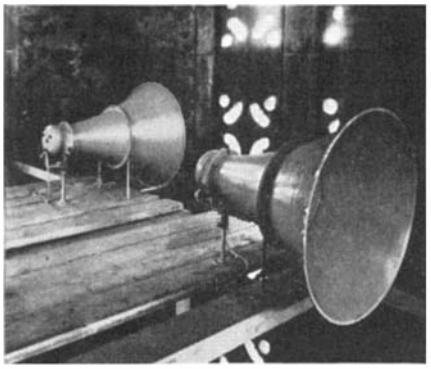
Torturing the Landing Gear

IN airplane construction the ships are subjected to severe loading tests, to destruction if necessary, but it is not possible to submit them to quite the same degree of rough testing as is done with automobiles—the hazard to pilots would be too great. Nevertheless, aeronautical engineers are rapidly developing a technique which will give guarantee of strength and safety in the completed ship. Thus, Lockheed Aircraft has recently introduced a piece of test equipment for landing gears which is a decided addition to this art of destructive or preventive testing. The three-wheel landing gear, of the tricycle or nose wheel type, is towed behind a car. On the three wheels is mounted a rather fantastic looking structure, on which the brave test pilot takes his seat, and on which tons of pig iron can be distributed in various ways. The wheels are provided with airplane brakes. Here are some of the test methods which the engineers adopt:



Landing gear torture unit

While rolling along at 40 to 45 miles per



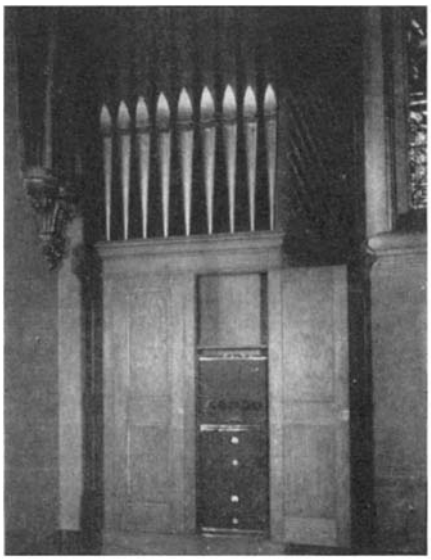
Above: **Loudspeakers in the belfry, and,** *right,* **the chime amplifier. The chimes themselves are concealed behind a set of dummy organ pipes**

hour, the pilot suddenly locks one rear wheel brake. The three tons of steel framework and pig iron swerve sharply, rock, but do not turn over.

At the end of the runway a steel plate is placed on the ground. It is about 12 feet long, ten feet wide and heavily greased so that it is as slippery as ice. The tow car reaches a very high speed, and releases the tricycle landing gear just before the greased plate is reached. The pilot bounces the machine on the rough terrain, raises the front wheel and, while it is off the ground, turns it sidewise. On landing, then, it is in exactly the opposite position to that which all good landing wheels should assume for a proper landing. Violent "shimmy" is thus induced, and the pilot is subjecting the gear to the most severe test possible. The machine bounces, jolts, and then to top off, skids onto the greased plate at 35 miles per hour. The front wheel swings around and the gear resumes normal operation, rolls ahead, and comes to a stop. That is to say, it should, if the designers have done a good job. Otherwise, the landing gear goes back to the experimental shop, and the pilot probably to the hospital!—*A. K.*

To Popularize Private Flying

RUMOR has it that the Civil Aeronautics Authority is seeking a method of stimulating private flying, but there is no inkling of the precise plan to be employed. In the meantime we have learned of the proposal of Alfred B. Bennett of the Bennett Air Service which has been well received in aviation circles. Mr. Bennett proposes that the Government should pay a student pilot $50 when he solos and $50 when he has had ten hours of solo flying. With the modest rates of flying instruction now available on Taylor Cubs and other low-priced aircraft,



the process of learning to fly would thus cost the young aviator practically nothing.

This plan would lead to an enormous increase in the number of student pilots. Thence would follow an equally large increase in the number of small airports, and an important increase in the construction and sale of low-priced airplanes.

In time of war there would be an enormous reservoir of pilots from whom to select the men capable of mastering the art of piloting a 300-mile-an-hour pursuit plane. With the dangerous and continued unbalance of the Federal Budget, every responsible citizen is loath to suggest any scheme, however meritorious, which involves an increase of public expenditures. But of all the propounded pump priming plans this appears to be one of the most meritorious.—*A. K.*

Empty Belfries

A SYSTEM of amplified chimes installed in an eastern church appears to have solved the problem of the empty bell towers in American churches. This system utilizes as its source a set of 21 standard tubular chimes such as those used by musicians. These are played from a small keyboard attached to the organ console and their sound is picked up by two microphones, placed for properly proportioned pick-up. These are standard crystal microphones and are fed into the mixing panel of a 250-watt amplifier developed for this service by Transformer Corporation of America. The heavy-duty, horn-type loudspeakers, four of which are mounted in the bell tower, are fed through a low-impedance line and are capable of handling up to 160 watts output.

Centrally located in a city which has an area of approximately ten square miles, it has never been found necessary to operate the system at full capacity. In fact both the amplifier and the loudspeakers provide more than ample reserve to take care of the surges which are characteristic of the initial "hammer thump" of the chimes, a feature which received the special attention of engineers in the design of the amplifier.

So realistic is the sound reproduction of this system that only a handful of the populace is aware that the church tower does not house a genuine carillon consisting of massive bells.

This is one heretofore empty bell tower that has been utilized to the entire satisfaction of everyone concerned—and at a very small fraction of the expenditure that would have been involved for genuine bells.

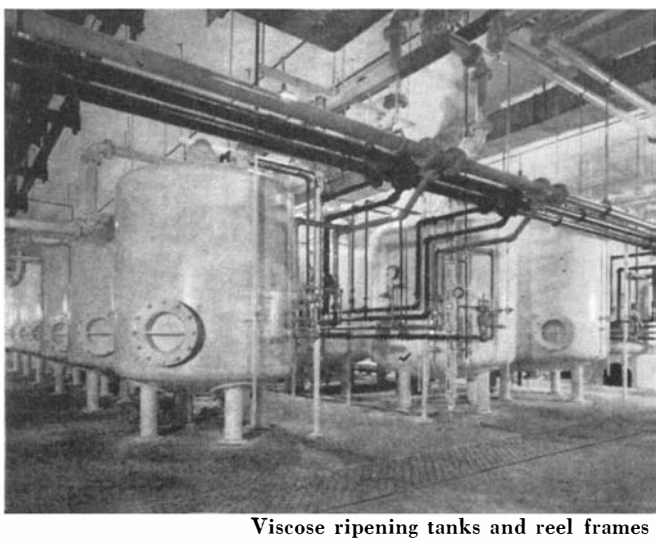
CORROSION PROOF

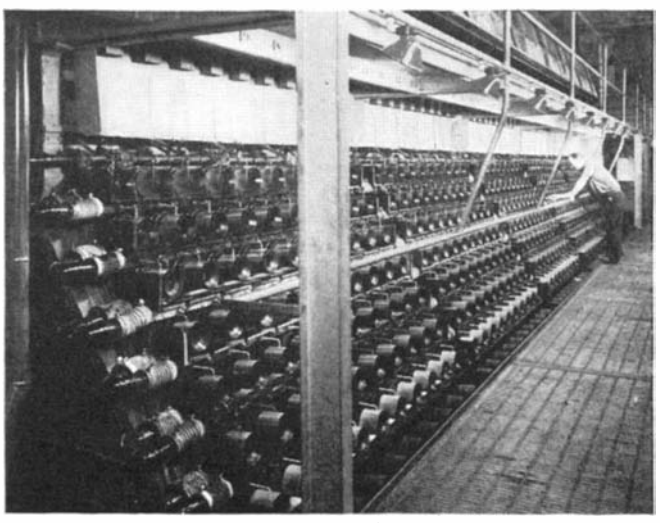
MORE than five tons of Monel nuts, bolts, and special studs are being used on the Fort Peck Dam project, North Dakota, as fasteners for valve seats and rings.

New Continuous Process for Producing Rayon

A NEW continuous process for the production of rayon, still America's fastest growing textile fiber, recently went into large-scale commercial use with the opening of a huge plant by the Industrial Rayon Corporation at Painesville, Ohio. The plant will produce 12,000,000 pounds of completely processed rayon yarns per year.

Starting with cellulose sheets at the top,





Viscose ripening tanks and reel frames in the new continuous process rayon plant

the process finally winds completely finished rayon threads, ready for delivery to textile mills, on bobbins set low on the floor. Differing from conventional procedure, the rayon is not spun and wound on the bobbins immediately after being formed, but is bleached, shrunk, prepared, dried, and twisted before being wound.

Six years of research are represented in the plant, built at a cost of $11,500,000. A pilot plant has been in operation successfully for two years. Fourteen acres of floor space have been provided in the buildings of the windowless air-conditioned plant. Daylight enters the factory through glass wall panels and monitors of glass block, 371,000 of which have been used in the factory, the laboratory, the power house, and auxiliary structures which, together, represent the largest glass block installation on record.

Special machinery for handling the rayon in this new fashion was developed by a subsidiary of the company. More exact conformation to specifications is one of the advantages claimed for the process.—*Science Service.*

For carrying explosives to remote oil-field locations

Non-Flood Device For Batteries

A NEW non-flood device for automobile storage batteries, to meet problems created by the modern practice of putting the battery under the hood, has been developed by engineers of The B. F. Goodrich Company. According to the manufacturer, a battery equipped with this device removes all fear that costly damage will come to engine parts through over-filling.

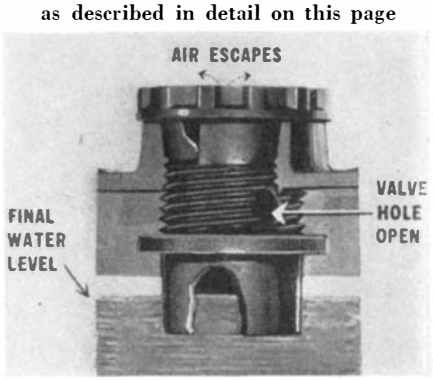
Three hard rubber parts—a barrel with two air vents, vent cap, and specially designed cell cover—make up the assembly. The barrel is screwed into the under side of each cell cover before the battery is assembled, a flange making it irremovable through the top of the cell cover when the battery is ready for service. A slotted top is provided in which the vent cap slides sidewise when being removed or replaced.

In operation, the barrel moves up when the vent cap is unscrewed and at the same time the two air vents located on each side of the barrel are closed, trapping air within the cell. As water is added, the air is forced to the top of the cell and when the electrolyte level reaches the bottom of the barrel, the air pocket beneath the cell cover prevents further addition of water.

At this point, scientifically determined, a small amount of water collects in the barrel, indicating that the safe filling level has been reached, with the non-flood device assuring sufficient space within the cell for the electrolyte to expand.

The barrel is firmly anchored, and holds the vent cap securely in place when the cap is screwed down. Air vents are opened, the trapped air escapes, and the water remaining in the barrel flows freely into the cell, without bringing the battery solution above the safe level.

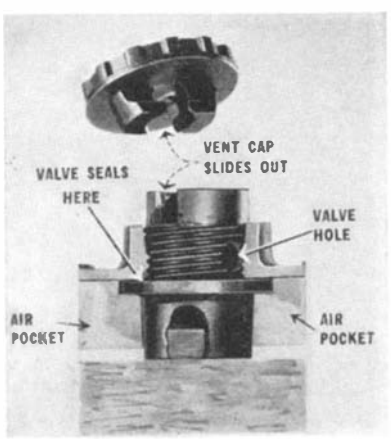
Below and right: **New non-flood battery cap, showing how it works, as described in detail on this page**



Just Wave the Magic Wand

THE physics principle discovered by the scientist who rubbed a stick of amber with wool and made cat's fur stand on end is used as the operating force in an interesting toy airplane manufactured by The Mystoplane Company. Simply at the wave of a wand, tiny aluminum airplanes are made to remain in the air for several minutes, executing strange gyrations and flying formations.

The "Mystoplane" Set consists of a hard rubber wand tipped with aluminum, a wool rubbing cloth, and a generous supply of tiny aluminum foil airplanes. The wand is rubbed with the cloth until a negative charge of electricity is stored up in the rubber, then one of the airplanes is touched with the wand, receiving a similar negative charge. Waving the wand then in the vicinity of the airplane repels the tiny ship and causes it to climb, dive, bank and turn, and behave like an actual airplane.



We predict that a lot of happy children are going to have a lot of fun watching Papa caper around the living room chasing a hunk of aluminum foil with a club.

Ten Tires Float Oil Explorers

MAN makes earthquakes to order in the crude-oil explorations which grow more scientific every day. These earthquakes are set in motion by explosives, so their reflections from subterranean layers of prehistoric rock can be measured in nearly a dozen ways.

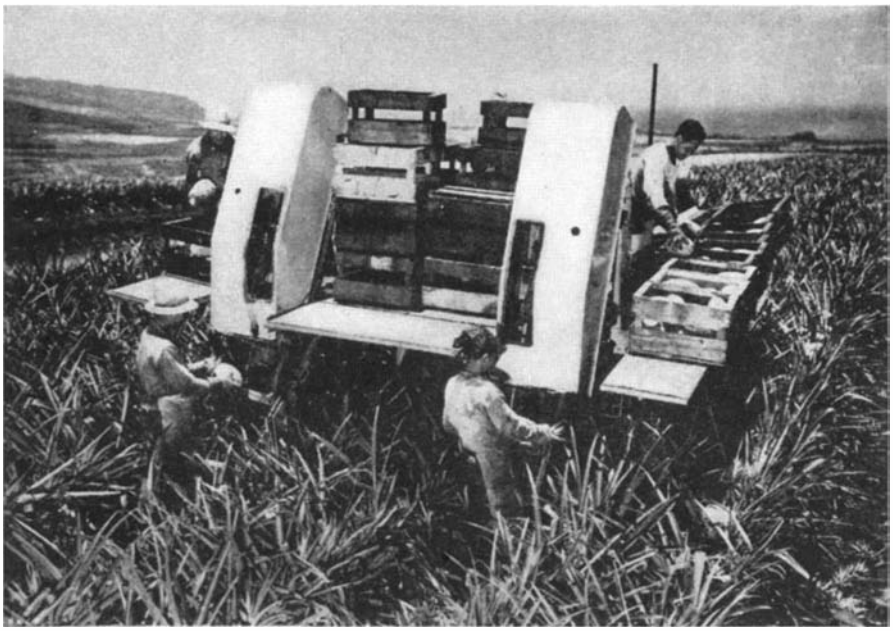
Since the ancient rock formations that might pocket a hidden oil fortune occur as often under impassable Louisiana swamps as they do under the paved streets of Texas towns, man was compelled to devise a means to overcome marshy hazards.

These swamps were literally impassable to humans until swamp buggies, such as the Continental Oil Company explosives truck shown in our photograph, were built. This swamp buggy actually floats its weight of several tons over the "bottomless" mire on huge Firestone Ground Grip tires. Of course, the tires are kept at a low air pressure to cushion the truck's testy cargo against jarring.

No More Exploding Cows

SOMETHING unusual in aluminum safety equipment is the Christiansen safety valve for cows. A rather common complaint of cows is too great indulgence in alfalfa, with the result that the cow becomes badly bloated and in danger of death.

The standard treatment for this condition has been to ram a pitchfork into the cow's ribs, puncturing the stomach and allowing the accumulated gas to escape. Since this is rather hard on the cow, Dr. P. J. Christiansen developed an aluminum safety valve with glass check ball, which is permanently inserted in the cow's side. A cow which boasts this latest piece of spare equipment can eat



Mechanical carrier for harvesting pineapples

its way through a field of alfalfa, and except for a slight whistle of gas through the valve, suffer no ill effects.

The aluminum valve is light in weight and is not easily corroded by the weather and the escaping gas.

Pineapple Harvesters

USE of 30 mechanical field fruit carriers during the 1938 harvesting season on the Hawaiian pineapple plantations of the Hawaiian Pineapple Company, Ltd., has convinced both workers and management that they effectively eliminate the most onerous feature of pineapple plantation employment.

Prior to the use of the machines, plantation workers gathered the picked fruit along each row and carried it in bags on their backs to the end of the row where it was placed in boxes to be loaded onto trucks. The mechanical carrier, moving under its own power, is now accompanied down the row by two loaders who need merely lift the previously picked pineapples from the tops of the plants and place them in one of the machine's two hoppers.

From the hoppers the fruit is fed automatically onto two elevators where the crown of each pineapple is cut off by a buzz saw. The elevators raise the pineapples to conveyors which carry them to the boxers, two of whom—one for each conveyor—stand with their supply of boxes between the conveyors, on the machine. At the end of the row the filled boxes are transferred directly from the carrier to motor trucks.

Motive power for the carriers is supplied by a Ford "60" motor, giving them a top speed of 10 miles an hour. The elevators and conveyors are powered from a separate two-horsepower engine.

Accurate Picture Records of Salesmen's Samples

MANY a business argument over substitutions or incorrectly filled orders can be avoided through use of a new Kodak Sample Record Outfit. Clear, accurate, detailed pictures of a salesman's sample can be made in a moment with this inexpensive, readily portable outfit—even by one who has not the least knowledge of photography. Regular snapshot film is used. Eight pictures—showing different samples or different views of the same sample—can be made on a 25-cent roll of film. Any photo finisher can develop this film, and prints cost but a few cents each.

Thus, the Sample Record Outfit provides a perfect means for completing store records—accurately, easily, inexpensively—and avoiding disagreements, ill-feeling, and time-consuming, profit-consuming correspondence when delivered merchandise does not correspond with the sample from which it was ordered.

The buyer places the salesman's sample inside the record outfit, along with a card bearing the catalog number as stated. He then presses a light switch and touches a shutter button. It's as simple as that, and the result is a clear-cut, detailed picture of the sample actually shown. Nothing is left for argument or misunderstanding. The picture speaks for itself when compared with the delivered merchandise. And with this outfit, it's quicker to take a picture than to wait while a salesman writes out a long description.

Pictures taken with the Kodak Sample Record Outfit may be filed for use when reordering. More complete stock records may be kept, a picture of each article or style being attached to the proper inventory card. Any sample or object up to 6½ inches high, 11¾ inches long, and 4¼ inches deep can be pictured.

Photography makes possible accurate recording of submitted samples

FOOD

RAILWAY dining cars serve approximately 25 million meals a year, the equivalent to serving every inhabitant of a city of nearly 23,000 population with three meals a day for an entire year.

Putting "B. O." to Work

BODY odor is finding important industrial applications quite aside from its function as much advertised "B. O." in selling a particular brand of soap. Sebacic acid, important constituent of human sweat, is being synthesized and used in large quantities as an essential raw material in making softeners (plasticizers) for resin plastics and in making a new type of resin which yields a silk-like fiber far superior to ordinary rayons. Caproic acid (normal hexoic acid), which bears a relation to the body odor of goats which is similar to that of sebacic acid to humans, is finding numerous important uses since its recent synthesis has made it an industrially available raw material.

No, the products made from these acids do not necessarily have the same odor. In fact, many of their industrially useful derivatives are odorless and still others actually possess pleasing fragrances.—*D. H. K.*

Hands Can Carry Dangerous Germs

HOW clean are your hands?

The "resident" flora of the arms and hands of Dr. Philip B. Price of Johns Hopkins University School of Medicine, under ordinary conditions, is around 8,000,000 micro-organisms. Some of these are disease germs. But, in addition to these "resident"

flora, Dr. Price and you and I have "transient" flora. When the hands are dirty, the transients are present in enormous numbers. The transients, however, are comparatively easy to remove or kill. Not so with the residents.

If the hands are in frequent contact with contaminated objects a dangerously large proportion of the resident bacteria may be pathogens. In such cases it is almost impossible to disinfect the hands. In this hitherto unsuspected manner a person may become a carrier of virulent disease organisms, according to Dr. Price.

After the long, elaborate, and painstaking scrubbing and disinfecting that the surgeon gives his hands before an operation, he succeeds in reducing the number of bacteria to around 200,000. Then he puts on sterile rubber gloves.

Dr. Price has tested various disinfectants with a view to use in preparing the surgeon's hands for an operation. A minimum of seven minutes with soap, warm water, and a good brush is needed to remove the transient bacteria and fats, gross dirt and, incidentally, about half of the resident flora.

Dr. Price has tested all the germicides in their effect on the resident bacteria. Some he finds good, some useless.—*Science Service.*

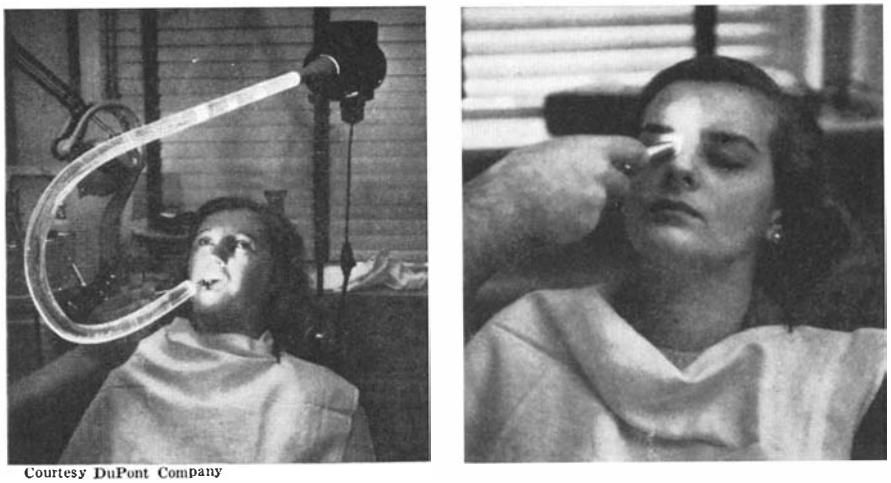
Preserving Finished Lumber

STAIN and decay which attack wood are not entirely avoided by painting. Consequently many toxic materials have been suggested for use in treating wood for its preservation before painting. The Western Pine Association has recently conducted careful comparative tests of some 43 such wood preservatives. As a result of these studies, four of the compounds tested have been shown to be effective. Of these, pentachlorophenol, tetrachlorophenol, and 2-chloro-o-phenylphenol are recommended for commercial use on lumber. A fourth compound, ortho-phenylphenol is also effective but at present is too expensive for commercial use. When dissolved in specified petroleum solvents and applied to finished millwork, these materials confer a high resistance to stain and decay over many years without interfering with painting or otherwise causing trouble in the normal use of the lumber.—*D. H. K.*

Cold Light (Lucite) Surgical Instruments

A GROUP of surgical and dental instruments which concentrate light at any desired point, and piped illumination bringing a powerful, sterile beam of light into the operating room without heat or glare or danger of electrical shock, have been made possible by Lucite (methyl methacrylate), the crystal-clear and practically unbreakable plastic developed in the laboratories of du Pont. The faculty of this plastic, like quartz, of carrying light around curves, is primarily responsible for the advantages of these instruments.

Among the surgical instruments with qualities not previously available is a tongue depressor, made from a curved Lucite rod, with focused light coming out at the end. By combining the light and depressor into a single instrument, the operator's hands are left more free, and the examination is simplified. The source of the light is a small electric bulb at the base of the plastic depressor, which receives its current either from a cord, transforming 110 volts to six volts, or from a flashlight base made for this especial purpose.



Courtesy DuPont Company

Two uses of piped cold light. *Left:* In dental work. *Right:* Transillumination of a sinus. Note the illuminated area visible just over the right eye of the patient

The tongue depressor gives a white and brilliant light, showing up the tissues in their truest color, because "Lucite" partially filters out the infra-red rays. Moreover, the light is cold, because Lucite is a non-conductor of heat—a comfort factor for the patient; and is shadowless because concentrated at the exact point desired. A laryngeal probe, designed principally for deep throat work, and useful in both diagnostic and operative procedures, is another dual-rôle instrument, combining light and probe in one.

The double function and improved lighting qualities are also found in a group of retractors. These instruments are used to hold back the tissues while operating, affording the surgeon a clearer view and better access to the field of operation. In these new illuminated retractors, here again there is the advantage that the curved shape and the accurate focusing of the light rays give better illumination to the field of operation. Also the elimination of heat, for certain retractor uses, is important to the patient's comfort.

Transilluminators for various specific purposes, intended for diagnostic work—for example, the sinuses—are included in this series of instruments made by the Curvlite Sales Company.

POWER

THE combined output of the first three generators now under construction for Grand Coulee Dam will equal 324,000,000 watts—enough electricity to light approximately 5,500,000 60-watt house lamps, or supply illumination to New York City and Chicago combined.

Truckveyor

A NEW coal truck device which offers a clean, quick, and economical way to deliver coal by eliminating wheeling and shoveling and by reducing delivery costs, has been anounced by Gar Wood Industries, Inc.

The truckveyor, as this device is called, makes it possible for a truck to do the same work as a high-lift or double-elevating unit, such as chuting coal over long distances, into elevated bins and over terraces, and at the same time reducing the over-all height

Coal from truck to bin without shoveling or handling

of the body as compared to a high-lift, eliminating excess weight, and permitting more pay load to be carried at considerably lower cost on the same size truck.

The truckveyor does not interfere with the use of the truck as an ordinary dump unit, when required, and it is not limited to coal deliveries, but may be used for other commodities as well.

The truckveyor consists of a strong, aluminum-alloy frame supporting a heavy-duty eight-inch rubber belt on two four-inch aluminum pulleys, one at each end of the truckveyor. The drive pulley has a right- and left-hand gear box operated by a flexible shaft which is connected to the truck power-take-off by means of an auxiliary shaft and universal joints. Hinged baffle plates and extension sides on the conveyor frame are provided to prevent spillage. When not in use, the truckveyor is carried in a compartment built inside the body, or held on the outside by retaining brackets.

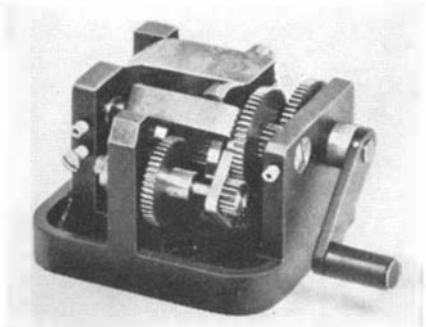
Acid Plants Use Rare Metal

TANTALUM, a relatively rare and expensive metal, is effecting important economies in the manufacture of hydrochloric acid. Because the metal transmits heat readily and much heat is generated when hydrochloric acid gas is absorbed by water, absorbers built of tantalum are almost midgets compared with stoneware and fused silica plants which have previously been the rule. Tantalum is one of the very few metals which will resist the attack of hot hydrochloric acid, and, despite its high cost, plants built of it are more economical than old style plants. A single absorbing column six inches in diameter and a little over six feet long has a capacity of 3000 pounds of 20-degree acid per hour.

This and other developments in the use of tantalum are encouraging the Belgians to develop rich deposits of its ores in Belgium's tropical African colonies.—*D. H. K.*

Voice-Powered Portable Telephone

A PORTABLE telephone which gets its power solely from the speaker's voice and requires no external source of power



Inside the batteryless phone

was announced recently by the Western Electric Company. A measure of the new instrument's effectiveness is gained from the fact that it will, with an efficient telephone line, transmit speech over distances in excess of 200 miles.

The "magnetic" telephone, as the device is known, was designed by Bell Telephone Laboratories primarily for use in such places as railroad yards, ships, coal mines, construction camps and similar locations where the need exists for simple, highly reliable, and portable communication facilities.

In size and shape the instrument resembles a child's building block and its secret of operation rests in a small, though power-

Voice-powered telephone that requires no battery. Hand crank is used only for calling the other party

ful, magnet. "Voice currents" are generated when the flux from this magnet is influenced by the motions of a metal diaphragm assembly vibrating under the impact of sound waves. An identical instrument at the receiving end acts in reverse order to reconvert the voice currents into intelligible speech sounds. Each telephone is fitted with a small hand crank for generating a signalling tone. The "called party" hears a shrill, distinctive note, similar to that emitted by a fire siren, which is especially capable of penetrating through noise.

Protection against weather and mechanical injury is provided by a semi-hard rubber housing, and convenient connection with the telephone line, a matter of a few seconds, is made by means of a waterproof cord, the conductors of which terminate in spring clips.

PLANES

AMERICA'S aviation industry could triple its present production rate of 320 planes a month without greatly expanding its factory facilities. According to a *Science Service* writer, there is only one potential brake: the need for a far greater number of highly skilled tool makers than are now employed in the industry and who would require time for training.

A New Mold Material

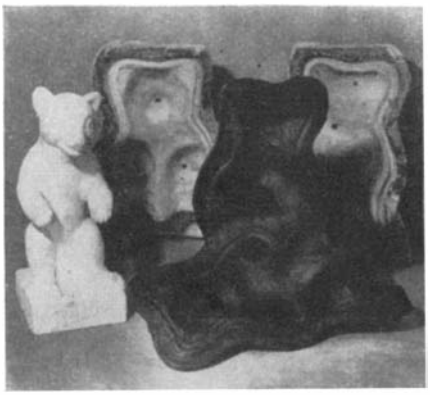
SCIENTISTS working with limestone, coke, and salt scored a victory over nature in the development of Koroseal, a synthetic product possessing rubber-like properties. After being tested for over four years, Korogel, a soft variety of Koroseal, is now being recommended and used as a mold material for casting plaster of Paris, cement and concrete, artificial marble, and almost any kind of synthetic stone.

Korogel is not affected by water or the common materials found in casting shops. Molds made from it do not require any sizing or other treatments between casts. It is not affected by atmospheric conditions so that the same composition may be used in winter and in summer. It does not dry out or deteriorate with age, allowing molds to be stored for indefinite periods of time and still be usable. Korogel does not shrink, expand, or distort in service. If handled with reasonable care, over a thousand casts may be taken from the same mold. Unlike rubber products which have been proposed for similar service, Korogel can be remelted and used over and over again.

Small lots of Korogel can be melted readily in an ordinary enameled household double boiler, using in the outer container a high boiling oil as the heating bath, and heating over a gas burner. Larger lots can be melted by adapting the double boiler principle to equipment of the required size or by using electric heaters especially designed for the job.

Having melted the material, it is allowed to stand without stirring or additional heating until it has cooled to the point where it will just flow freely. The model over which the mold is to be made is arranged in the usual manner with all high points of the shell or retainer fully vented. Obviously, for objects such as plaques and other simple pieces an open-back mold is satisfactory and a shell is optional. The Korogel is poured slowly until the space allotted is filled. After pouring, the mold is allowed to stand until cold. At such time the model is removed and the mold is ready for use.

Good Korogel molds can be obtained from models of wood, metal, glass, ordinary plas-



Molds of Korogel are pliable, can be removed from casting undercuts

ter of Paris, Hydrocal, metal casting plaster, Keene's cement, and almost any other rigid material which is not affected by temperatures of approximately 275 degrees, Fahrenheit.

A great deal of publicity has not been given Korogel thus far, the manufacturers and distributors preferring to carry on a conservative testing program with a few users. Adaptability to the service together with low operating costs is resulting in increased demands for the product.—*S. L. Brous, B. F. Goodrich Company.*

Colored Light for Motor Car Headlights

MANY thousands of motorists use headlights giving a colored light in the belief that they possess advantages over white light of the same power for driving at night or in fog. It is claimed that with colored light, objects on the road are more easily

seen, that glare is reduced, and that the colored rays penetrate farther into mist or fog.

Legislation in France compelling the use of headlights emitting yellow light has served to focus attention on this problem, investigation of which was undertaken by the British Medical Association. The Association reported that extravagant claims had been made for yellow headlights, and that no definite recommendations could be made in any direction.

It is emphasized that, in deciding upon the relative merits of white light and colored light, it is of great importance to note that when colored glass is put in front of a lamp it not only colors the light, but also reduces its brightness. False conclusions are often drawn through failure to separate the effects of change of color from reduction of brightness.

None of the claims made in favor of using a colored headlight beam, yellow in particular, rather than a white beam of the same power, has been substantiated. The claim for a greater range of visibility in fog may be regarded as definitely disproved. As for the other claims of less glare and greater facility of vision, the evidence is inconclusive, but it is apparent from the information at present available that no considerable advantage can be secured by using colored light.

Rotating Record Systems

TWO new and economical record systems that promise to make the office a new source of profits through savings in low cost of housing, increased volume of work per

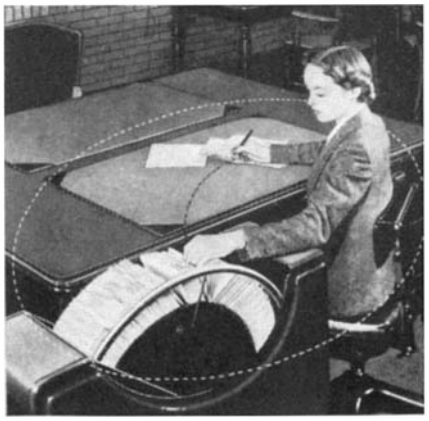
Revolving card index wheel that shows the entire face of any card

operator and decreased amount of floor space required, have just been announced by the Diebold Safe & Lock Company.

Years of laboratory and field research, including careful analysis and study of test installations under all kinds of operating conditions, brought to light the following as the desirable objectives for card filing systems: Systems should bring the cards to one common position for reading or posting; The entire face of each card should be in readable position; Both sides of the card should be quickly available; All reference and posting work should be done at one position—desk height; All reaching and stretching motions should be eliminated in order to avoid unduly fatiguing the operator.

Both Cardineer and Reveldex Filing Systems have been designed to afford these every-day working advantages. They have made practical the application of rotation to record systems—rotation that brings every card to one common reading and writing position.

The Cardineer is a molded plastic wheel, housed in either a metal cabinet or supported



Another type of index wheel that greatly simplifies clerical card work

on a stand. It is available in different diameters for housing from 1500 to 6000 cards and will take care of cards five, six, and eight inches wide. The cards are threaded on metal bars through slotted holes punched in the bottom of the cards, the bars being attached to the wheel by means of a patented locking device. For check or stamp posting, the cards need not be removed from the wheel. If they are to be posted by hand or machine, they are readily removed from the wheel with one hand, posted and returned with little effort.

Reveldex wheels revolve in a horizontal plane instead of the vertical plane in which the Cardineer wheel revolves. Reveldex cards are held at two points instead of one and are intended as reference records whereas Cardineer may be used for both reference and posting records.

Fertilizer Saves Beets

GROWERS of sugar beets and refiners of sugar from them have suffered heavy losses from rotting of the vegetables in storage piles. Recent experiments have shown that fertilizing growing beets with phosphates not only increases yield but at the same time makes them substantially more resistant to rotting. Beets grown on soil deficient in phosphate are reported to rot three to five times as fast as those properly fertilized.—*D. H. K.*

Man No Newcomer in America

BELIEF that primitive man lived in Florida at the close of the Ice Age, from 10,000 to 15,000 years ago, hunting the mastodon, elephant and saber-toothed tiger, has received fresh confirmation from investigations conducted by Dr. H. G. Richards of the New Jersey State Museum.

In a report made public by the Geological Society of America, Dr. Richards states that he revisited the site of Vero Beach on the eastern shore of Florida, where parts of three human skeletons, associated with bones of animals, including many extinct species, as well as hunting implements of flint and bone, were discovered in the bank of a drainage canal more than 20 years ago. Among anthropologists these finds have been the subject of years of lively dispute.

Since the human remains were found only a few feet below the surface some geologists suggest that they represent a burial that took place relatively late in geologic time. Others, arguing from the undisturbed condition of the layers of rock above, and from chemical analyses of the human and animal remains which revealed similar changes in mineral content, maintain that the human remains were contemporaneous with the remains of extinct animals which are known to be of Pleistocene age.

Dr. Richards's findings support the latter view. He examined the layers of sand and sandstone in which the remains were found, as well as the overlying and underlying beds of shell, marl, muck, and limestone. The older or underlying beds, he states, were laid down in periods when the Ice Age glaciers receded temporarily from northern latitudes, melting and feeding the seas, which then grew in depth and covered the coastal plain of Florida.

Dr. Richards found that, during the Ice Age, Florida's climate fluctuated much as did the climates in more northern latitudes. When ice sheets receded in the north, the climate was at least as warm as that of today, and when they advanced the climate was much cooler.

Stainless-steel cooking utensils that are good-looking enough to be used on the table are a new labor-saving device for the housewife. The one shown is a baking dish that came direct from the oven to the table

Starch from Sweet Potatoes

MANUFACTURE of high grade starch from sweet potatoes grown on cut-over pine land in the South has proved commercially successful on a scale of production of 15 tons per day. The project seems to offer promise in the agricultural rehabilitation of the southern states by providing a prolific crop with a ready sale to supplement cotton and tobacco as cash crops.

Yields as high as 500-600 bushels per acre have been realized in experimental plantings of selected varieties of sweet potatoes in southern Mississippi where this industry has been started. Average yields from many plantings over a period of several years have run as high as 300 bushels per acre. These compare with a general average yield of sweet potatoes of 78 bushels per acre in the

United States. Selection of variety of plants and care of the crop account for the difference.

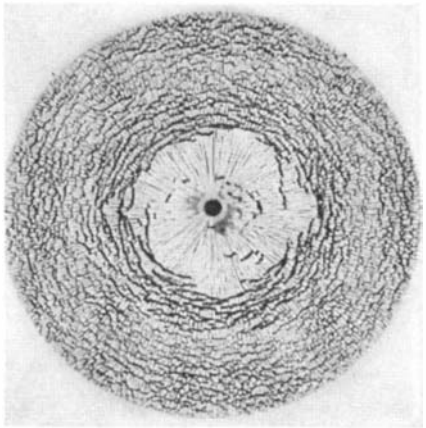
The starch manufacturing process is similar to that used in Europe and in Maine employing white potatoes as raw material but is modified to meet conditions. [See also page 280, May, 1938, Scientific American.—*Editor.*]

Development of the agricultural aspects of the sweet potato crop—it has not heretofore been a large-scale farm product—is being pushed to make it fully profitable to the grower since the feasibility of the project has been demonstrated.—*D. H. K.*

How Fast Does Glass Break?

WHEN glass breaks the cracks move at the amazing speed of nearly a mile a second or more than 3000 miles an hour. The speed of cracks, knowledge of which may lead to stronger and safer glass, was accurately timed by high-speed photographic research at the Massachusetts Institute of Technology.

The accompanying stop-motion photograph, made at an exposure of less than one-millionth of a second by Graduate Student Frederick E. Barstow and Professor Harold E. Edgerton, shows cracks radiating from the center of a piece of tempered glass and the formation of lateral cracks at the instant it was struck by a metal plunger, the dark spot at the center of the picture. Observe



High-speed stop-motion photograph that shows how cracks form in glass

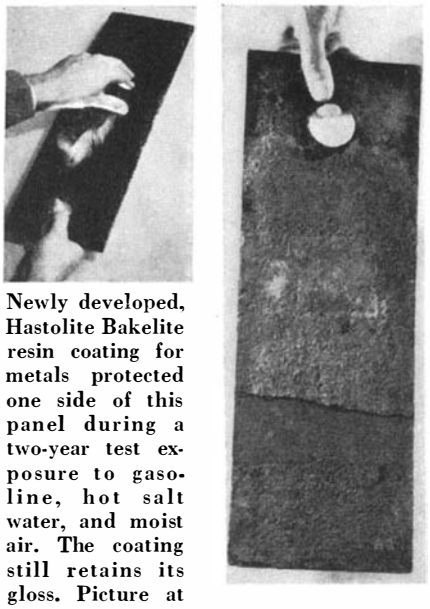
that the pattern of the cracks forms a perfect circle, visual proof that all cracks grow at the same velocity. Radial cracks appear to move outward, while lateral fractures seem to move inward.

Pheasant-Chicken Hybrid

AFTER five years of experiment, the members of the Science Department of Avon Old Farms, a college preparatory school at Avon, Connecticut, have finally succeeded in crossing a pheasant cock and a game hen. So far as is known, this is the first time this has been done. The boys found that the secret lies in mating the birds in the fall rather than in the spring.

The hybrid shows many chicken and pheasant characteristics. Both sexes seem to possess the red eye ring of the male pheasant. A ring is present around the neck of the birds similar to that of the Ringneck male but black in color instead of white. Plumage is markedly chicken in banding and color.

The boys who successfully conducted this experiment are 12 to 14 years old and are members of the first two forms of the school.



Newly developed, Hastolite Bakelite resin coating for metals protected one side of this panel during a two-year test exposure to gasoline, hot salt water, and moist air. The coating still retains its gloss. Picture at right shows that the unprotected surface of the same test panel is severely corroded

Hydrogenated Rosin

COMMON pine rosin, which contains the cheapest organic acid and whose industrial usefulness has been limited by its tendency to oxidize and discolor in use, has emerged from the process of hydrogenation as a virtually rejuvenated raw material. Treatment with hydrogen in the presence of a suitable catalyst improves the color of low-grade rosin until it is whiter than even the highest present grades. At the same time a change in the character of the rosin is produced which prevents it from discoloring in sunlight. This process, which is covered by patents, is expected to enlarge the usefulness of rosin materially.—*D. H. K.*

V-8 Engines Get Novel Task

AMONG the more unusual tasks performed by automobile engines should be listed that of four V-8s in the Ford Motor Company's new tire plant. The engines are operated for the exhaust gas they produce, and the power they make in the process is utilized to compress the gas.

While at first glance this arrangement might seem to be an example of industrial bootstrap lifting, it actually is the solution of a problem found in "curing" tires.

The curing process is one in which the tire, with a heavy rubber tube or curing bag inside, is placed in a mold and subjected to heat and pressure. This forms the tread and makes the tire tough and durable. As formerly done, steam was first shot into the curing bag under high pressure, then it was drawn off and replaced by compressed air. The method was entirely successful, but there was one drawback: because of the great heat and pressure the oxygen in the air caused the rubber curing bags to deteriorate too rapidly.

Tire engineers decided that using an inert gas, one containing no oxygen, instead of compressed air, would solve this problem. However, to buy enough inert gas for a busy tire plant would be expensive, and so they worked out the plan to make the gas with Ford V-8 engines, with the engines at the same time driving compressors to put the gas under the high pressure required.

Running at a fixed speed, the four V-8 engines on the job produce about 14,500 cubic feet of exhaust gas an hour, which is precisely the amount the four compressors are able to handle. The exhaust gas is piped from the engines through a series of cleaning and filtering devices, and then goes into the compressors as harmless carbon dioxide and nitrogen. The compressors raise the pressure to 450 pounds per square inch, and send the gas on to the curing molds.

Ultra-Short Radio Waves Bend

THE dream of using ultra-short radio waves as secret signalling means during wartime is receiving little encouragement from experiments undertaken at California Institute of Technology, indicating that such waves—believed at first to travel solely in line-of-sight fashion—really can bend around the surface of the earth.

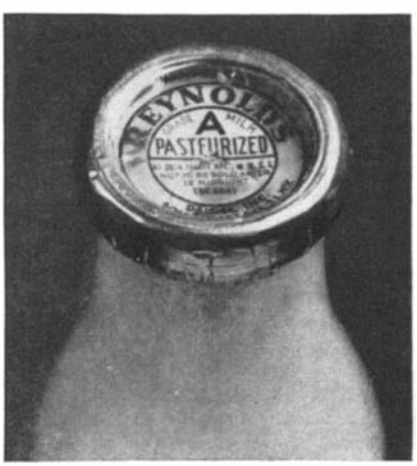
Prof. G. W. Potapenko and Dr. Paul S. Epstein of the Institute have recently completed preliminary studies showing that waves of five meters and one meter length can be picked up at a distance of 18 miles at sea.—*Science Service.*

Milk Bottle Hood

A NEW milk bottle hood that combines a pure aluminum band-seal and waterproof transparent window has recently been introduced in the dairy industry by Reynolds Metals Company.

The new "windoseal" is a pre-formed metal cap that completely covers the top and clamps under the lip of the milk bottle. The transparent window permits visibility of the regular printed paper plug.

Advantages of the new metal hood include: Elimination of stock of printed, predated hoods; elimination of preparatory and printing costs; and elimination of printing and embossing wearing away under icing



Metal bottle cap with window

conditions. The metal hoods are furnished in silver, gold, copper, and standard colors to distinguish between grades of milk or between competitive dairies.

SIGHT

THE fact that 23 percent of United States citizens have poor eyesight before they reach 20, and 48 percent before 40, as recorded by the Illuminating Engineering Society and American Institute of Architects recently, indicates the need for better schoolroom lighting.

NATURAL GAS STORAGE

THE storage of surplus natural gas in depleted gas sands during periods of low consumption is an important conservation measure, and a boon to distributing companies. Most of these companies procure their gas both from natural gas reservoirs and by purchase of gas that is a by-product of oil production and natural gasoline extraction. Due to the use of natural gas for heating, the greatest demand for it is during the winter, while the greatest supply of the by-product is available during the summer, frequently at a relatively low cost. Stored at low cost in underground reservoirs favorably located with relation to large markets, it reduces the load on long transmission line systems during periods of peak demand and may obviate the need for heavy investment in new pipe lines.

Practically 100 percent of the gas stored in an exhausted field may be recovered if the field is protected against offset drilling, if the formation is impervious to leakage, and if the old wells are tightly sealed.

Early in 1936, Oklahoma Natural Gas Company examined a small field in Tulsa County from which most of the gas had been exhausted. The original rock pressure in this pool had been 560 pounds per square inch. Several paying wells had been drilled and approximately 500,000 cubic feet of gas had been removed from the field before the pressure had declined to about 100 pounds per square inch. A series of dry holes showed that the pool was geologically closed and defined the limits of the pool which covered an area of nearly 160 acres.

In order that the entire area occupied by this reservoir might be covered by contract, the Company secured storage rights upon approximately 360 acres. In addition, a regular five-year commercial oil and gas lease was executed. The gas remaining in the reservoir that could be removed if the pressure were reduced to 50 pounds per square inch was calculated and the owners reimbursed. After the necessary rights had been acquired, all the abandoned wells were checked for proper plugging, and two wells were left for the purpose of introducing and later extracting gas. During the summer of 1937, gas which could be bought at a low price from gasoline extraction plants was injected into the depleted sands with the aid of a compressor. The reservoir was filled rather slowly in order that observations of the resulting pressure could be carefully noted. Approximately 77,000,000 cubic feet of gas was injected into the reservoir and the pressure increased to 232 pounds per

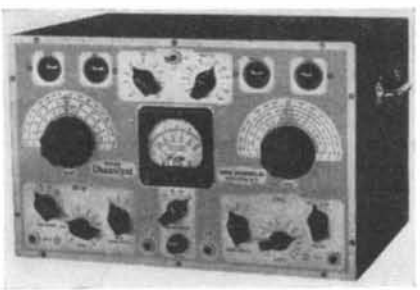
square inch. Starting some two months later, during the winter months, withdrawals were made in accordance with market demands in Tulsa. By the end of the winter nearly 79,623,000 cubic feet had been withdrawn, about 2,500,000 cubic feet in excess of input, and the pressure of the reservoir still was 50 pounds per square inch above the pressure at the time the injection of gas was begun. The reason for this increase in pressure is not known exactly, but it may be due to encroachment of water in the reservoir space sometime after starting the injection of gas.

Due to the fact that a relatively small amount of equipment was necessary to handle the gas, and no great expense was involved in securing the storage rights and placing the wells in condition, the total cost per 1000 cubic feet for storing and extracting this gas was below the standard field price in this area.—*Stone & Webster Bulletin.*

Radio Trouble-Shooter

ELECTRICAL communication has become a vital part of modern living—on sea and land, in business and in the home. The transmitting and receiving apparatus has reached a high state of development, but since it is machinery, the fact is recognized that it might get out of order. Hence one of the major problems encountered in the communication field is to repair the breakdown when it occurs. Naturally, this must be done quickly and accurately.

An entirely new method of diagnosing trouble in radio and television transmitters



Chanalyst

and receivers, public-address systems, and other devices in which vacuum tubes are used, has been made possible by the Rider Chanalyst. Heretofore, trouble-shooting methods have been based upon testing the static condition of individual components of the device, upon operating voltages, continuity checks, and the like, but these methods were uncertain and time-consuming. With this new instrument, it is possible to determine how different circuits are functioning without disturbing the performance of the apparatus as a whole and when that portion of the unit is found in which the signal departs from normal, the cause of the trouble is sought in that particular location with such secondary tests as those mentioned above.

Essentially the Rider Chanalyst consists of radio-frequency and audio-frequency channels terminating in electron-ray indicator tubes, by means of which the signal itself can be traced and studied in its course through the apparatus and without disturbing the delicate balance of the several circuits. An ultra-sensitive electronic voltmeter provides a means for measuring accurately

all D.C. voltages up to 500 volts without interfering with the operation of the circuits by loading, as the input resistance of the meter is 10 megohms. For aural or visual inspection of the signal, provision is made for plugging in head-phones or a cathode-ray oscillograph.

While the Chanalyst is especially adapted for test work, it readily lends itself to classroom and lecture demonstrations as a comparison receiver.

PLAYGROUNDS IN THE AIR FOR EVERYONE!

THE "City of Tomorrow," recently displayed in New York, proposed that sidewalks of the future be covered with "bouncing," resilient materials to reduce walking fatigue and to deaden the noise of millions of moving feet.

This idea is by no means new. Shock-absorbing surfaces for outside walking and other activities—decks, walks, and roofs—have long been sought. It has been realized that the development of a suitable resilient material would permit the wholesale conversion of acres of flat city roofs into recreational areas, open to the sun and safe from traffic in the streets below.

The recent development by engineers of The Celotex Corporation of a resilient wearing surface for exterior use is aimed at this problem. After a long series of tests, the material has now come into practical use under the appropriate name of "Promenade Traffic Top."

Traffic Top is a bagasse fiber board impregnated with selected bitumens by a special process. This board, left naturally black, or coated with an elastic color finish, may be bonded to any rigid base, it is claimed. When used as a roof surfacing, it may be applied directly upon the built-up membrane of the roof. When used on a walk or ramp, its manufacturers recommend that it be cemented directly to the concrete, wood, or composition base. The cement used should be either a hot brushed-on asphalt, or a cold asphalt adhesive that has been prepared expressly for this purpose by the makers of the board.

Good traction is claimed for the board, even when wet. For this reason, it is recommended as a promenade surface around swimming pools, or wherever there is a continually wet condition. All exposed surfaces subject to foot or light wheeled traffic may be covered with it. A concrete tennis court, for example, when covered with green Traffic Top, has much the "give" and the color of a real lawn court.

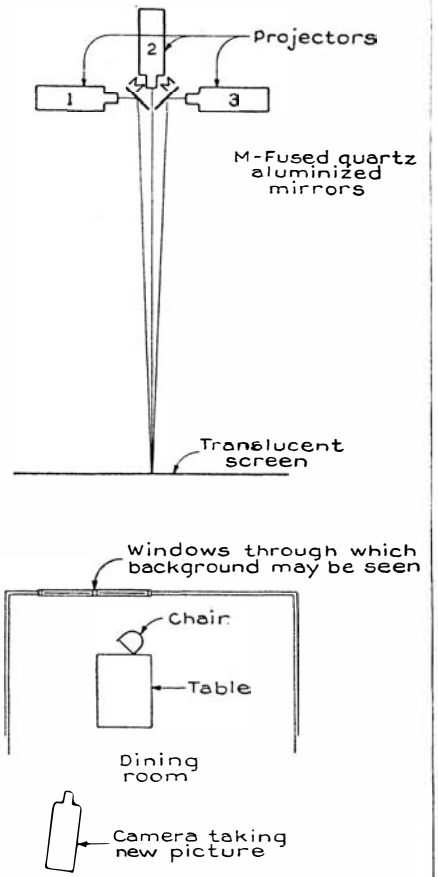
Playgrounds, roof tops, courts, and pedestrian approaches in schools, hospitals, apartments, office buildings, hotels, and residences may be advantageously covered with it. It makes an ideal surface for residential play roofs, since it will reduce transmission of noise of moving feet to the rooms below. It is light in weight—lighter, in fact, than a conventional slag roof—and requires no extra supporting construction.

FUSED QUARTZ SOLVES COLOR MOVIE PROBLEM

CLEAR fused quartz, a product of General Electric's Thomson research laboratory at Lynn, Massachusetts, has been given an exceptional assignment in the mo-

tion picture industry. It has solved a problem that arose with natural-color pictures and, as a result, a feature movie, soon to be shown, will have a scene depicting an old southern gentleman arguing with his negro servant about some pork chops, while through the dining room windows can be seen several thoroughbred horses grazing peacefully in a beautiful green Kentucky meadow.

The dining room in question is on a Los Angeles motion picture stage. Outside



How three projectors were used recently to produce a "composite" shot in a new color motion picture

the windows is a translucent screen called a "transparent" by the film folk. The meadow and horses are projected on this screen from the back, with a motion picture projector, and appear as natural as nature from the front side through the dining room windows.

In the days of "black and white" pictures this was simple. The camera taking the new picture and the machine projecting the background were driven by synchronized selsyn motors so that no flicker could be seen on the background in the new picture.

Then came color, and the technique was changed overnight. The amount of light required to take a picture in natural colors was two or more times greater than that required for black and white. It simply was not possible to get enough light from one projection machine for the average size background in color and in motion.

As a matter of fact, three projectors are required, and they must operate in exact synchronism, and in synchronism with the camera taking the new picture. This part was easy, for selsyn motors took care of that. But to make the projected image clear and sharp, the three cameras must project from

very nearly the same point, much nearer the same point than their physical size would permit.

This was solved by having one camera shoot directly at the screen from a point directly away from its center. The other two project against mirrors set at 45-degree angles. This may be understood clearly by referring to the sketch. The mirrors are so placed that, standing directly in front of one of the projectors and looking into its lens, the lenses of the three projectors appear to be equally spaced about an imaginary circle whose diameter is scarcely greater than the diameter of one of the lenses.

Because of the intense heat, ordinary silvered glass mirrors could not be used, so General Electric supplied aluminized fused quartz plates, accurately ground to ½ wavelength. The silvered glass reflectors first tried required refinishing after a few hours of use; the fused quartz mirrors have operated month after month with complete satisfaction.

New Element (?)

GERMAN research workers report a hitherto unknown product of radioactive transformation which may be a new element. The properties of the material suggest that it is eka-iridium with an atomic number of 95. Previously it has been generally agreed among chemists that there could not reasonably be more than 92 elements and that there was no use searching for others since all 92 are known. Perhaps, as this suggests, there are new elements yet to be found.—*D. H. K.*

If You Find a Meteorite

THERE may be "stones from Heaven" in your dooryard. If so, the Smithsonian Institution, at Washington, D. C., would like to add them to its collection. Scores of supposed meteorites are sent to the Smithsonian experts for identification. Usually they are almost exactly the opposite of what a meteor really is, due to a popular misconception of what such an object should be. Folks see a shooting star—a blaze of fire in the sky. They assume from this that the stone itself should be burned to a crisp when it hits the earth. As a result the most frequent specimen sent in for identification is a chunk of slag from some furnace.

Actually, if you pick up a stone that seems exceptionally heavy for its size, it is well to make inquiries. Meteorites are about the heaviest of rocks. Some of them are pure iron and nickel. Even in an iron manufacturing district, lumps of pure iron are very rare, and if you find one anywhere else the chances are greatly in favor of its origin in outer space.

Even the so-called "stony meteorites" contain a good deal of iron and are heavy enough, compared with ordinary stones, to arouse suspicion. A good way to get corroborative evidence is to take such a stone to the grindstone and grind away a small bit of surface. If you find the area thus exposed speckled with iron particles, the chances are rather good that you have a meteorite. Do not injure the exterior surface too much, as it is of interest to the students of meteorites.

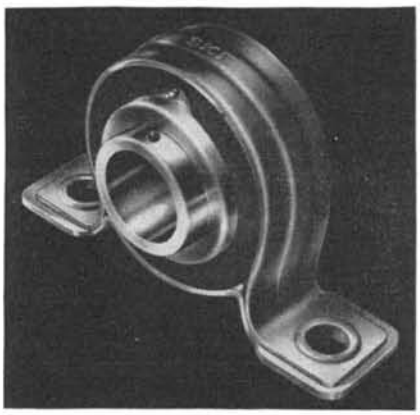
The discovery of a meteor is always worth while to the finder, although the value is not

so great as is often believed, but it will bring a very good return for a day's work.

It is sometimes wondered why a meteorite can strike the earth without setting everything on fire if it lands in combustible material. Strangely enough such an object might not be too warm to hold in the hands. It entered the earth's atmosphere far colder than anything on earth could possibly get except in a special laboratory. It made its whole journey to earth in a few seconds. Only an extremely thin layer on the outer surface was heated and this heat did not have time to penetrate the interior. So, if you should happen to see one of these balls of fire strike the earth rush to it and see how warm it really is. There is only a slight chance that it will be hot enough to burn your fingers. There is at least an equal chance that the meteorite may be covered with frost.

Rubberflex Pillow Block

IN answer to the widespread demand for a compact, sound-insulated pillow block, SKF Industries, Inc., is introducing the Rubberflex pillow block. This new unit comprises a self-locking bearing of the well-known SKF Grip-lock type. This bearing is inherently aligning, thus compensating for



inaccuracies of set-up and conditions of shaft misalignment without binding or in any way impairing the load-carrying capacity of the bearing. In addition, the use of this unit brings about manufacturing economies because it requires no machining of the shaft.

The bearing is encased in a pressed steel housing equipped with felt seals to exclude dirt. The housing is provided with means for lubricating the bearing. The bearing and housing are surrounded with an elastic material having special sound-absorbing characteristics, and the material has been specially treated to make it impervious to oil and grease.

Free from the objectionable vibration usually associated with rubber mountings, this unit carries substantial loads under practically all operating conditions. Its construction facilitates mounting. The units are first being released in the ¾" and 1" shaft sizes.

Measuring Ten-Millionths of an Inch

AFTER a rainy day, the puddles in a city street are often covered with surface films of oil, which reflect bright patches and streaks of color. A streak of oil seven mil-

lionths of an inch thick has a straw-yellow color, while a streak nine millionths of an inch thick appears red. The colored areas thus constitute an accurate contour map of the "topography" of the oil film, the scale of contour levels from one color to the next being one or two millionths of an inch.

The colors reflected by transparent films having thicknesses less than five 100,000ths of an inch, called interference colors, have been understood since the days of Isaac Newton. However, until 1934 no method was known of building standard films of known thickness which could be used as color gages for measuring films of unknown thickness.

A method which was devised in the General Electric Research Laboratory employs sheets of barium stearate which have a uniform thickness of one 10,000,000th of an inch. Each sheet consists of a single layer of molecules of barium stearate. The layer is prepared by placing a small amount of stearic acid on water containing a barium salt. The individual molecules of which the stearic acid is composed endeavor to attach themselves to the water surface, with the result that the stearic acid spreads out over the water until each molecule has a place on the surface. The molecular layers are transferred to a metal surface by a dipping process at a rate of about 20 layers per minute.

Color gages are made by building on a polished chromium plate a series of steps having 21, 41, 61, 81, and up to 201 layers of barium stearate. These steps have thicknesses of two, four, six, eight millionths of an inch, which is the range of thickness in which films reflect most vivid interference colors. Films of other substances such as iron oxides, showing interference colors, are measured by comparing the color of the oxide with the colors of the steps of the gage.

In certain ranges of the color series, the eye can easily detect differences of thickness of one 10,000,000th of an inch. By means of suitable optical apparatus, differences of one 100,000,000th of an inch are measured. This means that single molecular layers of many substances which are of utmost interest to the biologist, chemist, or physicist can be measured quantitatively by the color change which a single layer causes when deposited on top of a barium-stearate film. —*Dr. Katharine Blodgett.*

CO_2

HUMAN beings breathe into the atmosphere about half a billion tons of carbon dioxide a year, while all our chimneys pour forth some three billion tons.

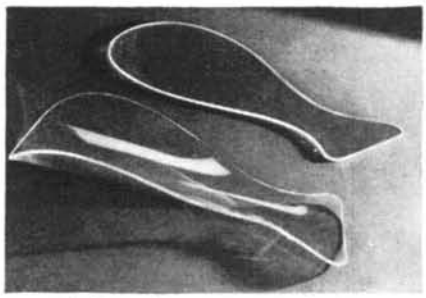
TRANSPARENT SPLINT AWARD

MEDICAL science is aided by the new transparent plastic Lucite splint which won first award in the Scientific Group of the Third Annual Modern Plastics Competition, sponsored by *Modern Plastics Magazine.*

The humanitarian service rendered by this new development is perceived in the fact that, in replacing former metal, plaster, or wood splints for holding bone breaks or

fractures in place in the finger, upper arm, or leg, it is now possible to observe the skin and wound without removal from the member, and also to take clear and accurate X-ray pictures through the splint.

The Lucite splint is light in weight, but strong enough for the purpose. It permits a neat medical dressing, and does not react



Splints of transparent plastic

to the skin, and feels neither hot nor cold. It can be easily shaped by dipping in boiling water, and then bending, and, consequently, can be re-used and re-shaped.

The Lucite plastic used is produced by the Plastics Department of E. I. du Pont de Nemours & Co., Inc. The splints were conceived by Dr. E. W. Probst.

Marking Ink for Glass

THE problem of marking on glass or vitreous enameled surfaces has apparently been solved by a new type of marking ink recently perfected. The ink may be applied, with a steel or other pen or a marking brush, to the glass surface, preferably warmed, and when dry is resistant to all types of destructive agents, including strong acids and alkalies even when hot, and the common organic solvents. The ink itself is non-corrosive and non-flammable, in which respects it is more convenient than hydrofluoric acid marking fluids and organic substances.—*D. H. K.*

Soldering Aluminum

ALUMINUM is hard to solder because of the oxide film that forms on it, according to *The Foundry*, which states that molten solder will not wet or alloy with aluminum covered with oxide. The most practical method, it says, is to abrade the surface of the aluminum under a film of molten solder so that the solder can wet the freshly exposed surface before it comes in contact with the air. When a small amount of solder has been melted on the surface, the solder is rubbed or worked with a wire brush. This abrades the surface, removes the oxide, and exposes a clean surface.

Simple—When You Know the Answer

AFTER an amateur has given up finding fossils in a given locality, a professional paleontologist often will go to the same locality, walk directly to a definite spot and unearth fossils, much to the amateur's puzzlement. Accordingly, the amateur often asserts that the professional must smell the fossils, for there apparently is no other way by which he could locate them. There is, however: the professional knows many a

sign that the amateur never notices. And so it is with the archeologist, who seems to know where to look for buried human artifacts when there seemingly are no visible signs or clues. Again, however, it is often "so simple" when the explanation has been given. For example:

Not only is vegetation more luxuriant over the sites of abandoned human villages in the Far North but it is composed of different varieties, says Dr. Ales Hrdlicka, Smithsonian Institution Curator of Physical Anthropology, who for 12 years has conducted archeological explorations in Alaska and the Aleutian Islands. Some plants seem not only to follow the footsteps of man but to cling tenaciously to the remains of his settlements and to his graves.

"One of the main results of these explorations," says Dr. Hrdlicka in a recent report to *Science*, "has been the location of literally hundreds of more or less ancient sites. They cover from approximately one half to more than ten acres. They are kitchen middens and village sites combined, their accumulations reach in depth from a few feet in some to more than 16 feet in others, and while some are fairly late others show human occupancy of many centuries.

"The uppermost of their deposits reach from historic to pre-historic time. The accumulations consist of ashes, shells, sea urchin spines, rotted wood and sod, bones of fish, birds and various mammals, blown silt, and all the organic refuse and cultural objects of such communities. In their constituents, depth, and other conditions, they are largely different from the soil of the surrounding country.

"Owing to these factors, the sites present wide and in some cases seemingly almost absolute botanical differences from the rest of their region. With some experience it is possible to detect such an old village site as far as it can be seen with some clearness. Its vegetation is darker and much richer in development. It sometimes reaches to over four, five, and in some cases six feet in height. At close range, moreover, it is seen to consist materially of different species of plant from those of the neighborhood. Some of these plants apparently exist nowhere else in the region, while not a few of those in the vicinity, in turn, do not grow on the site of the human habitation.

"Apparently under different physical and chemical conditions in the ground the same region may produce very different and richer flora than is characteristic of the region under ordinary conditions."

CURRENT BULLETIN BRIEFS

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

HUNTING WITH THE MICROSCOPE, by Gaylord Johnson, is a 96-page book, thoroughly illustrated with line drawings, that "tells all" about the interesting hobby of microscopy. It describes the uses of simple lenses as well as of compound microscopes, and gives instructions for making and using accessory equipment. "What to Look for With the Microscope" and "How to do

Microscopic Detective Work" are only two of the six highly informative chapters. *Leisure League of America, 30 Rockefeller Plaza, New York City.—35 cents.*

THE OBSERVER'S HANDBOOK contains planetary and lunar data for each month of 1939, also star charts and numerous tables and summaries having practical value to amateur astronomers, very many of whom obtain the booklet each year from *The Royal Astronomical Society of Canada, 198 College Street, Toronto, Ontario, Canada, for 25 cents.*

COLUMBIAN COLLOIDAL CARBONS is a 194-page book with semi-flexible covers, which deals with the industrial uses of colloidal carbon in the manufacture of rubber, inks and paints, and various other compositions. Attractively illustrated and complete in every respect. *Binney & Smith Co., 41 East 42 Street, New York City.—$1.50*

EQUIPMENT CATALOGUE, designed especially for radio "hams," service men, and sound equipment men, comprises 44 pages and has been compiled by an old time "ham" who is as familiar with quality requirements as are the users of the equipment listed. *Sears, Roebuck and Co., Chicago, Illinois.—Gratis.*

MODERN ENLARGING TECHNIQUE, by Hanns Neumann, is a beautifully illustrated 54-page book that deals with the whole subject of photographic enlarging from "Why negatives are enlarged" straight through to "Mistakes, and how to recognise them." It covers enlargers in general, the darkroom and its equipment, negatives and enlarging papers, exposure, and all steps in the entire process. The numerous illustrations assist in an understanding of the comprehensive text. *Burleigh Brooks, Inc., 127 West 42 Street, New York City.—60 cents.*

SAFETY IN STEEL is a 20-page illustrated pamphlet that tells briefly the running story of industrial safety, particularly as applied to workers in steel plants. It deals with such things as protective clothing, safe operation of machinery, avoiding dangerous falls, and so on. *American Iron and Steel Institute, 350 Fifth Avenue, New York City. —Gratis.*

THE MERCURY SWITCH OF TOMORROW, Bulletin No. 500, is an eight-page pamphlet which describes Durakool Mercury Switches, which are now finding wide application in industry in general. "Few indeed are the switching jobs which cannot be done more safely, more surely, and in the long run more economically" with the switches described in this circular. *Durakool, Inc., Elkhart, Indiana.—Gratis.*

CREATIVE HANDICRAFTS, by Mabel Reagh Hutchins, is a 94-page hobby instruction book that will point the reader along the path toward making profitable use of spare time. It gives instructive and specific suggestions, accompanied by pertinent illustrations, in the following hobbies: pottery, weaving, basketry, metalcraft, leathercraft, bookbinding, block printing, and dyeing. *Leisure League of America, 30 Rockefeller Plaza, New York City.—35 cents.*

Conducted by JACOB DESCHIN

Try Cropping It

LOOKS are sometimes deceiving. If a negative seems hopeless at first glance or even after some study, do not throw it into the discard without first giving it a chance to display its possibilities by projection on an easel under the enlarger. Such negatives may sometimes be faulty because of poor judgment in taking the picture, unsuspected movement on the part of the subject which threw your carefully laid plan out of line, but which you shot just "on a chance," or other causes. But whatever the reason for doubting the print possibilities of a particular negative, do not trust first impressions. Project it and see what can be done. There's always time for the waste basket.

Take, for example, the illustrations shown here. Figure 1 shows a print from the full negative. We were making a number of flash shots when the mother suddenly lifted the

Figure 1: From the full negative

child into the air, as you see. The camera was on a tripod and there was no time to do anything but shoot, come what may. The action was so spontaneous and graceful that picture appeal seemed inevitable. As it turned out when the negative finally came into being, the mother's head was quite close to the edge of the negative, and the chance of a suitable picture from even a part of the negative seemed hopeless for a while.

However, we put it into the negative holder anyway and, with the aid of the margin bands of the easel, made several attempts to frame portions of the negative. The results were decidedly surprising. The first attempt is shown in Figure 2, in which the vertical composition was tried. This did not appear fully satisfactory because the pose of the subjects gave the impression they were both headed straight out of the picture. Good balance seemed out of the question except by trying to cut down the portion of the negative used in making the picture. The projector housing was raised to fill the easel picture space with a more limited portion of the negative.

Figure 2: Vertical composition

The horizontal arrangement was the next experiment and the result, as shown in Figure 3, seemed to be an improvement. But we still were partial to the vertical arrangement and raised the enlarger housing still higher to make the finally satisfactory picture shown in Figure 4. In the last it was felt that the body of the woman provided a suitable balance and the inclusion of only part of the boy's image made the picture a stronger one than would have been the case had the boy's legs been included.

Of course, there is a reasonable limit beyond which one cannot go in taking out a piece of the negative to make a whole print, particularly if the latter is to be 8 by 10 or so. This limitation lies in the grain of the negative; the coarser this is the greater the problem of producing a suitable print. However, this difficulty is less troublesome in the larger negatives than the miniature type. In

Figure 3: Horizontal composition

Figure 4: **The final choice**

any event, should a good print be impossible in a larger size, be content with a smaller one. Better a small, good print than a large, bad one.

In the majority of cases, it will be found that a little fussing around with a negative that seems at first glance to be hopeless may prove highly advantageous and result in the saving of a picture that would otherwise have been lost. In short, let the motto be: Crop before you leap—for the waste basket.

Copying Kink

HERE is an idea from an old-timer that should be helpful when copying faded photographs. Instead of straining the eyes in trying to focus the old, pale image, attach to the copying easel a sharply defined print. When sharp focus is obtained, which should be easy with such a subject, remove the sharp print and substitute the old, faded one. Sharp focus will be assured. This, as you will recall, is based on the same idea as that of scratching a discarded negative and focusing with this when enlarging from a particularly dense negative when the latter, because of the thick silver layer, makes focusing difficult or impossible.

Film Prices Down

WITH increased consumption of the new high-speed Agfa films, the manufacturers announce they are now able to bring down the price of their films. These reductions apply to Superpan Press roll film, Superpan and Superpan Press film packs, 35-mm Ultra-Speed Pan miniature film, and 35-mm Infra-Red miniature film. All Agfa panchromatic roll films, film packs, and 35-mm miniature films now sell for the same price in each size. Your regular dealer can tell you what the new prices are as they apply to the films you employ.

Register Your Camera

MOST of the cameras in the better classes are sold with a registration blank or card on which the buyer is requested to indicate certain information concerning his ownership of the particular camera, such as his name and address, the serial number of the camera and lens, and so on. These are not provided merely to be impressive, but to serve as a protection for the camera user. Such registration cards should always be filled in promptly and immediately sent to the address of the manufacturer or importer given on the card. Should the camera be stolen or lost and you do not remember the serial number of the camera and lens, you have merely to write to the manufacturer or importer and request him to look up your card and give you this vital information. This card also identifies you as a user of the particular photographic equipment, and entitles you to new literature as it is issued. It proves your ownership of the particular camera should the issue ever arise, indicates the length of time the camera has been in your possession, thus assuring you service during the full guarantee period, and is helpful in other ways.

"Moon Over the City"

THE exposure required for making pictures by the light of the moon is 500,000 times that called for when the same scene is illuminated by full sunlight. But that does not make moonlight photography as impossible as it would seem, because no one who photographs a moonlit scene wants it to look as bright as the same scene illuminated by sunlight. Let it look like moonlight. The picture reproduced here was exposed for 30 seconds at *f*/3.5. The outline of the huge

By moonlight

shadow mass and the lighted windows are much more realistic and impressive than would have been the complete details that daylight would have shown.

Photography One of the Arts

THE works of photographers at their best have come to be regarded on a par with those of artists in other fields, and this opinion is subscribed to by no less an authority than Jonas Lie, president of the National Academy of Design. Addressing the preview of the Pictorial Section of the Annual International Exhibition of the Royal Photographic Society, held recently at the Academy rooms in New York City as a guest of the Academy, Mr. Lie said:

"Let me tell you that we do not feel strange in associating with photographers of this quality. We feel very much akin to the pho-

tographers. They have within their power a great deal of what the artist has. The liberties that the photographer can take are almost as limitless as the liberties which the painter is privileged to take. The advance of photography is stupendous and I think we more and more realize what a great art photography is."

The show was held under the auspices of the Oval Table Society, Inc., of New York, a non-profit organization which in the past several years has been responsible for some of the outstanding photographic shows of the country.

Picturing the Jamboree

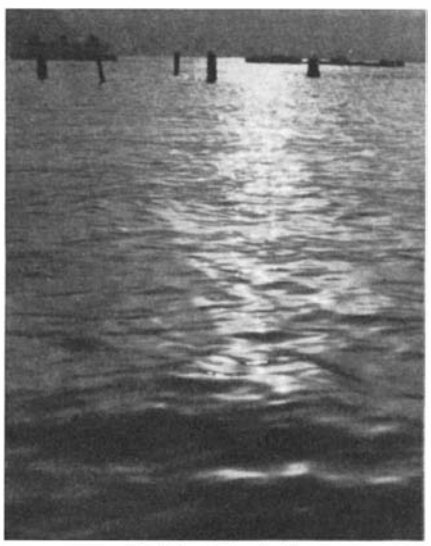
ONE evening when the weather was somewhat warmer than it probably is at the time you are reading this, we had the interesting experience of attending an outdoor

"The Skeptic"

charity jamboree. A number of tables were set up along the roped-off street, each presided over by a lady palmist, sketcher, or person of similar gifts. As we wandered from table to table we sensed the human interest possibilities and shot some candid pictures by the light of the 100-watt lamps suspended over the tables. A fiftieth at *f*/4 did the trick on supersensitive pan film. One of the shots was the one shown: "The Skeptic."

"Black and White" of Water Photography

THE water will show a "white" path where the sun is allowed free rein, as in "White Ripples," but will reveal a "black"



"White Ripples"

"Black Ripples"

path where the sun is blocked, as in "Black Ripples." In the latter case, the sun was just back of the boat's mast; in the former, it sent its late afternoon rays clear across the water, since there was nothing to intercept them. Of course, "White Ripples" is a demonstration of reflections of the sunlight, and "Black Ripples" is an example of the absence of these reflections. On the other hand, had the sunlight been coming from the other side it would have illuminated the section of the boat shown in the picture and reflections would then have appeared in the water, though naturally much darker in tone than those of the direct sunlight. Moreover, were the boat lighter in tone, the reflections in the water would have been proportionately brighter.

WHAT'S NEW
In Photographic Equipment

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

PHOTAR ($8.75): Photo-electric exposure meter. Large rapid-calculation dials. Announcement stresses sturdy construction yet delicate jeweled mountings of mechanism. Licensed under Weston patents, meter conforms to range of speeds prescribed by Weston ratings, with range extended so that the instrument may be used with the new high-speed films.

ELECTROMATIC SPEED PRINTER ($35): Through use of two photo-electric cells, this new fixed-focus Model EFA automatically controls exposure time for each 35-mm negative in accordance with its density. Direct enlargements to 2¾ by 4¼ inches. Operates on 110 volt, A.C. or D.C., taking but five seconds to expose print from negative of average density. Printer has four lenses, two optically ground and matched condenser lenses and two lenses combined to form the achromat objective

lens. Surface reflector system gives flat field illumination. Two levers provided, one setting timer for hard, medium, or soft paper; the other permitting choice of paper contrast. Printer cabinet all metal, mounted on rubber feet.

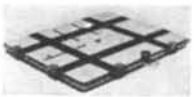
ARGUS MODEL C2 ($25): Equipped with coupled range finder, built-in calibrated split-image sextant type. Lens 50-mm Cintar *f*/3.5 anastigmat, equipped with front-operated iris diaphragm, moves as a whole in helical tube mount, focusing from 3½ feet to infinity. Interchangeable mounting permits use of other lenses and attachments, including macro attachment for close-up photography and new copying lens and portrait attachment. Behind-the-lens shutter provides speeds 1/5 to 1/300 second, plus "bulb." Camera trimmed in metal and polished plastic with black morocco leatherette covering. Separate view finder and range finder.

LAFAYETTE FOTOLITE REFLECTORS: 10- and 12-inch general purpose reflectors; five-inch "spot" reflector. Made of spun aluminum with parabolic reflecting surfaces corrected to combine maximum light concentration with even light distribution. Rubber-covered spring grips with ball-and-socket joints permit them to be attached anywhere. Push-switch sockets of standard size to accommodate No. 1 and No. 2 Photoflood lamps; equipped with 6-foot Underwriters approved cord and plug.

BROWNIE SPECIALS, SIX-20 ($4), SIX-16 ($4.50): Made with tapering fronts and curved backs. Camera case and film holder of steel, outer metal parts finished in smooth black japan, with panels covered in black pin-grain Kodadur. Tubular "spy-glass" type finder mounted on top of camera and used at eye-level. Shutter release and film-winding knob on top of camera body. Focus pre-set, with sharp focus 10 feet to infinity for the Six-20 and 15 feet and beyond for Six-16. Built-in supplementary lens brought into position by lever allows sharp focus for nearer objects. Safety catch prevents double exposure. Rotary type shutter with time exposure lever. Tripod socket, folding metal foot, folding carrying handle. Fabric carrying cases with shoulder straps and slide fasteners $1.10 for Six-20; $1.25 for Six-16. Six-20 takes pictures 2¼ by 3¼ inches; Six-16, pictures 2¼ by 4¼ inches.

LEITZ VIII-C 100-WATT PROJECTOR ($42 without lens): Designed for home use, visual education and for salesmen who desire still film projector for showing pictures before small groups of people. Measures 6¼ by 6¼ by 3 inches, not including lens. Made of plastic and metal. Embodies black top 100-watt, 110-volt projection lamp for projecting either 2 by 2-inch glass slides or 35-mm film strips. Three-lens condenser sys-

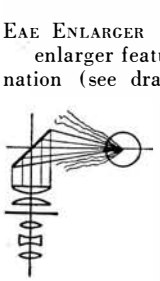
Micrograin Enlarging Easel: Makes use of microscope built into framing easel through which actual grain of emulsion is seen; focusing is done on film grain instead of on image as usual. "When focusing with this new device," announce the manufacturers, "the magnifying power of the optical system is so great that the image is not seen at all, but when the grain of the film becomes sharply visible the image of the negative is automatically brought into the most critical focus on the surface of the printing paper." Magnification is 15 times magnification of enlarger. Easel provided with quick-adjusting paper stops permitting border to be varied to any width. Rigid metal construction with die-cast framing clamps.



"S.F." Remote Control ($21.50): Robot camera attachment. Operates on electromagnetic principle and works the camera with aid of small dry cell and 15 feet of special light-weight cable. Finished in chrome. Can be instantly attached to Robot. By simply pressing small button at end of cable, camera shutter is tripped and picture is taken. "Because of the action of the Robot which allows the taking of a series of 24 pictures without rewinding," say the distributors, "the S.F. permits taking almost an entire roll of film without approaching the camera for any adjustments. During the set of exposures, the photographer is not obliged to disclose his presence or efforts to the subject."

Mount-O-Graph: Device for positioning prints on mounts. Centers all sizes of enlargements on all mounts. Resembling T-square, device is simple to use, involving three motions: centering picture on mat, lining up borders, and determining top and bottom margins.

Eae Enlarger ($14.75 to $21.25): 35-mm enlarger featuring new system of illumination (see drawing) employing reflected light rather than direct diffused light. Manufacturers claim coolness of operation, greater protection of negatives, flat-field illumination. Enlarger designed for use with Models A and AF Argus cameras or with special enlarging lens and adapter mount. Argus adapter lens (f/5.6 triple anastigmat) has aperture slide with f/8 and f/16 openings. Film holder is Bakelite molded, book-type, without glass. Handles either single negatives or strip film. Illumination by 100-watt pre-focused projection lamp, which is placed at right angles to the optical system. Thus only the center portion of the lamp, where flattest and most even illumination is available, is picked out and reflected down through condensers.



CAMERA ANGLES ROUND TABLE

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

***Q.* In one of the requests in the Camera Angles Round Table there was reference to "circle of confusion." Is there any definite way of finding this circle of confusion? I would like to know the circle of confusion of the x x *f*/3.5, 75-mm lens on my camera. Can you help me?—T. S. B.**

A. The "circle of confusion" designated in calculating a depth of focus table for a particular lens is not a fixed, but is a variable factor, as explained in our reply to P. P. A. in the September, 1938, issue, depending chiefly on whether the resulting negatives are to be enlarged and to what extent. In your case, allowing for enlargements usual with negatives of this size, a circle of confusion of 1/500 of an inch is regarded as appropriate. However, a larger disk would be permissible if only small enlargements are to be made.

***Q.* I have recently heard of a new method of printing contrasty negatives called "Tone Separation." The exact details are not known to me. Can you describe it?—F. E. L.**

A. This was explained by P. S. Milne in an article which appeared in the January 26, 1938, issue of the English photographic magazine, "The Amateur Photographer and Cinematographer."

***Q.* Can you suggest a formula for making an ink with which to write on negatives or prints?—L. R.**

A. Such an ink may be made up according to the formula given. When used on negatives or positives there is a bleaching action which leaves the writing white:

Potassium iodide	2 ounces
Iodine	90 grains
Gum arabic	90 grains
Water	6 ounces

***Q.* I would appreciate it very much if you could describe for me the elementary equipment and procedure required properly to develop a roll of film.—E.L.**

A. Paring available equipment to the barest essentials and having in mind that you prefer the least possible fuss, you will purchase a "daylight" developing tank; a bottle of liquid developer that may or may not require dilution, as you prefer, or a tube of developer chemicals for solution in an indicated quantity of water; a bottle of concentrated liquid fixing solution or the necessary dry chemicals conveniently available in half-pound or pound packages ready for dissolving in water; a graduate; a stirring rod thermometer; and film clips for hanging your negative strip up to dry.

The recommendation of a tank may seem an unwarranted expense, but for the man with limited or no facilities the advantage is obvious; it obviates the use of a darkroom. The only time absolute darkness is required is when the film is being loaded into the tank and this step may be accomplished very simply by suffering a few moments of discomfort behind a heavy barricade of hanging clothes in a closet corner. With the film loaded and the tank firmly closed, the rest of the business may be done in full daylight or electric light.

Prepare the developer as indicated on the bottle or package which you purchase, using the stirring rod thermometer to stir up the solution and to be sure that the temperature of the solution is that required. Pour the developer through the hole in the developing tank. Leave it there for the required time. During the interval get your rinsing water and your fixing solution ready, both at approximately the same temperature as that of the developer solution. When the developing period is ended, pour out the developer and pour in the rinsing water. Swish the water around in the tank for a few seconds. Pour out the rinser and pour in the fixing solution. Allow a fixing period of 10 to 15 minutes and pour out the fixer. Then wash for a half hour or so, allowing the water from the faucet to run directly into the tank. At the end of the washing period, attach a clip to each end of the roll, swab off the surplus water with cotton, and hang the film up to dry. And that's all there is to it.

***Q.* I recently purchased a copy of your book, "New Ways in Photography," and became very much interested in the chapter on transparencies and their application as lamp-shades, and so on. As a result I am now considering a small business along this line—photographing customers and enlarging upon transparency material, mounting upon a shade, and selling them to the individual customer. First, would I encounter any difficulty with**

copyright or patent laws? Second, please specify the required transparency materials. Third, what toners are available for transparencies?—D. W.

A. As to the first question, the making of transparency lampshades has been done for a long while by various methods and many persons. The principle of making lampshades by this method is not patented and is free to be employed by anyone. Second, Eastman Translite materials and Defender Adlux are both eminently suitable for the purpose. Both Translite and Adlux are double-coated, that is, the emulsion is coated on both sides of the paper or film, whichever the case may be. This aids in providing the transparency image with plasticity and roundness. Both materials are available in several standard sizes. Third, since the emulsions are no different from those normally employed on regular printing paper, any of the standard toners suitable for regular papers will do as well for Translite and Adlux.

***Q.* I wish to use the x x camera for taking pictures of the human eye and would like to have an additional lens tube that would give a normal size image; that is, 1 to 1. How long a tube would be necessary, how far would this place the lens from the eye, and what would be the added time of exposure? —Dr. A. G. S.**

A. A "normal" or life-size image of a subject is obtained at an extension which doubles the focal length of the camera lens. That is, with your 2-inch lens, a tube would be necessary that would extend the focal length of the lens to four inches. This same distance should intervene between the lens and the subject so that the total distance, from the plane of the film upon which the exposure is to be made to the focused plane of the subject, is eight inches. The doubling of the focal length of the lens will call for a quadrupling of the exposure time. That is, if the exposure calls for one second exposure with a normal set-up, the circumstances will require an exposure of four seconds.

***Q.* Will you please tell me how you dry your 35-mm film? When my film is dry, the sprocket holes are almost touching. I have tried resoaking and re-drying, but to no avail.—L. R.**

A. Drying 35-mm films requires no special procedure other than that the film strip be freed of excess moisture by passing gently between a "sandwich" of cotton or viscose sponges and then hung up to dry in a dust-free place. You know, of course, that the film has a tendency to curl as it is drying but then flattens out again when drying is completed. Too warm a room temperature or too long a drying time might increase this curling. Dry the film within a half hour or an hour and take it down immediately drying is completed. However, forcing the drying procedure through the agency of heat is not good practice.

***Q.* When using extension tubes with my miniature camera for obtaining large close-ups of small objects, will you tell me if it is necessary to increase exposure time and how much?—H. K.**

A. The use of an extension tube for obtaining actual size or one-to-one images of a given subject will call for a total extension of the lens to twice its normal distance from the focal or film plane. As a consequence, the *f* value of the lens will be twice that indicated on the diaphragm ring. For example, if you have a three-inch lens extended six inches from film plane to center of lens, the *f*/8 value, for instance, will really be *f*/16 and must be so considered. This will mean an exposure four times that required for the *f*/8 opening were the normal extension employed. Similarly, with an extension of 4½ inches, the *f*/8 value will be *f*/11 and call for an exposure twice normal.

***Q.* Could you tell me the names of manuals, pamphlets, books, etc., which would give me information on both ordinary and time-lapse photomicrography and macrophotography with an x x 16-mm movie camera?—W. T. H.**

A. A most practical book on this subject, which is also a story of personal achievement in this field, is "Picturing Miracles of Plant and Animal Life," by Arthur C. Pillsbury. A treatise on this subject is contained on pages 323 to 338 of a Smithsonian Report, 1937, by W. N. Kazleff, the title of which is "Moving Photomicrography." Other works on photomicrography include: "Photomicrography: An Introduction to Photography with the Microscope;" "Practical Photomicrography," by J. E. Barnard and F. V. Welch, and "The Student's Manual of Microscopic Technique," with instructions for photomicrography, by J. Carroll Tobias.

***Q.* Can you tell me how practical is the use of a Photoflood bulb for enlarging purposes?—S. G. N.**

A. Completely so, and particularly serviceable when employing the diffuser type of illumination and when a fairly dense negative may take a long time to print, especially where blown up considerably. When controlled by a rheostat device, the Photoflood bulb may be burned at "low" for focusing purposes and then burned at "high" for the actual exposure. A housing well designed as to ventilation is important when employing Photofloods. Those who disfavor Photofloods in enlargers complain, among other things, that the light intensity does not remain constant throughout the life of the bulb, that this intensity is considerably lowered toward the end, that the total life of the bulb is only 1½ hours when used this way and that the bulb has a bad habit of suddenly burning out in the middle of an exposure. However, take the one with the other and decide for yourself. There is something to be said for either side.

***Q.* What is the best type of material to use in making a photographic light reflector for use as an auxiliary lighting unit?—L. D. K.**

A. Any white surface will do the work, of course—a newspaper page, a white sheet, and so on. However, the most popular home-made reflector is an ordinary cardboard covered with sheets of the foil in which films and papers come wrapped. Matt foil is said to give the best diffusion, while others prefer the regular photographic white blotters. Aluminum foil, however, is said to afford better tonal values than the white blotter reflector. When using odds and ends of pieces of this foil in making a reflector it is important to glue them down to the cardboard as flat as possible, flattening them out under a print roller.

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

IN measuring a room we lay the measure directly on the floor, and we do the same in measuring somewhat finer work, but when it comes to measuring the separation

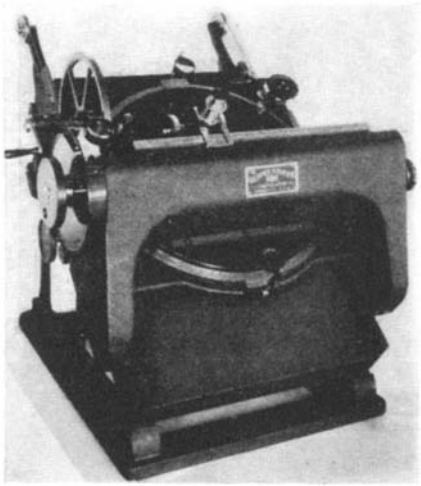


Figure 1: **Coördinate comparator**

of two star images on a plate this method is not followed by the astronomer: too rough. Instead, he mounts a microscope above the plate, makes provision to move it accurately in two dimensions of space, setting it first above the image of a selected "standard" star and then above that of the star to be measured, and reads off the difference on an accurate scale. At no time does the measure actually touch the plate, and the microscope permits centering by judgment on as indefinite an area as a star image. It magnifies 5X to 35X.

Figure 1 shows a typical measuring engine of this kind, a "coördinate comparator" made by Gaertner for professional astronomers' use. First, the carriage as a whole is slid up or down the sub-base, to place the microscope in a comfortable position for the user. On this carriage is mounted the circular stage, showing clearly in the figure. Within it but obscured by other parts, is the plate, set in a square recess. This stage, its periphery divided into angles, may be rotated by means of the little hand crank shown, and it is rotated until the two star images successively fall under the sliding microscope. The scales are read at each setting and then the angles and position are determined from the readings. The microscope is mounted on a slide, and runs on a long, precise screw beneath the slide, a screw having in this instance a periodic error of less than 0.001 mm, or about 1/25,000 inch. On the left end of this screw is a drum with a scale and this gives direct readings to 0.001 mm. The microscope reticule consists of two hairs set parallel and one at right angles to these. Angular separation of the stars may be calculated because the scale of the plate is known or may be computed. However, such an apparatus, costing as much as a fine car, is out of the amateur's reach.

The plate measuring engine shown in Figure 2 was therefore made by Lawrence A. Cox, one of the Cox brothers living at 47 Upper Green, Mitcham, Surrey, England, whose telescopes and observatory have previously been described here, and is described by Harold W. Cox. They have omitted the circular stage, and they measure by means of a two-stage carriage arrangement, obtaining rectangular coördinates, probably working out the hypothenuse by trigonometry.

"Basically," Cox writes, "the instrument consists of a frame or plate holder *1*, to hold the negative or plate, which can be moved accurately in one direction along round rails *2, 3,* by means of the fine adjustment provided by micrometer screw *4*. These rails are made from lengths of ½" silver steel rod purchased in very straight lengths. Motion at right angles to this is made possible by allowing the microscope *5* to slide on round rail *6* and flat rail *7;* it can be moved more accurately by means of micrometer screw *8*. The microscope not alone travels on round rod *6* but is hinged on it also, and may furthermore be swung back out of the way when required thus.

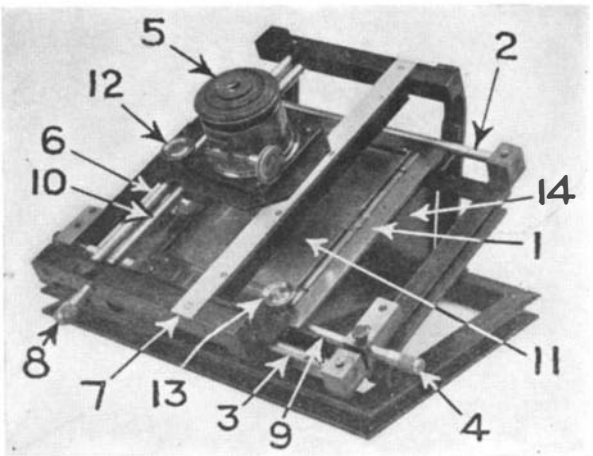


Figure 2: **The Cox apparatus**

"The micrometer screws *4* and *8*, of which *9* and *10* are the extensions, are ordinary heads from L. S. Starrett metric type machine micrometers and permit an adjustment range of ½"; actually, only ½" cm of movement is used. Extension *9* is kept forced against *4* by a spring thrust, *10* against *8* by gravity. When measurements are made between star images more than ½ cm apart we make use of a glass reference plate or reticule *11*, ruled with fine lines, which divides it up into sections ½ cm square. The plate is a photographic copy of a master ruled plate at Greenwich. Both the microscope and the plate holder can be released from the threaded micrometer extension, moved in position to bring star and microscope coincident, and then locked in position by milled-head clampscrews *12, 13*. Position is then read by counting off the lines on the reference plate or reticule and interpolating the rest by adjustment of the micrometers. The use of the reticule serves to reduce errors which would be cumulative if a long micrometer thread were used instead of the ½ cm movement, also errors caused by curvatures in the rails that carry the moving parts.

"Finally, the microscope itself has a cross-reference, in the form of very fine scratches on glass on a piece of microscope slide cover, made with the sharp edge of a piece of broken quartz rod. Even after several such scratches have been made with the same edge the scratches obtained are finer than those obtainable by most other hand methods. Cross-wires would be much too coarse, as this apparatus has a direct reading accuracy of 0.0001" (inch) on the micrometer scales and, by interpolation, to 0.00001".

"The reticule is always in position and the photograph for inspection is laid on top. The two are illuminated from below by a lamp in a white enameled base. Looking through the eyepiece of the microscope one can see the cross-lines in the microscope, the star images, and the lines of the reticule, all in focus at the same time. Sometimes the cross-lines in the microscope are removed and a fine metric scale engraved on glass is used instead. The lamp in the box *14* is so arranged that direct light does not illuminate the plate, but reflected light from the white walls gives an even illumination over the whole plate. As shown in the photo, the plate holder takes ½ plate size, but with an extra fitting dropped into position any smaller plate can be measured.

"Owing to the fact that any other person making a plate measuring machine would have his own ideas about details I don't think it is worthwhile including them here."

Regarding this, we agree with Cox and the author of page 84: few wish to copy details slavishly.

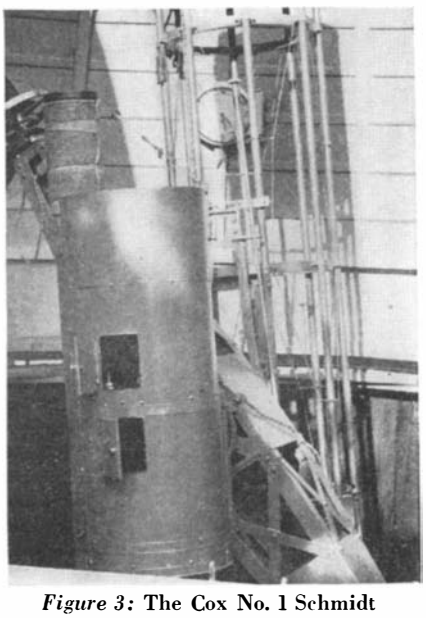


Figure 3: **The Cox No. 1 Schmidt**

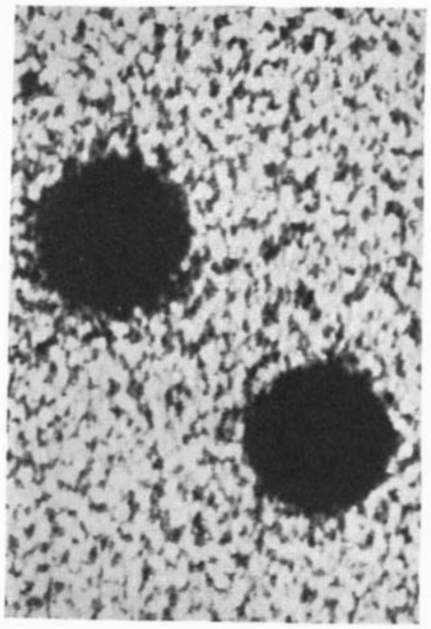


Figure 4: Your scribe's pet sun-spot

A SCHMIDT camera (Figure 3) having a 9″ mirror and 6½″ correcting plate (hence *f*/1.5) has also been made by the Coxes, and stellar photographs taken with it and submitted to Lower, of San Diego, California, for opinion elicited the significant response, "the Coxes have made *a Schmidt!*" The images were remarkably fine and round.

Now follows the sad tale of a self-inflicted joke on this department. A little later the two Coxes sent the photograph shown in Figure 4. On the same day came Professor Russell's manuscript for his September article entitled "How Hot is the Sun?" Calculation showed that something was needed to make it fit the usual two-page space—what better filler than this Cox picture? Study closely the familiar solar rice grain background and all its other details. The picture was inserted and given the legend, "Sunspots photographed with a 12″ reflector, by L. and H. Cox." The present reproduction is from the same half-tone plate that was shown in September.

Figure 5: The Cox No. 2 Schmidt

Well, as it turned out, the "sunspots" weren't quite that—not precisely. Instead, they were *a 140 times enlargement of two star images at the edge of a 16° field taken with the Schmidt camera shown in Figure 3!* The photograph had been sent to demonstrate the quality of the Schmidt. Note particularly the absence of coma in the round, clean-cut star images. However, there were

THE BEGINNER'S CORNER

BUGBEARS of the tyro's first telescope include the mounting for the diagonal. From S. R. B. Cooke, Assistant Professor of Metallurgy at the Missouri School of Mines and Metallurgy, Rollo, Mo., and an amateur astronomer, we have received the following:

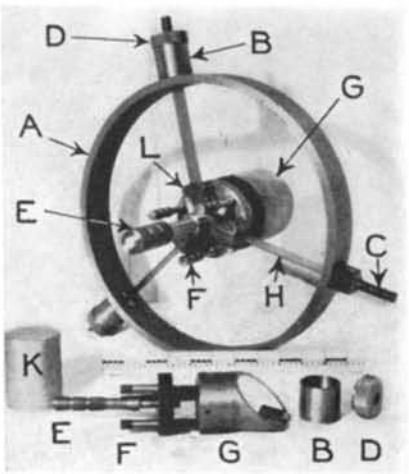
"Seldom have I seen in your columns a description of a satisfactory, easily made, yet rigid, secondary mirror support. I send a photograph of a type of support which I have used for 15 years in reflectors from 6" to 20" aperture. During that time I have found it to be the essence of rigidity, possessing the added merit of rapid adjustability. I do not claim originality of design; in fact the first telescopes in which I saw it used were those manufactured by Mr. J. T. Ward, of Wanganui, New Zealand. I strongly believe that a similar support was used by Browning, of London.

"My first reflector was a six inch, made in 1923 according to the articles by Ellison in *English Mechanics*. The flat support was made of the crudest materials, by the use of simple tools such as hacksaw, file, and a kit of bicycle tools, and it performed perfectly.

"The photograph shows at the top a complete assembly for a 12¼" Cassegrain, and, below, a flat mount from a 10½" Newtonian, the last-mentioned instrument having been made for selenographical work [study and mapping of lunar detail.—*Ed.*]. *A* is a strong steel ring, which fits just outside or within the tube proper. At positions 120° apart on the steel ring, three bolts, *C*, pass through square holes cut in the ring. The fit is easy. These bolts are riveted to flat strips of spring steel, *H*, which form the spider. A sleeve, *B*, fits over the square portion (shown near *C*) of each bolt, and tension on the spider system is maintained by the knurled nuts *D*. The support for the mirror mount is a three-armed steel spider, *L*, each arm being slotted and firmly bolted to a spring steel spider arm.

"*G* is a brass tube holding the mirror. It is firmly attached to a circular steel plate by means of the three adjusting screws *F*. A helical steel spring fits over each adjusting screw and, for rigidity, is maintained at considerable compression. These springs are shown in the flat mount in the lower portion of the photograph.

"The mirror mount is attached to the spider by means of the elongated nut *E*. This screws on to a bolt attached to the circular steel plate, and which passes through a hole bored or drilled in the heavy steel spider. *E* is long, to facilitate attachment in the relative gloom of the interior of the tube.



A secondary-support assembly

"The secondary mirror is adjusted centrally by the knurled nuts *D*. Collimation is effected by the adjusting screws *F*.

"*K* is a light-weight metal cover which slips over the brass mirror mount when the telescope is placed away for the night.

"Professor W. H. Pickering stated that the New England climate was the world's worst, as far as observing was concerned. It could not possibly be worse than the Ozark climate, in this respect. After ten years of it I find myself longing for the steady New Zealand atmosphere."

When a prism is used for a diagonal the mount will of course be modified accordingly. Few types will need so fine a mount.

TELESCOPTICS

(*Continued from preceding page*)

signs of coma elsewhere for your scribe went straight into a coma, especially when it turned out that the photo had been correctly described in the original Cox letter. Hereafter, this department is wearing two pairs of specs.

Several months have elapsed since the misnamed photograph was published. No reader has written the editor to apprise him of the error. No doubt all you readers noticed it, of course! For kindly forbearing to write in about it all are thanked. Their innate tenderheartedness has been quite touching.

So your scribe's face is red, red, red, almost infra-red, and now at sight of a sunspot picture he simply breaks down and sobs.

MORE recently the Coxes have sent Figure 5, showing their No. 2 Schmidt job, an *f*/1.5 with a 12" *f*/0.75 primary and a 6½" correcting plate. It covers a full 20° field. The cell for the correcting plate is all metal and alone weighs 120 pounds. Two doors, similar to those in Figure 3, show slightly on top of the tube; these bed down on rubber seatings.

To the *Journal of the British Astronomical Association*, Vol. 48, No. 8, the Coxes have contributed a 5-page article describing their work in figuring the correcting plate and making the film holder. Too long to reprint here, your scribe will lend it for a brief time to any who seriously aspire to make Schmidts.

FOURTH Cox item is a chronograph (Figure 6) "for use in our observatory," as they describe it. "We experimented with various forms of recording, one of them being that of burning holes in the paper by an electric spark. The voltage of the ordinary house supply was stepped up by a transformer, about 700 volts proving best for the paper we were using, and one side of the output was connected to a platinum point fixed to the armature of the magnets and the other side to the metal track over which the paper runs. The impulse from our clock, a Synchronome having an accuracy of about one second per month, actuated the magnets,

bringing the platinum point into contact with the paper, which was not sufficient to act as an insulation from the metal track.

"However," they continue, "this method was abandoned, as the sparks made interference with the radio used for giving clock checks against Greenwich. (We did this by connecting the radio receiver in place of the personal switch and then comparing recordings of our clock against that of Greenwich, and by this method we can check to an accuracy of about 0.1 second every day.) We are

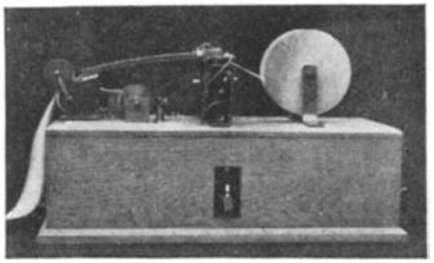


Figure 6: The Cox chronograph

now recording with the two siphons shown in the photograph, fed from a small tank of ink fixed to the inside of the track. One of these is fed from the seconds contact on the clock and the other from the half-minute impulses and also from the personal switch."

PRINCIPLE of a simple micrometer for measuring angular diameters, also for relative measurements of detail on Jupiter and other planets, is shown in Figure 7, redrawn from a sketch by F. L. Frazine, 1016 17th Ave. N., St. Petersburg, Fla. Adapter tube for connection to telescope. Brass plate soldered to this. To that, in turn, is soldered

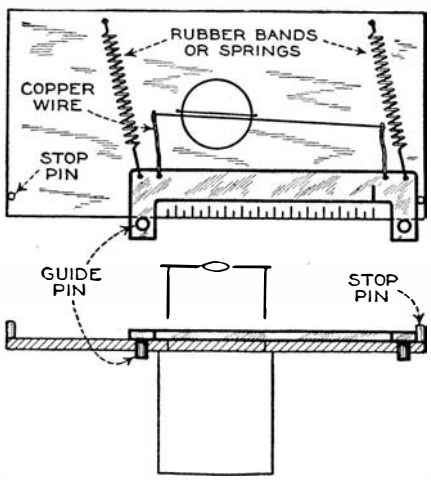


Figure 7: Frazine's micrometer

a bracket to support eyepiece, the eyepiece alone being sketched in on the drawing. Rider on plate.

Lap one edge of plate *straight*. Drill ¾" hole in center. Cement silk fiber or spider web across hole and at small angle with straight edge of plate. Second fiber is cemented to copper wires shown, and adjusted parallel and precisely over the first by bending these wires. At same time rider is at right-hand stop. "As I have constructed it," Frazine says, "the full scale reading equals 50 seconds and the scale is in 25 divisions. I find the micrometer is accurate to about 1 second of arc. To calibrate it, I timed a star from web to web when the webs were set wide apart."

Books

SELECTED BY THE EDITORS

PROCEDURES IN EXPERIMENTAL PHYSICS

By John Strong, Ph.D.

THE experimental, in contradistinction to the theoretical, physicist must be thoroughly at home in the laboratory, devising and inventing, constructing a wide variety of apparatus, and capable of doing refined mechanical work in many trades and skills. Laymen frequently inquire for treatises on these skills, only to learn that many of them have never been exposed in written form; one scientist learns direct from another—if he happens to be near that other. Now, in this unusual book, Dr. Strong, the well-known pioneer of the process of aluminizing mirrors by evaporation, assisted by four other scientists who have mechanical leanings, has assembled a wealth of useful data of a wholly practical kind for the constructor, experimenter, and skilled craftsman. In 15 chapters the following are covered: laboratory glass blowing; optical work; high vacuum technique; evaporation and sputtering; using fused silica; electrometers and electroscopes; Geiger counters; vacuum thermopiles; light sources, filters, and optical instruments; photo-electric cells and amplifiers; photography in the laboratory; heat and high temperatures; materials of research; construction and design of instruments and apparatus; molding and casting. The many clear, lucid illustrations, drawn by a man who comprehends the work himself, reveal fully as much as the text. Advanced amateur telescope makers will discover that the chapter on optical work presents in detail the methods of D. O. Hendrix, head optician at the Mt. Wilson shops—the first time a professional optician has made his methods public. The valuable illustrations of this chapter were drawn by Roger Hayward, an amateur telescope maker and architect. (642 pages, 6 by 9 inches, numerous illustrations.)—$5.10, postpaid.—*A. G. I.*

COLOR PHOTOGRAPHY FOR THE AMATEUR

By Keith Henney

QUESTIONS constantly arise in the minds of amateur photographers regarding the possibility of working with color. Is it difficult? Is it too expensive? Are the results worth the necessary efforts? The author of the present book has answered these questions in clear and concise style, giving the amateur photographer all the available information regarding the various color processes—fundamental principles, films and filters, transparencies, separation negatives, and color printing processes. He names names and estimates costs. (281 pages, 6 by 8½ inches, illustrated, including several color plates.)—$3.60 postpaid.—*A. P. P.*

THE YANKEE CHEESE BOX

By Robert Stanley McCordock

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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

Trade Mark— Land Mark

IN a decision of monumental importance in trade-mark law the Supreme Court of the United States upheld the exclusive right of the plaintiff to use the trade mark NU-ENAMEL on enamel paint products and sustained the validity of the registration of the trade mark under the Federal Trade Mark Act of 1920.

Under the common law, descriptive words were not regarded as valid trade marks because it was believed that to confer upon anyone the exclusive right to use such words in connection with a product would unduly restrain competitors in the description and designation of their products. Slowly but surely, however, the doctrine of secondary meaning has developed. Under this doctrine where, through prolonged exclusive and extensive use of a trade mark, a descriptive name has acquired a secondary meaning indicating the source or origin of the merchandise to which it is applied, the name will be protected as a valid trade mark. The Federal Trade Mark Act of 1905 which provides for the registration of trade marks does not recognize the doctrine of secondary meaning and descriptive words cannot be registered as trade marks under this act. This led to certain practical difficulties, one of the most serious of which was that American concerns engaged in international business were unable to register their trade marks in foreign countries unless they were first registered in the United States and consequently owners of descriptive trade marks, being unable to register them in the United States, could not register them abroad. To meet this situation a trade-mark act was passed in 1920 which permitted the registration of descriptive marks.

There is a very important distinction between the Trade Mark Acts of 1905 and 1920. A registration under the Trade Mark Act of 1905 is prima facie evidence of ownership by the registrant. This is not true of a 1920 registration. Prior to the present case there has been a great deal of uncertainty as to the nature and scope of the Trade Mark Act of 1920. In the present case the Supreme Court held that under the Trade Mark Act of 1920 a descriptive word may be registered as a trade mark. The Court also held that a registration under the 1920 Act gave the registrant the right to sue in the Federal Courts and to recover treble damages should the defendant be found to infringe the trade mark. The principal distinction between registrations under the 1905 and 1920 Acts, according to the Supreme Court, is to be found in the fact that since the 1920 registration does not carry with it any prima facie evidence of ownership it is necessary for the registrant to prove in court that he is the owner of a trade mark registered under the latter act.

In the present case the Court found that while the words NU-ENAMEL were descriptive they had been so widely used and extensively advertised by the plaintiff that they had acquired a secondary meaning indicating that the enamel product so labeled originated with the plaintiff. Under these circumstances the Court held that the trade mark was valid and was the exclusive property of the plaintiff. The importance of this decision resides in the fact that the Supreme Court has recognized the following principles:

1) A descriptive trade mark may be registered under the Federal Trade Mark Act of 1920. 2) A descriptive name or word may become a valid trade mark if it acquires a secondary meaning. 3) The owner of a 1920 Federal Trade Mark Registration is entitled to bring suit in the Federal Courts for treble damages against an infringer.

Muffled

AN individual is sometimes restrained from manufacturing and selling an article which the rest of the public has a perfect right to make, use, or sell. This situation arises where the individual acquired information regarding the article by unfair or fraudulent means.

This principle is illustrated by a recent case in New York in which a manufacturer of silk scarfs or mufflers sought to restrain a competitor from manufacturing a similar scarf or muffler. Plaintiff had conceived of the idea of printing on a scarf, in which the pattern depicted football and other collegiate scenes, a pennant with the authentic color, seal, and name of a particular school or college. To reduce the expense of manufacture the plaintiff had his printer prepare a master screen for printing all of the scarf with the exception of the pennant. The master screen was formed so as to accommodate a small insert screen which would print the pennant on the scarf. In this way the same master screen could be used with different insert screens so as to print scarfs having the pennants of the many different colleges. The Court found that the printing of scarfs in this fashion was an original creation and that certain former employees of the printer who prepared the screens for the plaintiff and who had acquired knowledge as to the manner of printing the scarfs while employed by the printer subsequently, for a consideration, made for the defendants a copy of the distinctive screen employed by the plaintiff. The Court also found that the defendants knew that the former employees had acquired the information when employed to make scarfs for the plaintiff and that they were fraudulently abusing the trust which had been imposed in them when they imparted this information to the defendant. Even though the scarfs had been published the Court held that it would restrain the defendants from manufacturing, exhibiting, and selling scarfs of this type because they had acquired the information by unfair means.

In this connection the Court stated:

"Defendants had a legal right to copy and to sell as their own creation the exclusive model designed by the plaintiff if the model or an inspection was procured by fair means, but defendants had no right to obtain the plaintiff's trade by unfair means."

Pajama Crisis

IF by chance any of our readers are of such a temperament that to enjoy a good night's sleep they require individual and distinctive pajamas, we recommend that they patent their pajamas.

In a recent case for unfair competition involving pajamas the Court held that in the absence of patent protection anyone is at perfect liberty to copy the pajamas made by another. In the case in question, the plaintiff manufactured a man-tailored type of pajamas for women, having witty statements and slogans imprinted on the garment. The plaintiff contended that the defendant had copied its pajamas and asked for an injunction to restrain further copying.

The Court refused to grant an injunction, stating:

"Since plaintiff has placed the pajamas upon the market without securing the protection of the Patent Laws, it thereby published the design of the pajamas and no longer has any exclusive property right * * * In the absence of a showing of any unfair competition, such as an attempt by the defendant to mislead or deceive the public or to 'palm off' its product as the plaintiff's, equity will not aid plaintiff by restraining another from copying and selling the article in question."

What Is a Book?

WE have heretofore pointed out on this page that dictionary definitions and popular interpretations of the meaning of words are sometimes disregarded by the copyright law. An example of this is the rather liberal interpretation given to the word "book."

A recent suit for copyright infringement involved a copyrighted chart to be used in analyzing handwriting. The chart consisted of a single sheet of paper divided into small rectangular subdivisions, each subdivision containing an illustrative specimen of handwriting and a description of the supposed characteristics of a person having that type of handwriting. The Trial Court held that the chart was not proper subject matter for copyright and dismissed the suit. The Circuit Court of Appeals, however, disagreed with the Trial Court and sustained the copyright. In reaching its decision the Court of Appeals pointed out that under the rules of the copyright office the chart was a book and that a book was proper subject matter for copyright.

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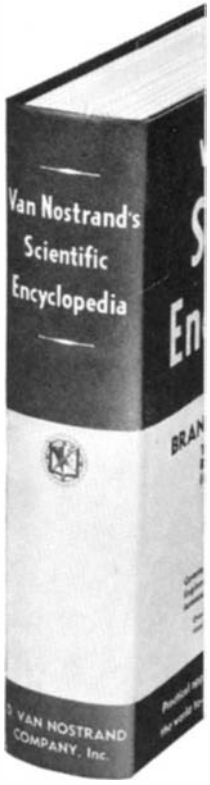

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