ARE YOU A PARANOID?

By Paul Popenoe, Sc.D.

SCIENTIFIC AMERICAN

February · 1938

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ROBERT YARNALL RICHIE

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SCIENTIFIC AMERICAN

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NINETY-FOURTH YEAR • ORSON D. MUNN, Editor

CONTENTS • FEBRUARY • 1938

COILED copper water tubing from the Bridgeport Brass Company's automatic machinery, illustrated on our cover, has advantages over rigid copper pipe. There is a saving of space in both shipping and storage; the pieces may be handled with ease on the job. Standard lengths of tube, from 20 to 60 feet, are coiled in a flat "pancake." These flat coils are then annealed so that, slightly softened and ductile, they may be readily uncoiled and fitted to the shape or contours of individual installation requirements.

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50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of February, 1888)

CANAL—"The indefatigable de Lesseps has been forced to take a backward step in the construction of the trans-isthmian canal. Finding the work far from complete and his capital approaching exhaustion, he has determined to construct the canal for the present with locks. . . . This is by no means to be interpreted as an abandonment of his original project of a canal without locks. But as a source of revenue, it is absolutely essential that the canal should be in receipt of tolls. Without receiving an income at an early date, the work may have to be abandoned."

VOLAPUK—"For some years past, and much more frequently of late, there have been references in English and Continental journals to the Volapuk, world's speech, or universal language, and it would seem as if in some quarters there is a growing inclination to take its pretensions seriously."

LOST SPECIES—"Those species of North American birds termed 'lost' and excluded from many of the lists in consequence, are at present of considerable interest to many ornithologists, both from the fact that a thorough search may, at any time, reveal the existence of some one, and that within the last few years two at least, the great auk (*Plautis impennis*) and the Labrador duck (*Camptolaimus labradorius*), are believed to have become absolutely extinct."

POUGHKEEPSIE BRIDGE—"This structure, now under process of erection by the Union Bridge Co., of importance both as a monument of engineering and as a link in the railroad system of the Eastern States, is rapidly approaching completion. . . . The cantilever has been utilized as far as possible. Pin fastenings have been used in the more important truss work, and small members have been employed. Almost all the riveting was done in the shops, and the eye bolts, struts, and chords were delivered on the ground ready to be put at once in place without delay. . . . The river is crossed in five spans, involving the placing of four piers in the channel. The clear opening of the spans varies from 500 ft. to 521 ft. 6 in., with 130 and 160 ft. head room. . . . On each of the two piers nearest the shore, four sets of steel rollers, 3 inches by 3 feet 6 inches, and twenty four in a set, carry the ends of the anchorage trusses and of the cantilevers of the east and west spans. These allow for expansion and contraction under changes of temperature."

ELECTRICAL TYPEWRITER—"This apparatus, which fulfills the functions of a typewriter at any distance from the keyboard, consists of a type wheel, which contains the letters of the alphabet, numerals, and stops. The rotation of the type wheel is effected by means of intermittent currents transmitted from a commutator under the control of a pianoforte keyboard acting on propelment pallets carried by the lever suspended over an electro-magnet . . . Ink is supplied from an inking wheel."

GAS FUEL—"The American Manufacturer says that Mr. Jacob T. Wainright, a well-known metallurgical engineer of Pittsburgh, Pa., has succeeded in making pig iron with natural gas as fuel."

NO SOCKS—"The experiment, begun some time ago in the German infantry, of doing away with socks and keeping the foot soldiers' feet well greased, has proved thoroughly successful. To say nothing of the economy of the plan, the men march easier, and, generally speaking, show few blisters."

GAS LOCOMOTIVES—"For some time . . . experiments have been quietly conducted by Gen. Supt. W. W. Worthington and the General Master Mechanic of the Fort Wayne, Cincinnati & Louisville road, with a view to the transportation of natural gas in tanks, for use in heating and lighting cars and for fuel in the fire box of the locomotive. The experiments have been successful enough to warrant the hope that the time is soon to come when the public will be able to ride on smokeless and cinderless cars."

ELECTRIC CARRIAGE—"The dog cart represented in the adjoining engraving was built by Messrs. Peck, coach builders of Brighton, and is driven by an Immisch motor of ½ horse power type. The current is supplied by 16 E. P. S. accumulators, which at the normal rate of discharge are good for a six hours' run. . . . The motor at present employed weighs 40 pounds, though it is scarcely large enough for the work it has to do. The experiments so far made have resulted in obtaining valuable data as to the tractive force required for vehicles on roads of various kinds. . . . With a load of two persons a grade of 1 in 30 can be surmounted."

ALUMINUM—"Works for the manufacture of sodium by the Castner process and its conversion into aluminum under the process of Mr. James Webster are now being erected by the Aluminum Company, of St. Mary Axe, London, at Oldbury, near Birmingham. . . . By this process the cost of sodium is reduced from 4s. to 1s. per lb., and of aluminum from 60s. to less than 20s. per lb."

SOCIAL LIGHTS—"The ballroom of Mr. Ogden Mills' residence, 69th Street and 5 Avenue, was lighted by means of the New York Isolated Accumulator Company's storage batteries on Monday night, 16th ult. The occasion was a ball and house warming, and a large assemblage of the leading members of New York society were present. The ballroom was brilliantly illuminated by sixty 16 candle power lamps."

CAST GUNS—"In Europe all the very large cannon are wrought or built up, but we are trying the experiment of casting the steel gun whole, a very much cheaper and more expeditious process. One such gun has been cast in Pittsburgh, and to all appearances it is a success but it has not yet been tested. Should it stand the test of trials, it will mark a great advantage in the making of great guns."

AND NOW FOR THE FUTURE

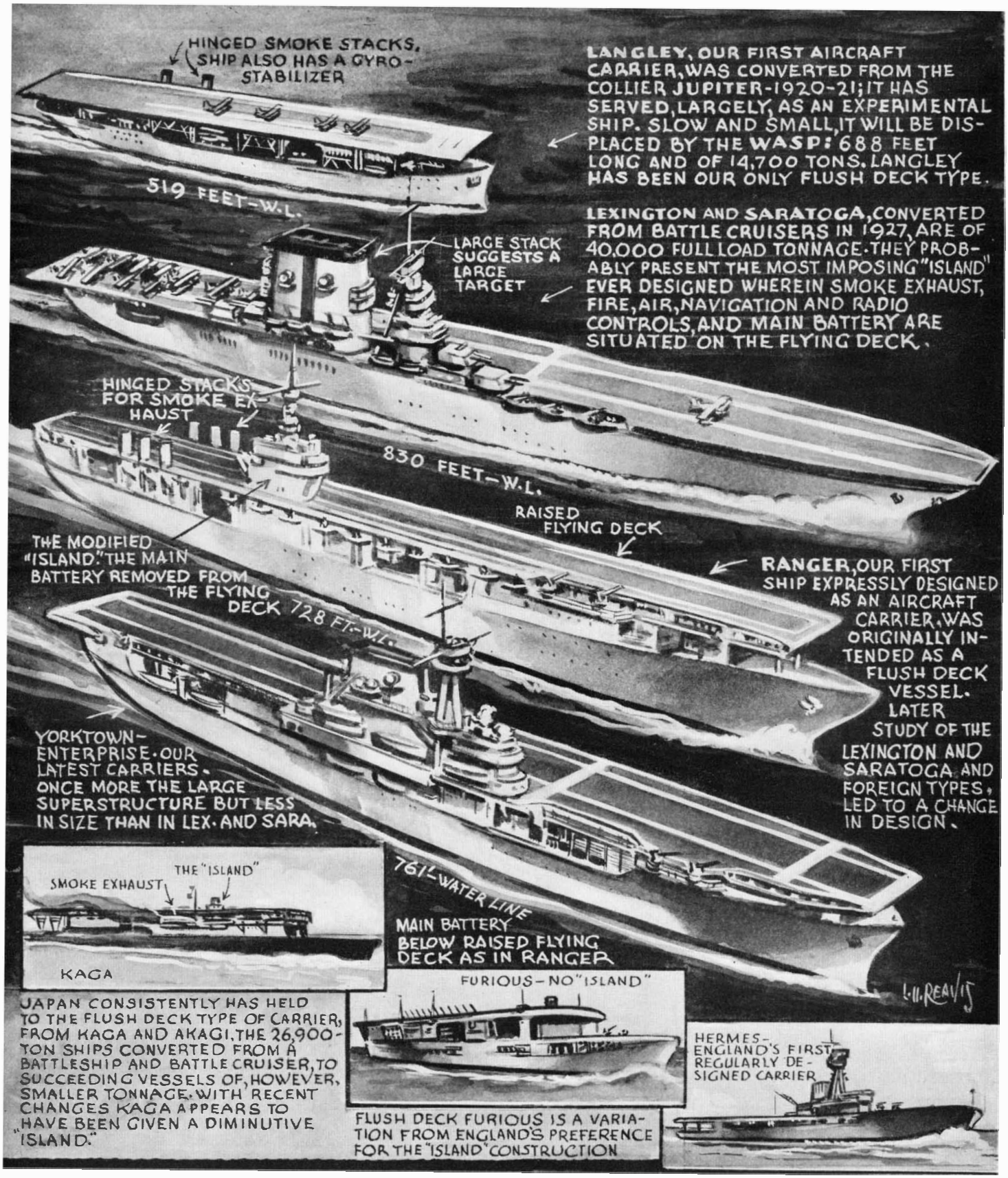
¶Enzymes hold the keys to life and death, by Barclay Moon Newman.

¶Streamlining plants for better agricultural crops, by Keith C. Barrons.

¶China pioneered in invention, but not in modern science. Why? By Rufus Suter.

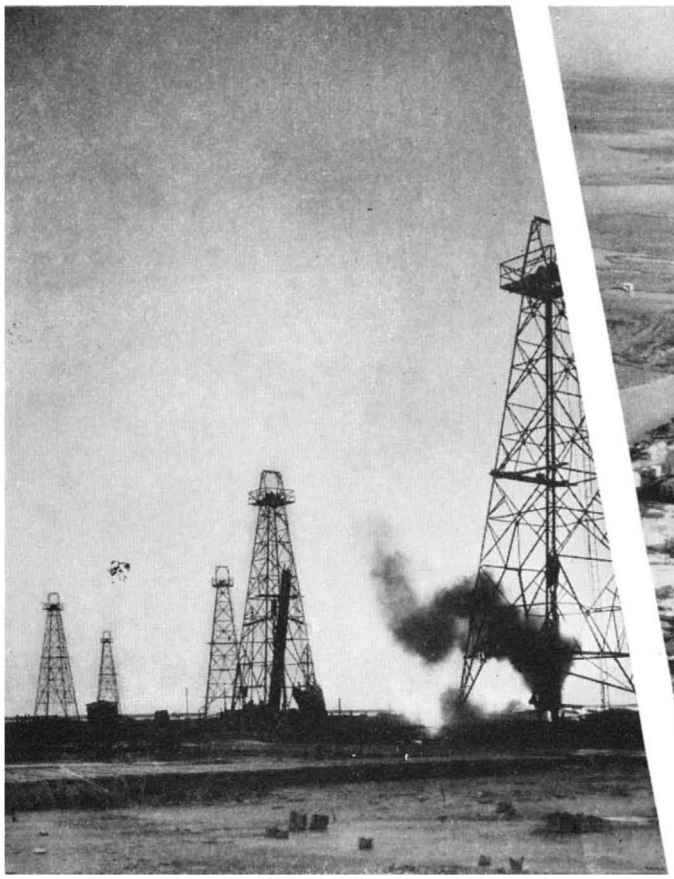
¶Photo-engraving now produces oilcloth, textiles, wall-paper, by Philip H. Smith.

¶Engineers are converting the Everglades into a land of promise, by R. G. Skerrett.

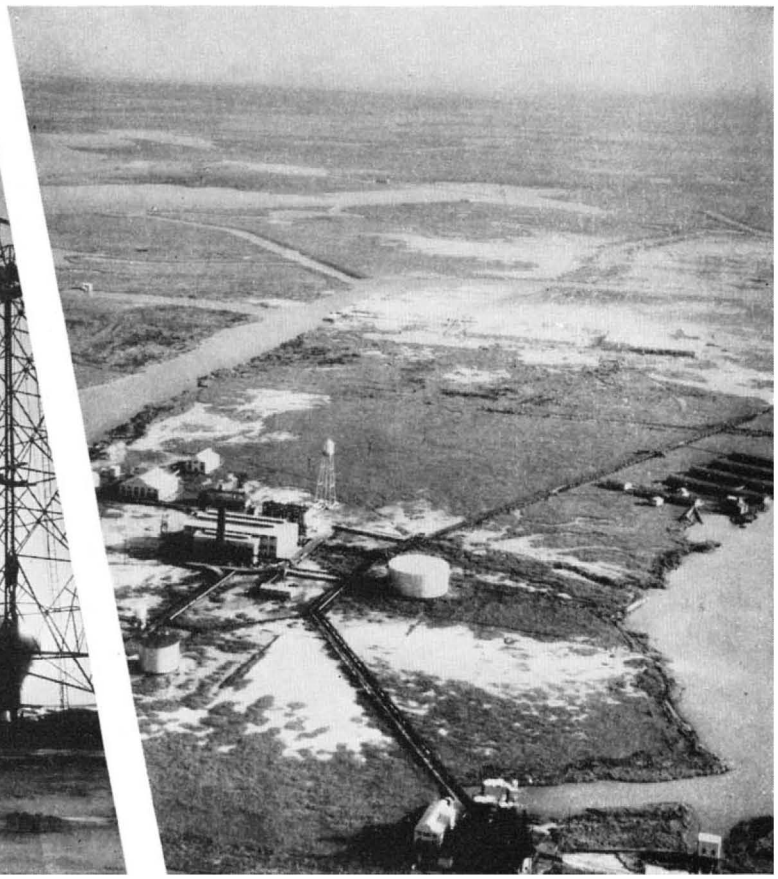


TREND OF DESIGN IN AIRCRAFT CARRIERS

HOW best adequately to perform all necessary functions on aircraft carriers is the unceasing concern of the naval architect. From the time the old collier *Jupiter* was converted into our first mobile flying field *Langley*, there has been some difference of opinion regarding the placement of navigation and fire control, defensive guns, and smoke stacks. Consequently, *Ranger* was at first planned without an "island" but a small one was added. One important thing that has been learned is that carriers must be designed as such from the keel up.



General view of the sulphur derricks at Grande Ecaille to bring sulphur to the surface by means of the Frasch system



The sulphur plant with sulphur storage vats right center. Background shows marshy nature of terrain

An Industry on Stilts

Industrial City on Useless Tidal Marsh . . . Over 35,000 Piles Support 326,119 Tons . . . Difficult Construction Job in Mud . . . Unique Features

By HOMER S. BURNS
Superintendent of Construction, Freeport Sulphur Company

LITERALLY suspended in air on 35,854 pilings, which vary in length from 40 to 80 feet, an industrial community weighing approximately 652,238,000 pounds has been erected on what a few years ago was considered a useless tidal marsh of the Mississippi River delta. This unusual industrial and engineering feat was accomplished by engineers of the Freeport Sulphur Company in consultation with the J. F. Coleman Engineering Company, of New Orleans, and the J. G. White Engineering Corporation of New York, for the mining of sulphur at what is now Grande Ecaille, Louisiana.

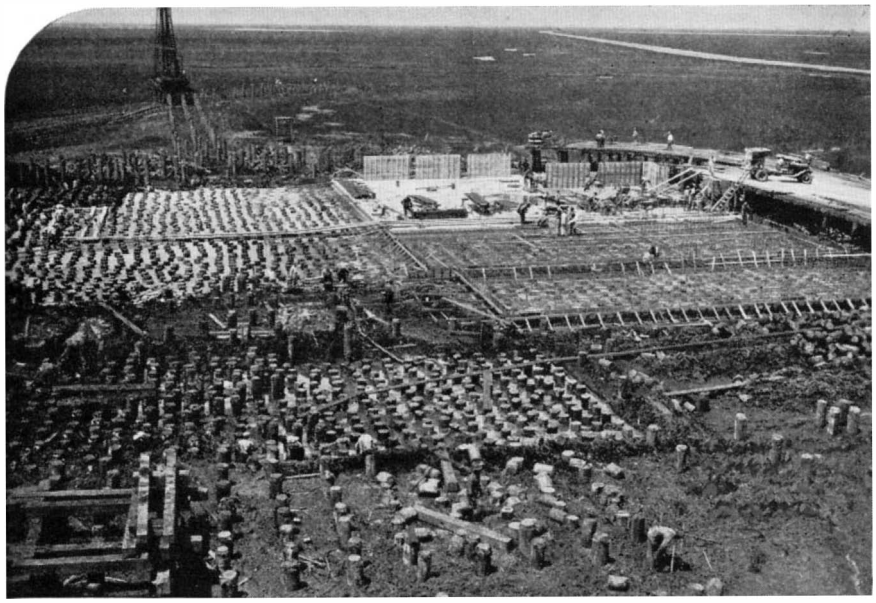
No chapter in the story of sulphur—from its first recognition more than 4000 years ago, to the development of extraordinary processes for its extraction, such as the Frasch hot-water method—is more interesting than the story of this achievement in placing several million dollars' worth of necessary modern equipment in a geographical location which contributed absolutely nothing to the mechanical aspects of the undertaking. Today this plant in operation produces heavy tonnage of sulphur, helping greatly to steady supplies of this element which is widely used in scores of industries.

The Grande Ecaille salt dome is in Plaquemines Parish, Louisiana, 10 miles west of the right descending bank of the Mississippi, 45 miles below New Orleans, and within four miles of the Gulf of Mexico. The terrain is a low, flat, uninhabited area of marsh land, intersected by innumerable shallow lakes and bayous. Except for salt grasses, the region is devoid of vegetation and presents an unobstructed expanse to the vagaries of the winds.

IN July, 1929, prospecting began in this bleak, forsaken area—but for oil, not sulphur. The land was owned by three oil companies and one of these was delegated to do the test drilling. In addition to finding oil, the drills brought sulphur cuttings to the surface from a depth of 1500 feet and more.

The Freeport Sulphur Company acquired the sulphur rights to these swamp lands in 1932, and prospecting was begun immediately. In addition to prospect drilling, a torsion balance survey was made under the supervision of Dr. Donald C. Barton of Houston, Texas, to determine the size, depth, and configuration of the cap-rock area.

While these two methods indicated that there were large quantities of sulphur in the area, there still was no way of knowing, without vast expenditures for plant and equipment, that sulphur could be mined at a profit. It was initial-



Thousands of piles driven into the marshes at Grande Ecaille form the foundations for all plant structures. On these, concrete mats were built to support piers

ly estimated that the cost would amount to millions of dollars and subsequently the actual expenditures boosted the final costs well over 6,000,000 dollars, which was the original estimate.

In the face of pessimistic opinions on the possibility of a plant being built on an almost submerged swamp, the company executives decided that the undertaking was worth the risk. Almost immediately after this decision was reached, actual construction work got under way.

The first difficulty to be surmounted was the job of transporting material to the swamp area. While the salt dome is within ten miles of the Mississippi, there were at that time no practical means of transportation to the location. It was necessary, therefore, to ship materials from Harvey, opposite New Orleans, through the Harvey Canal to Little Barataria Bayou, on through Big Barataria Bayou, Bayou Dupont, Dupree Cut, Cutler Bayou, Bayou St. Denis, across Barataria Lake into Lake Grande Ecaille and thence to the dome, a distance of 70 miles. As the lakes and bayous were shallow, the barging not only was costly, but exceedingly hazardous.

The next difficulty to be overcome was the horde of insects which added greatly to the discomfort of the men. This obstacle was overcome by erecting airplane propellers on automobile motors and blowing the insects out of the area.

The sites for the power plant and auxiliary buildings were marked off away from the dome area to insure freedom from the surface subsidence which was expected to result from the extraction of sulphur by the Frasch system.

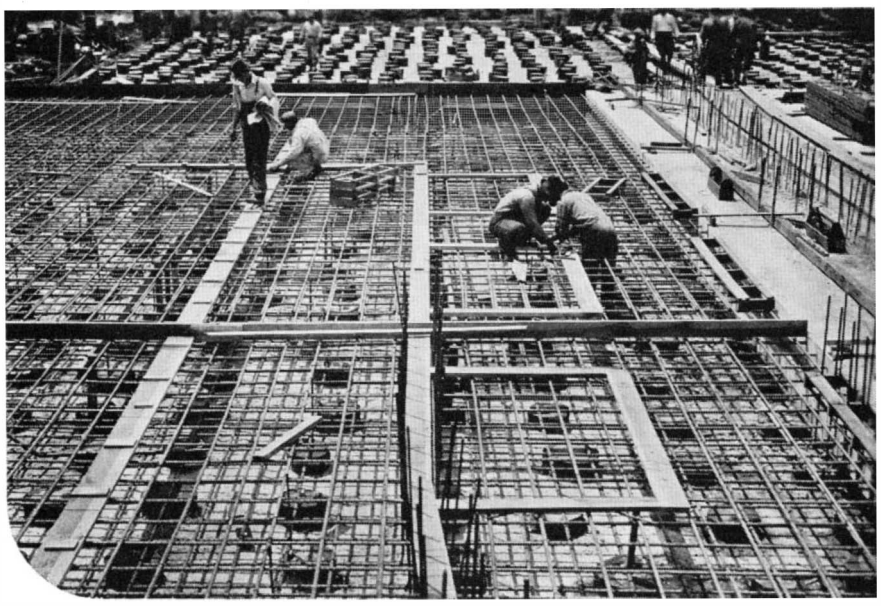
During the prospecting period and after site locations had been selected, the engineering department of the sulphur company prepared and studied several tentative plans for equipping the property. The chief difficulty lay in the selection of the proper foundations. After exhaustive tests, the plan adopted called for heavy reinforced concrete mats supported by piling for the foundations of the buildings, and hydraulically-made fills for the vat foundations and mining area.

Port Sulphur, a site on the Mississippi River accessible by train and highway, was purchased as the supply base. From Port Sulphur to Grande Ecaille, a canal 100 feet wide, nine feet deep, and ten miles long, involving the movement of 2,000,000 cubic yards of dirt, was built to facilitate movement of supplies to the dome.

With transportation simplified, materials began to move into Grande Ecaille by the hundreds of tons. Piling totalling 2,126,301 linear feet, or 403 miles, was shipped in; and other shipments included 4,000,000 board feet of lumber; 200,000 linear feet of pipe from four inches to 42 inches in diameter; ten miles of 33,000-volt power line; five miles of 2300-volt; 15 miles of telephone line; 9102 tons of structural steel; 586 tons of roofing, siding, sashes, and doors; 5832 tons of material and machinery; 19,206 tons of concrete; and 6757 tons of wooden buildings.

More than 8,300,000 tons of dirt were moved, either in building canals or for fills, about half with dipper dredges and the remainder pumped by hydraulic dredges.

The mats on which piers are constructed to support building floors are built of concrete heavily reinforced with steel directly on top of the sawed off piles



FOUNDATION conditions in the Mississippi Valley have been found to vary considerably, usually improving as the river is approached. Soil conditions where pressures up to 1200 pounds per square foot could be used were encountered in various places, while at others it was found this loading would produce prohibitive settlement. Because the soil has virtually no supporting power a short distance from the river, it was decided that structures of any magnitude would have to be supported on piling. During driving and loading tests, it was found that no stratum existed sufficiently close to the surface to be of value for supporting the piling and that only the friction between the soil and the piles could be depended upon.

During driving of the piles it was found that the upper 45 feet of soil offered practically no resistance, the piles almost always penetrating this depth under their own weight before a blow was struck. It was also noted that in spite of the soft character of this soil, it had a tendency to set up within a few hours. Where driving was continuous, a penetration of eight inches per blow was recorded, as against only a half inch pene-

tration from the 10,000-pound hammer after the piling had been allowed to stand partly driven overnight. From these tests, it was decided that 75-foot pilings would carry a safe load limit of eight tons each.

The concrete mats were designed to distribute the load uniformly and to provide adequate strength for any variations in the individual supporting power of the piles, as well as for future requirements. The foundation for the boiler plant alone required 3500 untreated piles, 75 feet long, driven on approximately two-foot eight-inch centers. The firing tanks and the water storage tanks also were built on piling foundations capped with concrete mats.

When it came to construction of the plants, many factors had to be considered—weight, resistance to settlement, high winds, corrosion, and tidal storms. All permanent buildings are constructed of steel with corrugated asbestos roofing and siding. To decrease weight and eliminate corrosion, aluminum bolts and clips of high tensile strength were used for fastenings. Because of the exposed location, the steel frames were designed to withstand winds of 125-mile velocity. Window sash is of galvanized steel, and gutters and downspouts are of aluminum to minimize the effects of corrosion from the salt air.

THE floor of the plant is at an elevation of 12 feet above mean Gulf tide and 11 feet above the surrounding marsh, which was considered by engineers ample to protect it from storms and high tides. The mat itself is only slightly above the marsh, the pilings being cut off about one foot above the water and capped with the thick concrete mat on which piers were constructed to support the plant floor and equipment. The space between the plant floor and the mat is used for water storage.

When the unfavorable location is considered, construction costs were kept relatively low, foundations for auxiliary buildings such as the blacksmith shop, machine shop, and warehouse averaging $2.11 per square foot of floor area.

In addition to the plants, it was necessary to construct a 50,000,000-gallon earthen reservoir for settling the turbid water from the Mississippi before pumping it into the plant. A pipe line approximately nine miles long conveys the water to the plant where storage for 2,000,000 gallons of water was provided.

The weight per square foot of area of a sulphur vat with a 20-foot depth of sulphur averages approximately 1⅛ tons. To prevent excessive settlement, the supporting power of the vat area was increased by 60-foot piling in its bed, placed on four-foot centers.

It is estimated that the total tonnage now suspended in air on piling at this plant is 326,119. Despite this great weight on a foundation entirely of piling driven into marsh land which may seem precariously situated to the layman, the amount of settlement is almost nil after three years of steady operation —an excellent indication that the engineers not only planned well, but also constructed solidly.

The difficulties faced by these linemen, who are shown stringing power and telephone wires, exemplify those faced in the entire job of building the plant

Their work, however, did not stop with construction of the plant. They also had to take into consideration living quarters for 200 men, transportation, shipping, and other details which, while they may appear minor now, were major engineering feats at the time.

It was decided that Port Sulphur would be the shipping terminus for the plant. Here were constructed the mine offices, laboratory, and a model industrial village, with a school, community center, parks, and recreational facilities for the employees and their families. Today, Port Sulphur is considered one of the model towns of Louisiana, with a population of 600.

In addition to the foregoing, a dock 1000 feet long was built on the Mississippi River for the accommodation of vessels with a draft of as much as 35 feet.

Material for the plant and commodities for the village now are brought in by boat, by the New Orleans and Lower Coast Railroad, a branch of the Missouri Pacific Railroad System, and by a highway from New Orleans. And by these same facilities, many thousands of tons per month of 99.5 percent pure sulphur are trans-shipped from the Port Sulphur canal to 71 industries throughout the world to find its way, in one form or another, into 32,000 manufactured products in everyday use.

Even the roads had to be built on stilts. This raised board road on piles leads from the construction office at the water-side to the sulphur domes

Trenching overburden to uncover dinosaur footprints in limestone bed of the Purgatory River, Colorado. (The two holes in the foreground are not footprints)

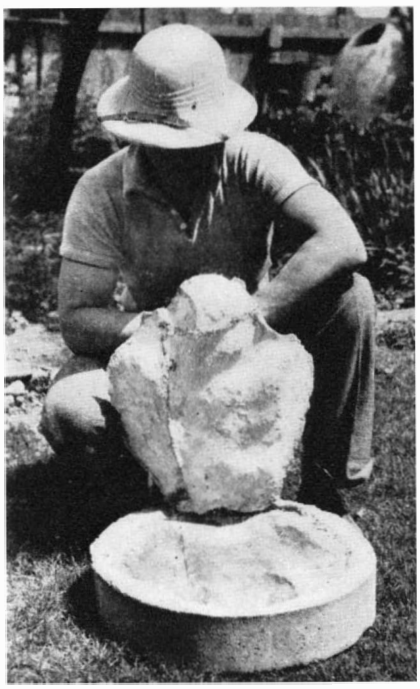
Dinosaur Trails of Purgatory

By JOHN S. MACCLARY

IN the limestone stream bed of Purgatory River, in southeastern Colorado, the positive record of a Jurassic *day* has been uncovered. There, the almost perfect trails of both carnivorous and herbivorous dinosaurs have been preserved side by side.

In addition to the large round tracks of a quadruped, the limestone contains numerous impressions from the feet of ancient three-toed bipeds. The large round tracks, which average 30 inches in diameter, were made by a monstrous herbivorous dinosaur. The three-toed footprints, 18 inches long and 12 inches wide, are credited to dinosaurs of carnivorous nature. The entire assortment of ancient impressions, apparently, may have been made in the same distant day —possibly within the space of a single hour.

One three-toed trail angles to follow that of the huge four-footed creature, obviously indicating that the carnivorous biped pursued the huge vegetarian. The deliberate gait of the two-footed flesh-eater, whose strides almost uniformly measure 48 inches, gives the impression that the killer felt confident mastery of the situation. Irregular spacing of prints in the four-footed trail may be regarded as evidence that the herbivorous dinosaur was aware of impending conflict, which it did not relish.



Plaster was poured into the best of the Purgatory River footprints and the hardened "foot" is shown. Beneath it is a reproduction in concrete, made from this plaster copy. It is used as a bird-bath

The matrix which has preserved the trails of primeval saurian foes is composed of oolitic limestone and the exposure is classified as belonging to the Jurassic period, Mesozoic era. Although succeeding geologic periods left deposits of earth and stone which reached a height of more than 1000 feet above the tracks on the Jurassic beach, the bed of covering shale effectually cushioned the ancient trails—until erosive Purgatory River bared the pages of Nature's diary.

Local cowboys have picked up innumerable fragments of fossilized bones, believed to be portions of dinosaur skeletons. No scientific excavations had been conducted in the Purgatory. In the Colorado Museum of Natural History, in Denver, there are two blocks of track-bearing oolitic limestone from the Purgatory site. "Paleontologists who have viewed the specimens," according to Mr. H. C. Markman, Curator of Geology, "seem to believe the three-toed footprints were made by a variety of dinosaurs yet unknown."

Since the Purgatory tracks exist on land which is privately owned, interested visitors do not barge in and quarry specimens for souvenirs. The writer satisfied the desire for ownership of a dinosaur "foot" by pouring plaster of Paris into the best-preserved footprint that could be found in the Purgatory group. Around that form have been molded in concrete numerous reproductions of the ancient track, creating unusual bird-baths.

Where dinosaurs once sloshed in Jurassic ooze, now is the edge of America's "dust bowl." The Purgatory "badlands" are well-named!

A close-up photograph of the same trail that is shown in the illustration at the top of the page. These tracks are 12 inches wide and 18 inches long, but the dinosaur's plodding stride was only 48 inches

OUR POINT OF VIEW

A Scientific Art

IF you heed the critics on one side, you'll agree that it is not a science. Another set of critics will make you believe that it's not an art. Perhaps then, photography feeds and grows fat upon criticism; for grow fat it does. At any rate it has grown into an industry to reckon with and is growing faster every day. Don't ask us to tell you how very many millions of dollars are spent upon it annually, how many billions of prints —candid and otherwise—are made.

Probably in your own home you have a little snooper with a flock of lenses (candid variety) and a dark-room. If not, there are probably six in your office and *do* you have the time of your life joshing them, when they proudly, gleefully, exhibit their latest batch of pictures! These are the candid cameramen, the neo-or-something artists. You caustically suggest as their coat of arms a shield with argent bar sinister (for their undercover work) with a lens couchant (the photographer on his head) shooting a field vert with unsuspecting persons rampant, super-sensitive panchromatic films entwined. And then you consign the whole candid tribe to perdition.

But, without boring with oft-repeated details—in too much detail—let's look at the record. This magazine—most others, too—would be poorly illustrated without photographs. History would give but little idea what the man Lincoln was like physically, or Teddy Roosevelt, or General Grant, or McKinley; science could portray only with poor sketches the appearance of germs or a laboratory set-up or a new kind of animal seen in the jungles of Borneo; tens of thousands of acres of land could not be surveyed from the air; manufacturers, engineers, scientists, workers in all walks of life would not be able to show the multitudes how a new product is made, how Boulder Dam was built, how blood flows in the veins of a rabbit's ear—without photography all those vitally concerned and those merely interested in these things for the sake of knowledge would not be so enlightened.

That photography has enormous value goes without saying. Whether it is an art or a science may be argued by the hotheads. We believe that it is both. Certainly somewhere back down the line it sprang from science and its developments continue to emanate from the laboratories of serious scientific researchers. Just as certainly somewhere in the future it is going to make an important place for itself in the world of art. Judging from the photographs submitted in our contest, which is discussed on another page of this issue, it has won that place already. The thing photography must do now is to gain full *recognition* as an art.

Pass This Bill

ONE of the strangest traits of the American people is its ostrich-attitude toward many things of great import, and then its hysterical clamor when some tragedy results. We look on apathetically, if we take the time from our little personal interests or pleasures to look at all, while someone with more foresight and gumption expends much effort to save us from ourselves. Immediately a disaster falls, however, we lift the roof with our cries of condemnation of everybody and everything for having let it happen to us.

This has been the case with the attempted revision of the Food and Drugs Act. That Act has a number of loopholes, as Senator Royal S. Copeland explains on another page—loopholes that have permitted the sale of harmful drugs that have caused the deaths of many people. The fault lies in the law, not on those who administer it; for it is truly a bustle-and-ruffle law doing the very best it can in a streamlined age.

For several years a strenuous effort has been made to pass a new Act which would close the loopholes and give the Food and Drug Administration effective power to prevent the advertising and sale of dangerous drugs and untruthful advertising of others. The public has been indifferent. Actually, there has been some strong opposition. Yet when an elixir of sulfanilamide kills more than 70 people, the same public wants to know why sale of it was permitted!

There will, however, be stronger support, because of those deaths, for the revised Food and Drugs Act, Bill S. 5, which is now, or shortly will be, before Congress for passage. It may have defects. It may have loopholes which should be plugged. Perhaps, even, certain of its provisions will work too great a hardship on honest businesses. Congress will do its best to take care of any and all of these, but help will be needed, help from an articulate electorate. We cannot urge too strongly, therefore, that you write your Congressman about this Act. Favor it, criticize it, make suggestions, but write. Properly amended, it should pass so that your wife, your mother, your sister may not court disaster every time they purchase a cosmetic, or that worse does not befall you or your family because of loopholes in an out-dated law.

Doublfeaturitis

ARE you a victim of doublfeaturitis? Are your legs cramped; do you break out in a nervous perspiration, shift uneasily in your chair in an endeavor to find a spot that does not ache as a result of prolonged pressure; do your eyes twitch, your fingers pluck uneasily at the buttons on your vest? Clip these questions, take them with you the next time you attend a movie, and if you can answer all of them truthfully in the affirmative, then you are a victim of doublfeaturitis.

Basing their action on the erroneous assumption that, if one good movie is worth the price of admission then two mediocre movies should be better value for the same price, motion-picture exhibitors throughout the country have gone in whole-heartedly for double—in some cases even triple and quadruple —feature programs. By so doing, they have made necessary the mass production of a large number of cheaply made features, resulting in a flood of movies that, to say the least, insult the intelligence of a large proportion of the movie going public. True, some of the larger producers are turning out movies that are a credit to the institution and art. But such films involve huge investments, take long months to produce. They cannot be turned out in sufficient quantities nor rented to exhibitors at a price low enough to meet the demand for double feature programs.

But, regardless of production problems, what can the victim of doublfeaturitis do to alleviate his distress? He can do the same thing that he did not so long ago regarding smut on the screen. He can protest, and, as soon as his collective protests are loud enough and vehement enough, results will follow.

You victims of doublfeaturitis must arise en masse. Make sure that your local exhibitors are told positively and often about your distaste for interminable and mediocre programs. Use your daily papers to spread the alarm. Then watch the producers and exhibitors, when they feel the pressure in their treasuries, begin to offer good single features with a variety of succulent short subjects. The future of the disease is in your hands. Arise and strike before it becomes chronic!

EDITORIAL anticipation, based in part on previous experiences with "ticklish" articles, suggests that the accompanying one will fall in that category. It should not, however —if readers will read it closely, read *all* of it, and judge it solely on the basis of what is stated in it. There is a human tendency to color controversial discussions by unconsciously pouring in with their content various points of view brought from previous sources of belief. Too often these beliefs are from erroneous tradition or even old wives' tales.

As the reader will see, the bottom brick of the pile leading sometimes to full paranoia is the feeling that the subject should have amounted to more than he did. How irrational this is may be shown by a study of Nature. To only a few individuals does she happen to grant unusual abilities, a matter evidently of genetics and one that lies beyond the responsibility and control of the individual. Hence, if one has failed to attain to great ends there is plenty of company. Incidentally, our American over-worship of the god Success may have something to do with our high insanity rate.

Taken solely on the basis of its contents the accompanying article should offend none and alarm but few, while it ought to reassure and assist many. It may also prove useful in enabling the individual to estimate some of the numerous public figures of our troublous times, not omitting some of the heads of governments.

The choice of illustrations for this article must not be awarded undue significance. Because psychology is not an exact science there is no proof positive that any of these characters were of the paranoid type. It is certain that, if they were, they were so to dissimilar degrees. Also, had it been desired to select types that go further into the paranoid personality—often into sheer paranoid insanity—illustrations of Ivan the Terrible, some of the Borgias and some of the Roman emperors could have been chosen. This might, however, have done injustice to the others, since some readers might then make the wrong inferences.—*The Editor.*

THE PARANOID PERSONALITY

Merely our Everyday Traits Exaggerated . . . At its Roots is the Unwillingness to Admit Inferiority . . . How to Avoid it, How it Grows, How to Deal with it

By PAUL POPENOE, Sc.D.
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DRIVING down from the White House, President James A. Garfield entered the railway station to take a train for Boston. He was looking forward to a pleasant vacation, in the course of which he would attend Commencement exercises at his alma mater, Williams College.

From the spectators, one man pushed forward. There were two shots from a revolver, and the president slumped into the arms of his Secretary of State, James G. Blaine, with whom he had been walking.

The murderer gave his name as Charles J. Guiteau and explained his motives at once. "I killed him as a political necessity under Divine pressure," he announced, "after two weeks of earnest prayer."

HOMELESS, penniless, syphilitic, a failure in life from start to finish, Guiteau considered himself a great man, a political power whose campaign activity had done much to elect the former canal boy to the presidency. It transpired that this political activity consisted mainly of a speech delivered once to a few dozen negroes. But Guiteau felt that he was entitled to office as a reward of his exertions. He wanted to be consul-general in Paris. When the president proved "ungrateful," he decided that it was for the good of all concerned that the "stalwart" vice-president, Chester A. Arthur, should take his place.

"Guiteau was crazy," you will remark; and you may remember that you have heard him described as a paranoiac.

Just because he is such an extreme case he provides a good illustration of the fact, axiomatic in psychology but difficult for the public to grasp, that there is no sharp line of demarcation between the sane and the insane. *The "symptoms" of the insane are merely the everyday traits of mankind, exaggerated to an inconvenient or dangerous degree.* Indeed, the type of personality which, passing out of bounds, leads a

Carry Nation, the saloon wrecker, typical of the crusading makeup

Guiteau to the gallows, is the same type of personality which, kept within bounds, is at least partly responsible for the achievements of some of the world's greatest men.

Two factors stand out in a study of Guiteau: first, his unwarranted conceit, which led him to think himself an important person entitled to reward, and, second, his unwarranted suspicion, which led him to think that the president was doing him an injustice.

These two factors, conceit and suspicion, are the soil in which the paranoid personality has its roots. But the seed is found farther back in a feeling of inferiority or failure and an unwillingness to admit the cause.

This cause itself may be anything at all—in one instance perhaps a sexual inadequacy, as the Freudian psychoanalysts assert, in another perhaps a shriveled arm, as with the ex-Kaiser.

SO far as the complex interplay of forces in life can be simplified into a diagram, nine steps lead to the development of a paranoid tendency. They are easy to follow, one after another. Fortunately, though all of us start down this path, common sense prevents most of us from going to the end. The steps are about as follows:

1. Every man wants to succeed in the world, to amount to something, to attain power and recognition.

2. For some reason, John Doe fails to attain the position in life which he thinks he ought to have.

3. This results in a feeling of dissatisfaction, weakness, mortification, or shame.

4. Such a feeling is uncomfortable and he seeks to be rid of it.

5. He is not sufficiently indifferent to ascribe the failure to fate; still less has he the strength of character to admit, even to himself, that it is "all his own fault."

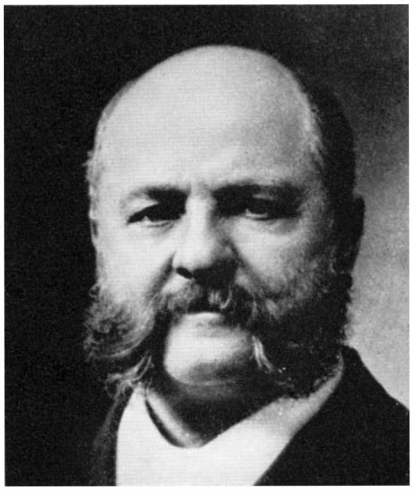
6. He therefore seeks to blame it on someone else—on his environment. Since he cannot admit that his failure is just, this requires him to believe that someone is unjustly persecuting him.

7. If he is being persecuted, it must be because the enemy is afraid of him or jealous of him, for no one would take the trouble to persecute a man who did not amount to anything. By easy steps, then, he convinces himself that he is a very superior person: the more he fails, the more it is proof that someone is opposing him; the more he is opposed, the more it is proof that he must be a great man to excite such formidable opposition.

8. This feeling of grandeur compensates for his unconscious feeling that he is a failure and gives him a quasi-rational and highly satisfying explanation for the suspicion which leads him to believe he is being persecuted.

9. Little by little these various ideas become established in his mind as an organized system, and if he goes this far John Doe has become a full-blown and probably insane paranoid.

Whether delusions of grandeur or delusions of persecution are more fully developed in the insane paranoid seems to depend partly on his natural temperament. If your man is an optimist, he will



Anthony Comstock, over-zealous crusader against indecent matter

go in for grandeur. The grotesque exaggerations of the feeling of self-esteem, which one encounters in mental hospitals, are well-known. "Don't call me Henry," a patient requests. "My name used to be Henry but I've been promoted. I was King Henry for a while but now I'm God Almighty Lord Jehovah."

If, on the other hand, your man is a pessimist, the idea of persecution is likely to be most prominent, and eventually to take the form of a well-organized and logic-tight system of delusions. Frequently the patient thinks that some powerful and far-flung secret society is after him —it may be the Masons or the Knights of Columbus or the Ku Klux Klan or the Silver Shirts or the B'nai B'rith, according to what his own contrary views happen to be. On the principle that there is safety in numbers, it is a good thing to have the paranoid's suspicions directed against a body of 100,000 men instead of against one individual. Unfortunately, however, you never can tell when he will pick out one individual from the mass, as an envoy who has been particularly designated by the Inner Council to "get" him and who therefore has to be liquidated. An insane paranoid is always a potential criminal.

SINCE any trait is more easily recognized when it appears in an exaggerated form than when it is at a minimum, the paranoid personality was first identified *in its extreme development* among the insane; just as I have started this discussion with the example of Guiteau. Nearly half a century ago Emil Kraepelin, the great German psychiatrist, described paranoia as a distinct form of mental disease, and the term "paranoiac" became current. This word has largely fallen into disuse in recent psychiatry. Paranoid tendencies are now recognized as one of the common components of the human personality. Emphasis is shifted from the insane to the normal. Most of the "paranoiacs" or insane paranoids are now diagnosed as victims of dementia praecox, the commonest mental disease and in many ways the one most serious disease of mankind. On the other hand, the great bulk of the paranoids are not insane—*they are as normal as you and I.*

Obviously, there must be all grades of this personality. One can find a complete series of transitions, from the momentary feeling any one of us may legitimately have that he has been done an injustice, his merits not properly recognized, to the complete mental breakdown that one finds in the psychopathic hospitals or in a criminal like Guiteau.

It will be interesting to look for these paranoid tendencies in some of the great men of history. Remember that conceit and suspicion in varying degrees are certain to be present in the paranoid. Conceit may take the form of an exaggerated ego but it is often disguised in the average man as a strong feeling of self-righteousness. Suspicion is often disguised as a very strong resistance to accepting other people's opinions.

Napoleon is a striking illustration. His poverty, his family situation, his alien appearance in France, perhaps also his short stature, all contributed to give him a sense of inferiority. He reacted to this by a boundless self-esteem, and by a feeling, which grew on him with the years, that he was surrounded by enemies and could trust no one. On the other hand, his constant suspicion that his guards at St. Helena were trying to poison or destroy him may have been largely pretense, for he was a poser who did not know the meaning of sincerity; but paranoid tendencies can be recognized at any stage of his life.

Woodrow Wilson furnishes an exam-

Emanuel Swedenborg, a Swedish scientist who turned mystic. He heard mysterious conversations and experienced extraordinary visions

ple closer home. As a child he did not know how to get along with others, and this difficulty followed him to the day of his death. He could not get along with his faculty and trustees at Princeton or with his cabinet and Congress at Washington. During his illness the Secretary of State, Robert Lansing, wanted to see business carried on and queried whether the vice-president might not sign routine documents. Wilson saw in this a plot against himself and demanded the secretary's resignation. He broke with almost every intimate, one after another—even with Colonel House. His last years were passed in the shadow of a cloud of suspicion, resentment, and bitterness.

IN earlier American history John Randolph, John C. Calhoun, John Brown, and Charles Sumner come promptly to mind. The Adams family of Massachusetts appears to have had its full share of paranoid traits. As a fact, this type of personality tends to run in families, and there is probably some biological basis for this, but studies do not yet prove how far its development is due to constitutional factors and how far to childhood experience, or to mere imitation.

A candid examination would show, I believe, that many lawyers and politicians are paranoids. One may be helped to succeed in these two interrelated professions by aggressiveness, stubbornness, determination, and self-esteem. In

the case of politicians, an exaggerated idea of one's own importance is probably an asset, a tendency to blame one's failures on other people is a habit, and tendencies toward both fault-finding and revenge are so common as to make it appear that they must be useful to their possessors. (Another type of politician, however, succeeds for the opposite reason—through his great deficiency in paranoid traits. He is the glad-hander, the "joiner," the man whose main objects in life are never to make an enemy, never to espouse an unpopular cause, but to keep his ear to the ground and be "loyal to his friends.")

But the lawyers and office-seekers have no monopoly on paranoid traits. You can find them in any direction you may look. They are not absent, for example, among many religious "reformers," particularly those belonging to some of the more fanatical fundamentalist sects.

Parenthetically, Guiteau proclaimed, "I'm a lawyer, a theologian, and a politician!"

A STRIKING illustration from the scientific world is furnished by Gregor Johann Mendel, the monk who is universally recognized as having found the long-sought clue to the riddle of heredity. Born a poor peasant's son in an Austrian village (now in Czechoslovakia), he went into a religious order merely because he could not afford to get an education in any other way, and carried on his plant-breeding experiments while teaching science in the local high school. He was made abbot of the monastery—a wealthy and influential one even by the standards of a country where the church has seldom lacked wealth and influence. Soon he started a fight with the government on a question of taxation. Single-handed, and against the judgment of his associates, he defied the power of the state, which retaliated by depriving the order of its most productive properties, one by one. He shut himself up in his palatial headquarters and alleged that his enemies were trying to poison him in order to get him out of the way. His death half a century ago ended the sort of impossible situation that is bound to arise when an irresistible force meets an immovable object; and his successor lost no time in arranging a satisfactory compromise with the government.

In the light of these illustrations, it should be easy to recognize that the paranoid personality is not found merely among the derelicts and discards of society—that it often accompanies outstanding intellectual qualities. Analysis of a large number of normal, everyday cases would show that such traits as the following are likely to be found in the paranoid:

1. Excessive pride, haughtiness, conceit, self-righteousness, and disdain of others.

2. Sensitiveness to what others think about him; uneasy about this.

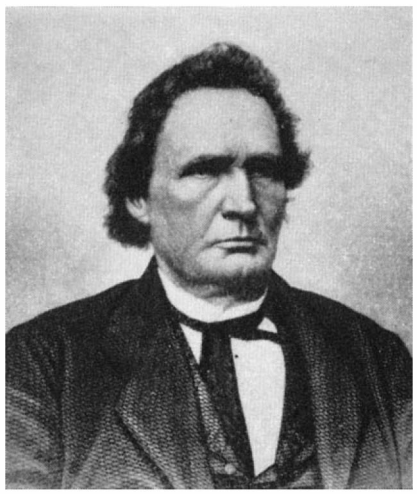
3. Strong, stubborn, propagandistic, opinionated, resistant, biased and prejudiced—"a one-track mind."

4. Rigid and unadaptable; not willing or able to discuss controversial subjects freely; can't make concessions or compromises easily or gracefully.

5. Suspicious and revengeful; remembers slights and holds grudges indefinitely; nurses quarrels instead of forgiving easily.

6. Given to scolding, nagging, complaining, and fault-finding. Over-critical,

Sir Isaac Newton, greatest of all intellects but a "difficult" personality



Thad Stevens, a noted political leader who, opposing Lincoln, demanded vengeful treatment of the South after the close of the Civil War

exacting, jealous, and often intolerant.

7. Aggressive in his own defense; becomes abusive or quarrelsome on slight provocation; seeks for grievances and exaggerates them; "is looking for trouble."

No one person will show all these traits in equal degree. Every one of us will show some of them. The paranoid will show a number of them. If any man has at least half of these to a pronounced degree, it will probably be accurate to class him as a paranoid.

When any person encounters an emotional obstacle in life, he may take one of three different courses: (1) advance and attack; (2) surrender, "lie down and take it", just "quit"; or (3) run away. The individual who reacts in the first manner is the only one who is likely to become paranoid; the other two types will develop other difficulties of personality, but not paranoid tendencies. Hence, the trait No. 7 above, aggressiveness, is an essential part of the picture.

Men are more likely to become paranoid than are women, because aggressiveness is typically a male, not a female, characteristic.

A REVIEW of the seven kinds of traits I have mentioned above as likely to be found in paranoids will show that many of them are, in a moderate degree, of great value and responsible for much of the world's progress. Consider a man who lacks them altogether: among other things, he is likely to be weak and easily influenced, wanting in persistence, determination, and a willingness to stand up for his rights or those of anyone else. No one should be worried, therefore, if he finds on self-analysis that he possesses some of the constituent parts of a paranoid personality. Perhaps he has reason to congratulate himself. Perhaps he would rather be Napoleon or Woodrow Wilson than to be Warren G. Harding, who appears to have been notably deficient in paranoid traits and who might have left a greater name in history had he possessed more of the paranoid's strong convictions and willingness to fight for them.

But, at least, one must take care that one keeps the paranoid traits in balance, uses them constructively, and suppresses at the same time their most annoying manifestations such as the tendency to continual fault-finding.

Any community is fortunate to have a few intelligent, influential, socially-minded, and wealthy paranoids who will be duly suspicious of demagogs, constantly alert to expose injustice and correct wrong-doing, and ready to set themselves against unwise measures, no matter how popular.

On the other hand, the paranoid who gets the worst rather than the best of the qualities that inhere in that type of personality is likely to be a perennial nuisance. He may be a harmless one, haunting the courthouse and seeking justice in some long-continued litigation or for some, perhaps imaginary, injury. He may be an inventor, trying to protect his perpetual-motion machine from the strategies of his enemies who are trying to steal the secret. He may be a more prosaic trouble-maker in the organization to which he belongs. The

business establishment, shop, or factory which does not have at least one paranoid employee, continually complaining and stirring up dissension, may consider itself lucky. Employees who do not have a paranoid boss are likewise entitled to congratulate themselves.

Some of the worst types of paranoids thrive in times of turmoil. When the public is confused, lacking both direction and discrimination, the energy, self-assurance, and perhaps unscrupulousness of the paranoid give him an advantage. Hence every depression, every period of social or industrial unrest, every revolution, is likely to bring them to the fore and land them, for the time being at least, in places of authority. It is not necessary to go back to the French Revolution; those who are familiar with the popular revolts in Europe after the World War will think of abundant illustrations. Indeed, the contemporary newspaper reader will probably have no difficulty in identifying some of the prominent actors on the world's stage today, as motivated by this type of mental mechanism.

Bad enough as chairman of a grievance committee, the paranoid sometimes becomes intolerable as a husband or wife. One need but think back over the seven paranoid characteristics listed above, to realize how hard they might be to live with, day after day. Sometimes the mate appears to become paranoid too, merely by "infection" or "induction."

HOW should one deal with a paranoid?

Psychiatrists testify that it is a hard job, the extremes being considered incurable. But in the normal range, as for example, between husband and wife or employer and employee, they would probably agree on the following:

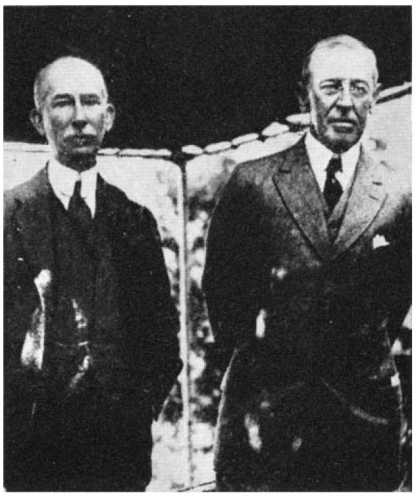
1. It is of no use to argue. Opposition merely intensifies the paranoid trend.

2. You must start from his premises and, while appearing to agree with him on these, must try to carry him to other conclusions. To illustrate this by citing the extreme case once more, it would doubtless have been useless to argue with Guiteau that he was not a great man and that he deserved nothing from the president. He would merely have added you to the list of his enemies. But you might have assumed that he was a great and deserving politician and have helped him plan a campaign which would have kept him busy and given him more permanent satisfaction than did the assassination.

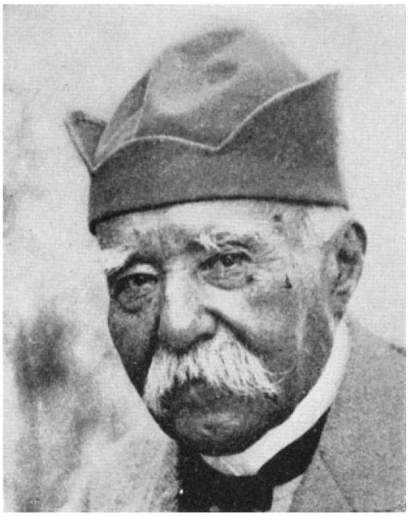
3. In other words, you must help him to get self-assertion in a reasonable rather than an unreasonable way. He really needs encouragement, not discipline. He is fighting because he feels threatened or menaced. The fighting tendency which he manifests is not wholly bad; it is one of the most deeply rooted biological tendencies. Not suppression but re-education and re-direction are required.

It is even more important for all of us to understand how we ourselves can keep from drifting into an unwholesome paranoid outlook on life. To build up such an attitude is far too easy—the ingredients are present everywhere.

In the first place, everyone has some feeling of inferiority. We grow up with



Woodrow Wilson, who even broke with his fidus Achates, Col. House



Clemenceau, the "Tiger," domineered even over his allies at Verseilles, forcing a short-sighted peace

it from childhood, when we are daily confronted by our own weakness and dependence on those who are stronger than ourselves. Throughout life, there are always things we should like to do, which we attempt unsuccessfully. If a man has a proper realization of his own limitations and a correct understanding of human nature, this sense of inferiority will not make any trouble for him; rather, it will keep him out of trouble, for he will not try to do things that are beyond his capacity. Personality analysis, vocational guidance, tests of temperament and intelligence—all the resources of science should be used. They are a great help to realistic adjustment in life, and should be part of the routine of high-school education.

If an abnormal feeling of inferiority is avoided, an abnormal feeling of conceit will probably be escaped, for the latter is usually an attempt to compensate for the former. One who is becoming too self-centered must force himself to take a more active interest in other people.

Finally, suspicion must be abandoned, and this again requires better mental hygiene for a large part of the population. Unless one stops to think about it, one will not realize how easy it is to form groundless suspicions. Do you remember the first time you appeared in public in a dress-suit? You thought everyone in the room was looking at you and commenting on you. As a fact, probably no one paid the slightest attention to you; but you yourself were uncomfortable and projected this feeling on others.

Some day when you feel particularly calm and contented, think over your past life and see how you have reacted to disappointments and defeats. If you have tended to blame others—to think you failed of promotion because "the boss had it in for you" or because the boss's wife didn't like your wife—it is well to be on your guard. Introverts are somewhat more likely to develop unhealthful paranoid ideas than are extraverts, because they are normally more concerned with themselves and brood more over their troubles; but they have no monopoly on this mechanism. Some of the conspicuous paranoids are marked extraverts.

THE dangerous thing about a paranoid trend is that it is so satisfying! No one wants to be a failure; and if one fails, nothing could be more consoling than to believe that one is really a great man thwarted by sinister and powerful forces that are beyond control. Sound mental hygiene will begin by teaching children not to blame other people for their difficulties, and will carry them through life with a good mental balance. This implies continuous adjustment, varied reactions, and an enthusiasm for living. Such habits of life will prevent the onset of many difficulties—paranoid tendencies are only one of them.

The paranoid personality, in conclusion, is a common one and when properly controlled may be a very useful one. But it gets out of control too easily. "Knowledge is power," as the advertisements of encyclopedias advise us; and a knowledge of the origin and manifestations of paranoid feelings will enable anyone to live his own life more successfully and to get along better with those around him.

THE SCIENCE OF

(In Two Parts—Part One)

By SIDNEY J. FRENCH
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NO one doubts today that we live in an age of alloys, for every day marks the birth of some new alloy with particularly useful qualities. We have become accustomed to reading about alloy trains, alloy aircraft, alloy trimmings, and alloy gadgets. Yet, it is surprising to know that until recently the whole process of alloy making has been a shot in the dark, a cut and try process. Two melted metals were mixed together and allowed to cool, sometimes rapidly, sometimes slowly. The result was an alloy. But, like the genius born of mediocre parents, the alloy often possessed unusual qualities, resembling neither parent. There was truly no Mendelian law of inheritance in alloying.

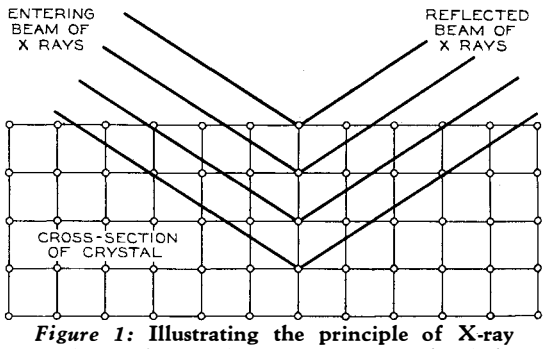


Figure 1: **Illustrating the principle of X-ray analysis of crystals. Atoms reflect the light**

THE first man who mixed together melted copper and nickel in the proportion of 3 to 1 must have been vastly surprised to obtain an alloy which had the luster of nickel alone and showed no evidence of the presence of copper. Yet this alloy was much harder than either copper or nickel alone. So it is today that we have our nickel coins composed largely of copper, and the very useful Monel metal resembling nickel but composed largely of copper. How can it happen that in mixing copper and zinc in certain proportions we get a soft brass easily machined and yet, by changing the proportions only by a few percent, we obtain a brass so hard that it cannot be machined? One type conducts electricity readily, the other, poorly. How does it happen that very soft lead can be hardened by the addition of 1 percent of arsenic? Pure iron is soft and malleable; the addition of from 0.5 to 3 percent of carbon gives tough, hard steels. Tin melts some 200 degrees above the boiling point of water while lead, bismuth, and cadmium melt at even higher temperatures, yet an alloy of these four metals is known which melts readily in hot water. And if indium is added to them an alloy is obtained melting slightly above body temperature. Truly, the domain of alloys has been a veritable Alice in Wonderland where each new turn carried its own surprise. Prediction was useless, for there were few rules to predict by. It was all a matter of try and discover. When a useful alloy was unearthed by this method, the experimenters were content.

Today, however, new rules are creeping into the alloy-making game, and we can begin to predict with some little certainty what kind of alloy will be produced when two or more melted metals are mixed in certain proportions. We are now in the science of alloys about where we were in the science of chemical combination a century and a half ago. But our progress is being greatly hastened by our newer tools.

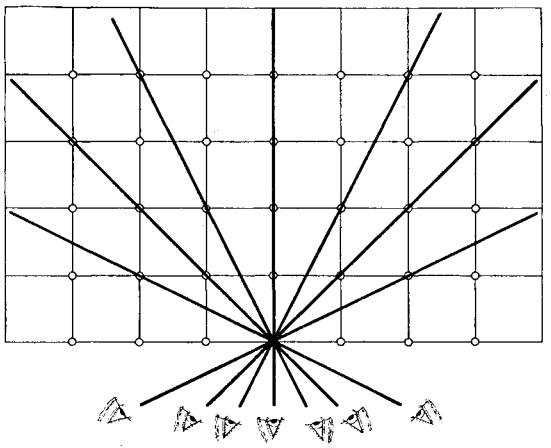


Figure 2: **Lines formed by the regular spacing of objects, as seen by the eye at different angles**

Before we can know what gives alloys their unusual properties we must know what is inside of them. We must study them as we study human anatomy, as we study the works of a fine watch, as we study the structure of a beautiful painting: we must analyze the alloy. For many years we did this by carefully polishing the surface of the alloy, then etching it with acid. The acid, attacking the joints between minute crystals of metal, set the crystals up in relief. With a high-powered microscope the crystal structure could be seen or photographed. This in turn gave evidence of the type of alloy present, and the percentage of each metal present.

The story is told of an unlettered workman who, through long experience, could look at a cut section of a particular alloy and state the percentage composition so accurately that the laboratory soon quit checking his figures.

But this type of analysis is still an external affair. We are still on the outside of the alloy attempting to look in. We are judging the watch by its tick; we must go deeper still—we must go to the atom itself for our answers and no microscope, however powerful, will do for such a purpose. How can we hope to see inside the metal, to see the very atoms when they are of such size that it would take a number of them far greater than the entire population of the United States to make a row one inch in length. Yet, within the past decade or more we have been able by indirect means to do just that thing—to see the atoms, or at least to see the positions they occupy, and to measure their relative sizes. This remarkable achievement has come about through the happy thought of using X rays. Because of their remarkably short

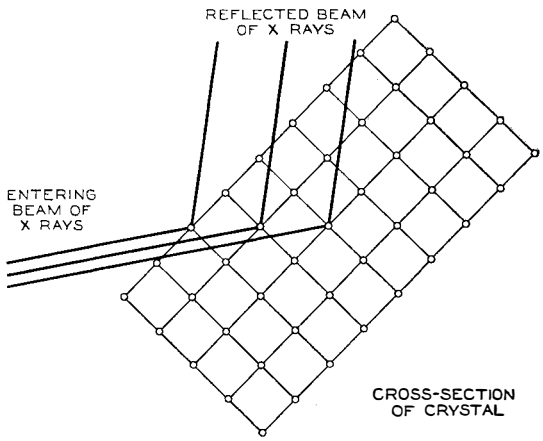


Figure 3: **If the crystal is turned, the X rays are reflected from different layers of atoms**

Alloy Building

Ours is the Alloy Age . . . Alloy Making Today is No Longer, As Once, a Shot in the Dark . . . New Rules in the Alloy Game . . . How We Ask the Atom

wave-lengths, X rays will penetrate flesh and, to a lesser extent, bones, and metals. Not only that, but just as light can be reflected from a mirror, so X rays are reflected from a metal surface. To the X ray the metal acts as if it were a series of polished screens one below the other. Some of the rays are reflected from the top screen, some from the next screen and so on to a relatively considerable depth (Figure 1). Instead of having the opaque or solid surface we imagine it to have, therefore, the metal is full of openings, openings too small for ordinary light to penetrate but large enough to admit the X rays.

A particular X ray will then penetrate the metal until it strikes an atom, either on the top layer or beneath, whereupon it will be reflected. By placing a photographic plate in the proper position, we can, in a sense, take reflected pictures of these atom layers. The details of this process are somewhat mathematical and involve a knowledge of the nature of waves. We need not concern ourselves with such details, beyond noting that this process, properly worked out, gives us the arrangement of the atoms in the metal or alloy and gives us, further, a measure of the distances between rows of atoms. [The theory was explained in detail in Scientific American, January, 1931.—*Ed.*] We shall have more of this later.

No one with the least observant eye has failed to notice the many and orderly rows of corn in a well planted cornfield. As we stroll past the field, we note not only the rows at right angles to the road but many others running off at various diagonals. From each point of view are seen serried rows lined up in orderly fashion. But the distance between plants is different for each of the many lines of sight, just as in Figure 2.

The reflected X ray tells a similar story for the structure of a metal. As the metal under observation is moved on a pivot to present different faces to the beam of X rays, different layers or rows of atoms become the reflecting screen (Figure 3). We are in a sense walking past the crystal and gazing down different lines of atoms. Of course, the analogy to a cornfield is not quite correct, for the crystal is a three-dimensioned affair while the cornfield may be said to have but two dimensions.

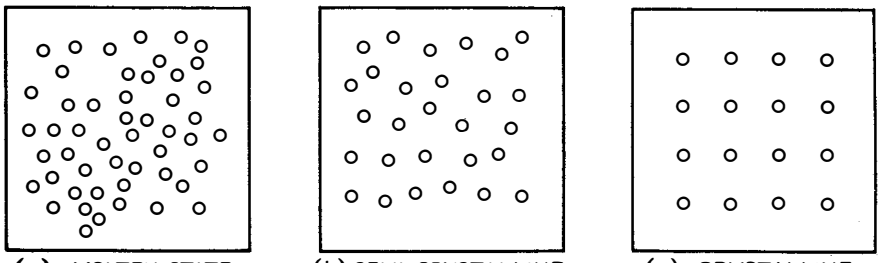


Figure 4: **Atom arrangement in molten, semi-crystalline, and crystalline states**

When we have found all of these planes of atoms in the crystal and have determined the distances between them by means of a simple mathematical formula, we know the position of every atom in the crystal. What do we find—atoms scattered like an unorganized mob, or atoms lined up in orderly battalions? It is the latter, of course. The atoms are the soldiers of picked battalions on parade. Thus, by means of our X-ray probes we may study the interior of metals and alloys to determine their arrangement. But this, of course, does not answer our questions about the unusual properties of alloys. It merely gives us a starting point in the attack.

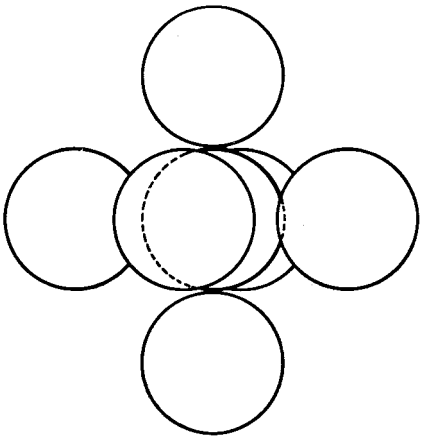


Figure 5: **In the cubic lattice arrangement the central ball is in contact with six surrounding balls**

Before passing on to the types of crystal structure we may well consider what happens to the atom when a melted metal freezes or solidifies. In the melted state, we may imagine the atoms to be swarming about like the members of an angry mob. There is no order, but the greatest disorder. Each fellow is attracted to his neighbors but moves about from group to group. As the temperature falls, the movement decreases and the atoms begin to fall into regular lines; some still moving about, to be sure, but with sluggish motions. When the freezing process is complete the mob has disappeared and in its place we have the orderly battalions of atoms, each atom in a fixed position. This is the crystal of metal. But suppose we cool the metal very suddenly. Atoms do not have time to get into their regular line-up and we have a semi-crystalline metal the properties of which are quite unlike those of the crystal (Figure 4, *b*). This is tempering. When such a semi-crystal is heated up close to its melting point the misplaced atoms drawn by their organized neighbors begin a slow migration into proper position and the metal becomes more crystalline. It begins to lose its temper.

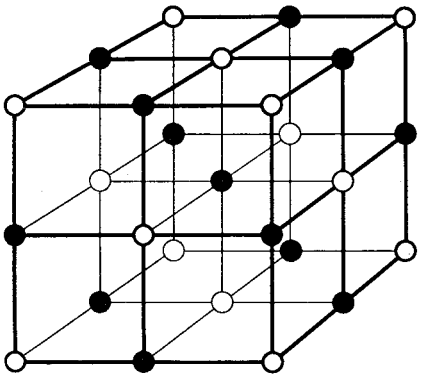
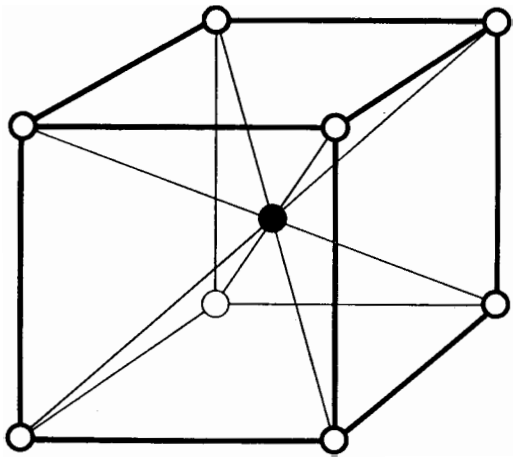
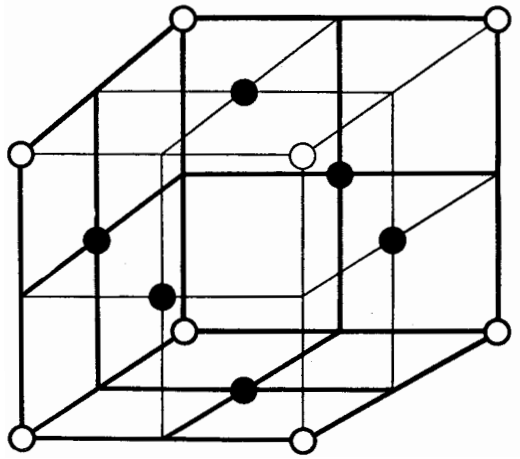


Figure 6: **Cubic lattice. One central ball attached to six white balls**

SOME materials, such as glass, become so viscous before they freeze that the atoms cannot get into line and we have a non-crystalline material sometimes called a supercooled liquid. Yet, even in glass the atoms are slowly migrating into place over periods of many years, so that old glass may become quite brittle or crystalline.



Left, Figure 7: **In the body-centered lattice each ball is held to eight neighbors. (Balls, of course, merely *represent* atoms—are not models)**



Right, Figure 8: **Face-centered crystal lattice. Circles in black are in the centers of the faces of the cubes, as shown**

Though it might be thought that there would be myriads of forms and shapes in which metals might crystallize, these all resolve down to a few simple types, of which the three, called respectively cubic, body-centered, and face-centered lattices, are by far the most common. To visualize these we may imagine shaking up a number of baseballs in a barrel. The balls would take up a more or less orderly arrangement such that one ball would be touching and be surrounded by several others. The simplest form is that in which one ball is surrounded by six others, one above, one below, and one on each of four sides. This arrangement, called the cubic lattice, is shown in Figure 5. A better idea of this structure is obtained by making the balls smaller and connecting them with lines, as is shown in Figure 6. Here it is noted that the structure is a continuous one, the center ball being attached to six neighbors; and if the structure were continued, each interior ball would be attached to six neighbors. The simplest section of this structure is a simple cube with a ball at each corner.

IN the body-centered lattice, each ball is held to eight neighbors, as is illustrated in Figure 7. And in the face-centered lattice each ball has 12 near neighbors (Figure 8). The relationship is, however, difficult to see without the aid of a model. Most pure metals crystallize on one of these three patterns.

Thus far we have said little or nothing about the relative sizes of the atoms or about their other characteristics. We have looked upon them as though they were tiny, solid balls. But such is not the case. Each atom is indeed a complicated system of units and we are by no means sure as yet just what all of these units are.

Before we can consider alloy formation in any scientific manner, we must understand more about the atom itself. In so far as we know, each atom is composed of a very small but very heavy inner portion called the nucleus. In fact, the nucleus makes up far less than 1 percent of the total volume of the atom, yet it contains practically all the weight of the atom. Could we but bring together the nucleii of even our lightest atoms, we would have a material so heavy that no man could lift a match box full of it from the earth.

Out beyond the nucleus—far out in space, as atoms go—lie the almost weightless electrons, like satellites or outposts guarding the nucleus. The atom of each species of metal has its own particular number of electrons arranged in guarding layers around the nucleus. Some light metals, like aluminum, may have less than ten of these flanking patrols, while others, like lead, may have upward of 70. But in all cases they are arranged in layers such that the outermost layer or shell contains less than eight and generally less than five of these electrons. These are the tiny units which tie atoms together, the fewer the electrons per atom the less rigid the tie and, conversely, the larger the number the more rigid the tie. [This will be discussed more completely in an article by the author, to be published later.—*Ed.*] Thus, the force holding metal atoms together resides in the electrons, and the softness and ductility of a metal depend in a large part upon the number of electrons present. Where there are few electrons, the atoms, though held together by considerable force, can, nevertheless, slide past one another and the metal is soft and ductile. Such is the case with silver, copper, and gold, where each atom has but one of these outermost electrons. On the other hand, bismuth, with five electrons per atom, is hard and brittle, crumbling at the blow of a hammer.

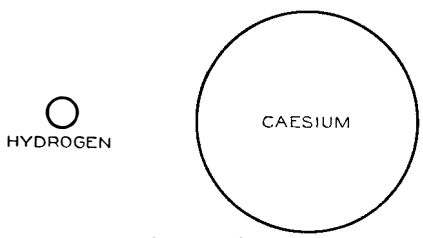


Figure 9: **Showing the relative sizes of atoms of hydrogen and caesium**

The last factor which we may consider before applying these factors to the science of alloy formation is the size of the atom. Atoms are, in general, so small that we seldom think in terms of size difference. Yet in this world of the invisible there is more difference in size between that of the smallest atom (hydrogen) and that of the largest atom (caesium) than between pygmy and giant (Figure 9). The volume of the copper atom is some 60 times that of the hydrogen atom. The size of the atom also plays an important part in the nature of the metal and in alloy formation. As might be almost predicted, metals having the largest atoms are the softest and most ductile metals, while those with smaller atoms are harder and more brittle.

IT becomes evident that the softest, most ductile, and most malleable of all the metals will be those having both the largest atoms and the fewest flanking electrons. To this group belong, in addition to copper, silver, and gold, the little-known metals, sodium and potassium. These metals are so soft that they cut like cool butter to exhibit a brilliant metallic surface which tarnishes rapidly in the air. Because of their bad rusting habits, these metals play no part in commercial alloy building and are, in fact, largely laboratory curiosities. At the other extreme with small atoms and a larger number of flanking electrons come the hard, brittle metals, boron and beryllium. Though still a rare metal, beryllium has begun to find important uses in alloy building because of its extreme lightness. It is the lightest of the usable metals, being but two-thirds of the weight of aluminum.

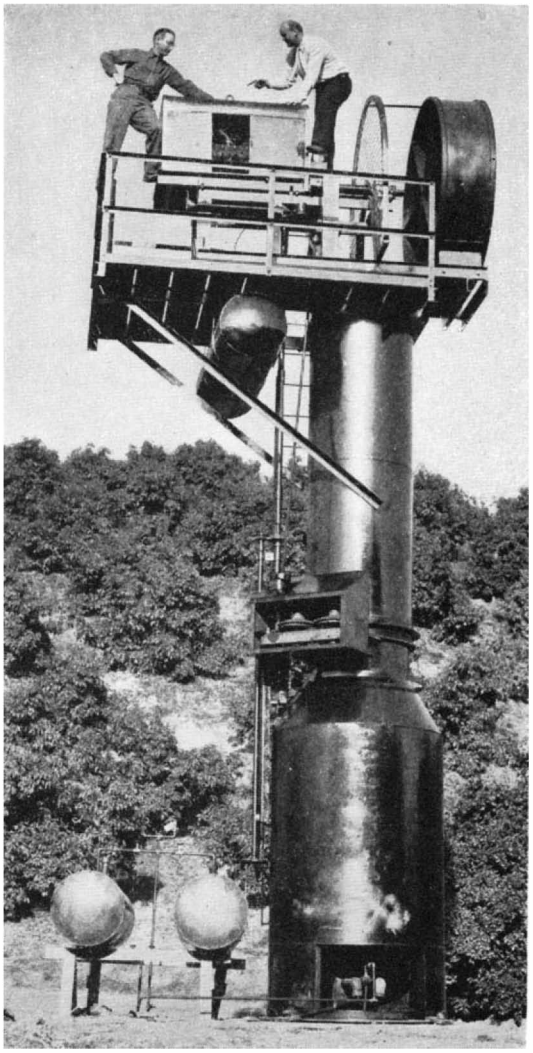
We have now considered the three important factors in the science of alloy formation. They are (1) the type of crystal lattice, (2) the number of electrons in the outer layer or shell and, (3) the size of the atom.

In Part II we shall show how these factors are applied to the formation of alloys to determine in a considerable measure the type of alloy to be expected.

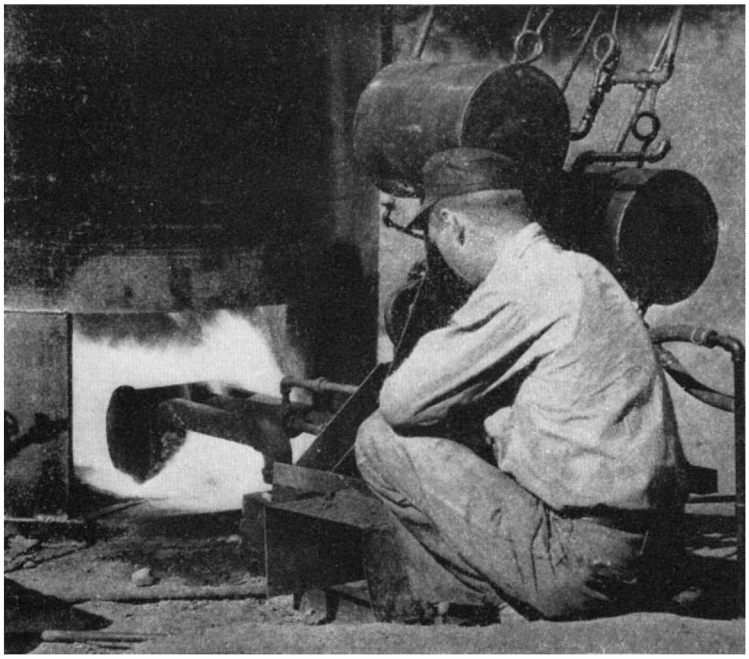
(To be concluded)

Oil Heat Saves Fruit

WHEN Mother Nature slips a cog, and sends cold weather where warm weather ought to be, fruit growers must supply artificial heat to protect their valuable groves. Old type smudge pots, long used in Florida and California, are being replaced in some sections by oil-burning heaters from which warm air is blown over large areas by a huge engine-driven propeller.—*Andrew R. Boone.*



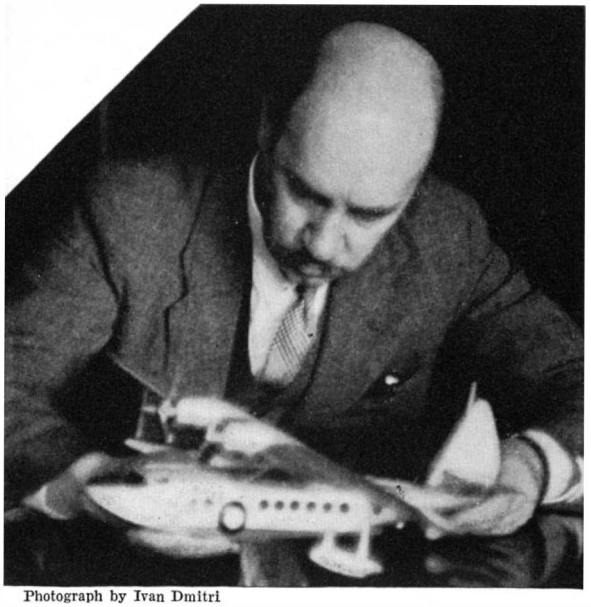
One of the new heating machines in a fruit grove at La Habra, California. The machine stands over 30 feet high, can be used to circulate hot air or to mix upper and lower strata, equalizing temperatures. Being smokeless, these machines have advantages over old smudge pots



Oil burner at base of wind tower. Crude-oil flames impinge on a heat chamber, heat rises up the stack and is blown out over the fruit grove

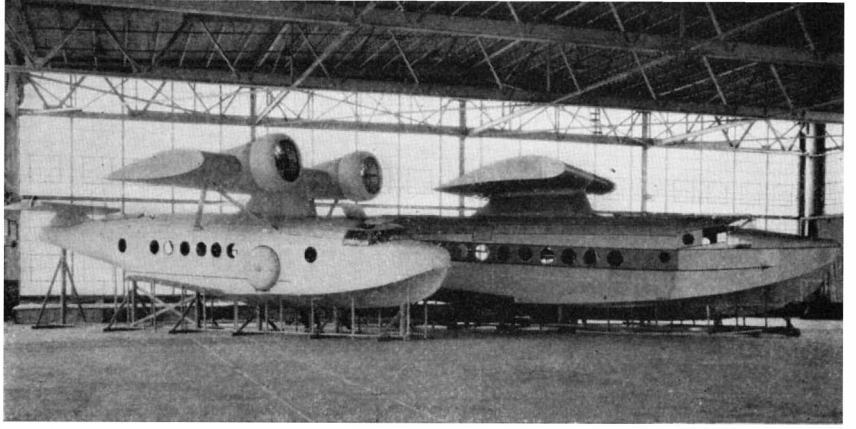
Although in actual use the heating machines give forth no smoke, smoke was added to the warm air to illustrate in photographs how the machine distributes heat over a wide area. An automobile engine drives a six-bladed propeller and rotates the tower top. It is claimed that one of these machines can protect 10 acres of trees against frost

A Clipper Ship is Built

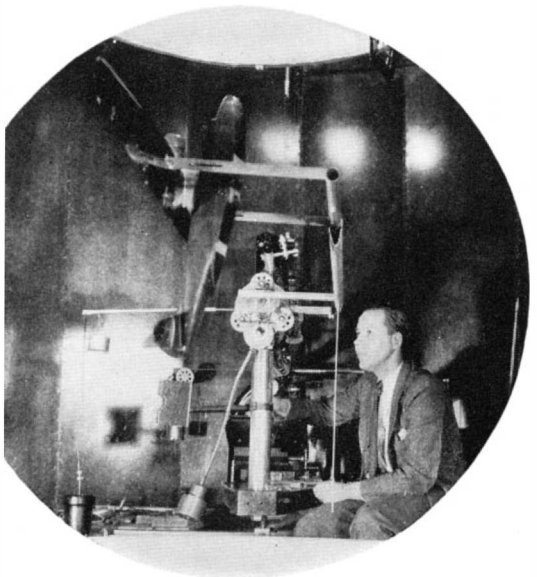


Photograph by Ivan Dmitri

1 The name of Igor Sikorsky is definitely linked with huge, multi-engine flying boats. Since the construction, in 1913, of the first multi-motored airplane in the world, Mr. Sikorsky has forged steadily ahead in the design of larger and more powerful ships. He is pictured here with an exact scale model of a flying boat, the first concrete step to be taken by engineers in the production of a new type



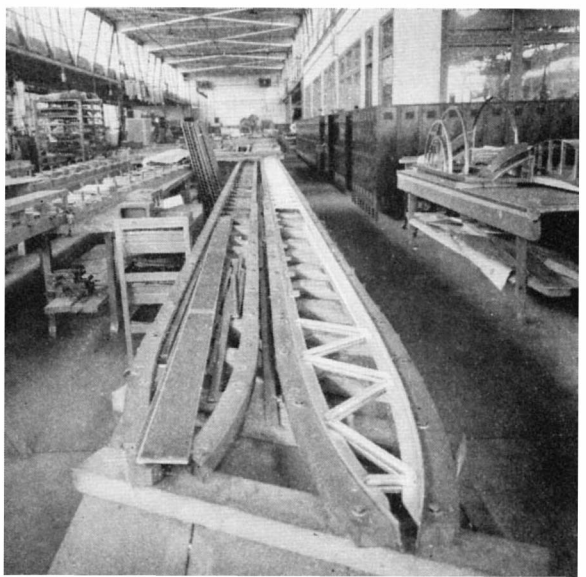
2 "Round-table" discussions, preliminary sketches, estimates of performance, strength, and weight, precede the construction of the scale model shown at the left. Then follow the experimental engineering stages, during which the scale model is made, wind-tunnel tests are conducted, hull models are towed through water, and a full-size "dummy," known as a mock-up and shown above, is constructed of wood and fabric. This mock-up, no small construction job in itself, enables the designers to determine the best locations for controls, seats, and other details both exterior and interior



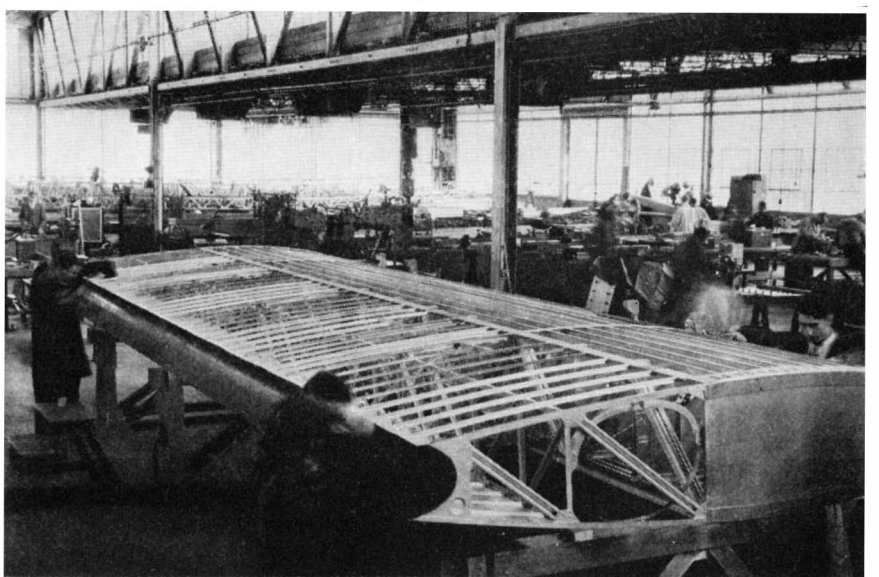
3 *Left:* Delicate instruments make possible accurate tests in the vertical wind tunnel, one of the few of its type in the world. From these tests come accurate predictions of performance and aerodynamic characteristics, as well as important contributions to basic design of aircraft

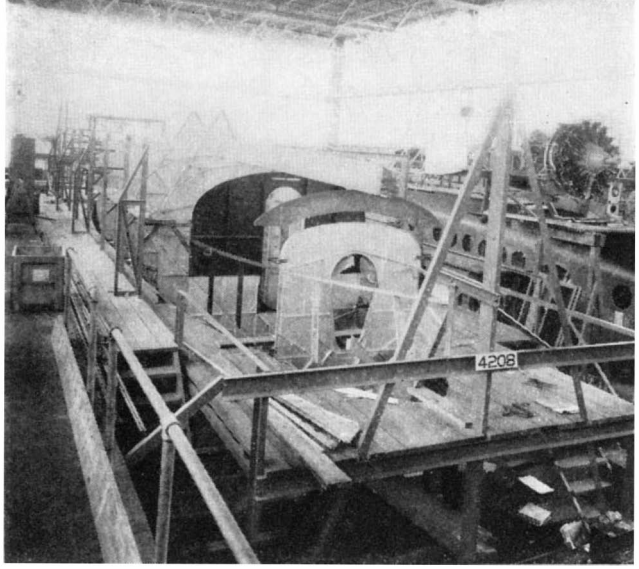
4 *Right:* A corner of the drafting room. In a plane like the Sikorsky S-42 there are nearly a million and a half detail parts. Two thousand complete working drawings are made

5 *Below:* After mechanical specifications have been decided, fabrication begins. Spars of aluminum alloys are assembled in jigs, as shown, for wings and tail surfaces. The structural members are built up of either formed or extruded sections

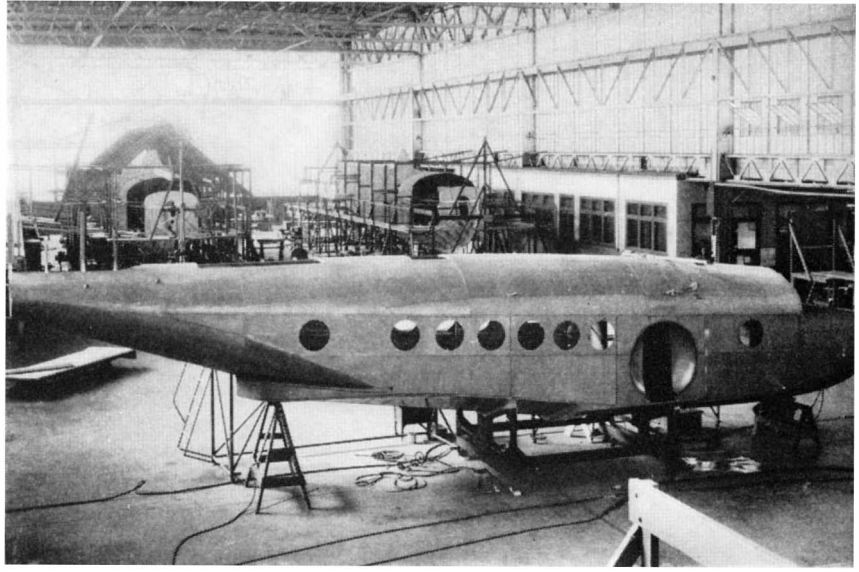


6 *Below:* Assembling the wing center section, where also aluminum alloys are used throughout. Work on the various structural units of a Clipper ship goes forward simultaneously in different departments, all geared to bring the units together for final assembly and to insure accurate fitting and interchangeability of a multitude of parts





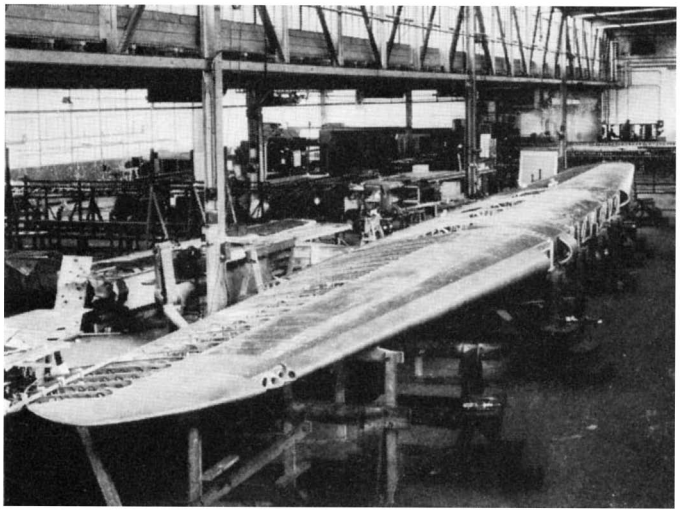
7 In a huge jig the hull takes form. Materials purchased for use in these huge ships of the airlines are subjected to rigid inspection for size and physical or chemical properties before they are released for shop use. This policy of meticulous inspection, supplemented by strength tests of structural parts, is followed throughout the construction; nothing is left to chance

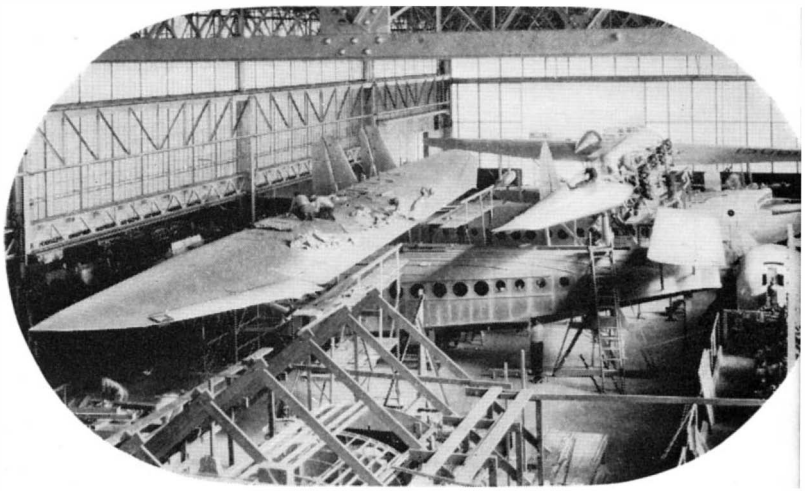


8 Out of the jig comes the hull, a metal shell into which must be fitted the luxurious interior of a modern airliner. Sound-proofing materials must be installed, the seats put in place, the galley equipped, and provision made for the controls and instruments in the pilots' compartment. The exterior of the hull is covered with a sheet metal skin which is riveted over the metal bulk-heads shown at the left. More than 5000 square feet of sheet metal are used for the entire plane

By A. P. PECK

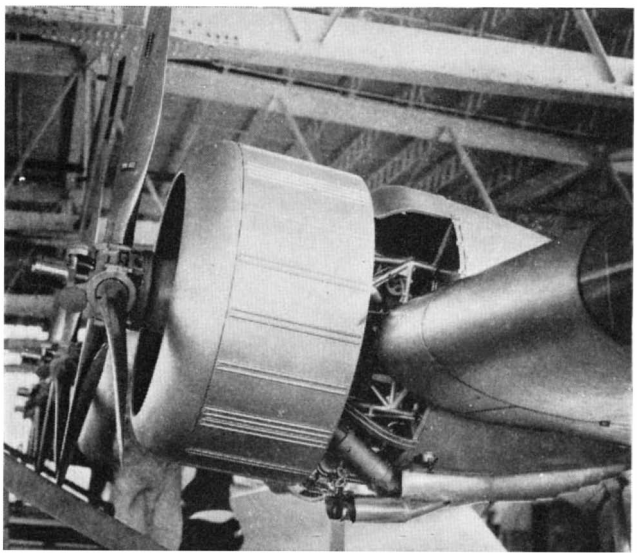
9 *Below:* The three sections of the wing are brought together and assembled, prior to installation above the hull. One of the most important parts of the finished plane, the wing does the greatest amount of work. It is built with extreme care and accuracy, and is stressed far in excess of any loads that may be imposed on it in any attitude of flight occasioned by varying flying and weather conditions





10 The final assembly floor, with three huge Sikorsky flying boats nearing completion. Here for the first time the wing and fuselage meet, completely covered with their metal skins and ready for the installation of power plants, accessories, the intricate "nerve-system" of control cables, electric wiring, and instruments. Over half a million rivets are used in the assembly

11 *Below:* Engines installed, cowling in place, propellers attached—an assembly job is finished but the most important work of all is still to be done. After the power plants have been tested for proper functioning, the ship takes to the air for a long series of test flights—the final proof of the design



12 *Below:* Thousands of hours of discussion, planning, testing, construction, bear fruit as the huge Sikorsky proves up under flight conditions, verifying the performance characteristics that had been pre-determined by the engineers in their search for the ultimate in mechanical perfection

PULSATING STARS

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.

THERE are thousands of stars in the sky that vary in brightness, and more are being discovered every month—usually by comparison of photographs of the sky taken on different dates, and often as a by-product of quite other lines of investigation such as the search for proper-motion stars. When the discoverer has identified his star, by publishing a chart on which it is marked, or otherwise, and the variation is confirmed by adequate evidence, it receives a letter or number in the great list of variable stars which is kept up by international agreement by the German Astronomische Gesellschaft. Then the work of astronomers has only begun. It is not very important merely to know that the star changes in brightness—we must find out how it changes. Some stars lose and regain part of their light, at regular intervals, in a way which can be accounted for by eclipses by companions revolving close to them. We have a very satisfactory theory to explain the variations of these stars; but it starts by assuming that the separate stars of the pair do not really change in brightness at all! They only hide one another from us.

MOST variable stars change in a way that cannot possibly be explained by eclipses—they must be *really* variable. This happens in many ways, but it is noteworthy that there is hardly a single star whose behavior is unique—in practically every case others have been found which vary in a similar fashion. For some, the changes are quite irregular, for others, there are great outbursts of light, gradually fading away; but there are a great many which repeat their variations time and time again, some of them approximately, and others precisely. Stars which do the same thing regularly, at equal intervals, are obviously the most promising for intensive study, in the hope of finding out what really happens to them. The most noteworthy objects of this sort are the Cepheid variables—so called from the bright star Delta Cephei, which is a typical example. These vary continuously in brightness in periods exactly fixed for each star, but ranging from 1½ to more than 50 days from one to another. (A very similar group, with periods less than a day, need not be mentioned here.) The range in brightness is moderate, very rarely more than four- or five-fold, for visual observations. Photographically it is somewhat greater, for the stars are always whiter when they are bright, and redder when they are faint. At the same time the spectrum changes, being "earlier" at maximum light than at minimum—that is, nearer the head of the Harvard list of classes, B, A, F, G, K, M.

This set of simultaneous changes makes us practically certain that the immediate cause of the variation is a change in the temperature of the star's surface. A hotter star should be brighter, whiter, and have an earlier spectral type. The changes in all three agree pretty well with those which would result from a change of 15 or 20 percent in the temperature—and no one doubts that such changes actually occur.

But why should the temperature of a star change, over billions of square miles of surface, by almost a thousand degrees? and then come back where it was at first, and do it again and again? and take the same time about it on every repetition? The regularity in time gives us a clue. There are two types of oscillation which we use, in every-day life, as time-keepers—motion of a body under gravitational force, like the pendulum of a clock, and motion under elastic forces, like the balance-wheel of a watch or a tuning-fork. Both forces are operative in a star—gravitation pulling it together, and the elastic force of gas-pressure keeping it from collapsing. An ordinary star is in equilibrium. But suppose we could take such a star and suddenly compress it in every part, so that it was reduced to 90 percent of its original diameter. Gravitation would be stronger, since all parts of the star are nearer together, but a simple calculation shows that the gas-pressure would be still more increased. So, if the star, after being held at the smaller diameter, were let go, it would expand to its original size. When it got there, all parts of it would be moving outward (the surface fastest) and it would overshoot the mark—like a pendulum drawn to one side and let go—and keep on expanding till it got as much too big as it had been too small. In this condition the gas-pressure would be too weak to balance gravitation—the star would contract again, and return to the state from which it had started, just as a pendulum swings back to the point of its release. Successive oscillations would take just the same time—again like a pendulum. Such a change in size of a star is called pulsation. Once started, it would keep on for a very long time; for, though there are influences which act like friction to slow the motion, these are very small.

When the star was smallest, the gases in the interior would be compressed and hotter than the average and, when it was largest, they would be expanded and cooler. This pulsation theory—suggested by Shapley and developed mathematically by Eddington—is now generally accepted as the explanation of Cepheid variation.

THE changes are on an enormous scale, for these stars are very bright. They have been observed in distant star-clusters and clouds—notably the Magellanic Clouds—and even in the nearer spiral nebulae, and in every one of these systems it is found that the average brightness is nearly proportional to the period of variation. Knowing this, we may utilize observations of the stars in our own system, which are near enough to be visible with the naked eye, to get the actual brightness corresponding to a given period. Though these stars are near the outer limit for direct measures of distance, the evidence is strong that, for a period of ten days, the brightness averages about 1000 times that of the sun, ranging in a typical case from 600 to 1400 times the sun's light. For a period of three days the average light is some 350 times the sun's, for 40 days about 3000. The luminosity does not increase quite in proportion to the period.

The *changes* in brightness of even the least of these stars exceed the total light-emission of a hundred stars like the sun.

In size, as well as in brightness, these stars are giants. Those with periods of three or four days have on the average spectra nearly like the sun's and probably give out about the same amount of light per square mile—which would make the diameter of such a star 20 times the sun's, or about 17,000,000 miles. The stars of longer period are cooler, and must have larger surface areas in proportion to their light, so that one of ten days' period is about 40,000,000 miles in diameter, and the diameter for a period of 40 days probably exceeds 100,000,000 and perhaps 150,000,000

When Stars Pulsate in Brightness, What Really Happens and Why? Such Changes Take Place on an Enormous Scale . . . A Star's Diameter May Rise and Fall by as Much as 40,000,000 Miles and at a Rate of 25 Miles a Second . . . New Data Increase Our Knowledge but We Still Have Much to Learn

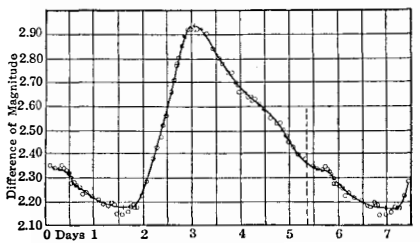
miles—comparable with the earth's orbit.

If stars as huge as this expanded and contracted by any considerable percentage, the motions of their surfaces would be fast enough to be detected by the spectroscope—and, in fact, every Cepheid variable which has been adequately observed shows changes in radial velocity. The rate of motion is moderate—as such things go—averaging about 20 kilometers per second on each side of the mean (which represents the steady motion of the star's center toward or from us).

But even this "small" value (compared with other astronomical figures) means that the diameter of an average variable—which is affected doubly by the motion of both surfaces—is at times increasing or decreasing at the rate of 25 miles every second, or more than 2,000,000 miles per day. For the stars of shorter period the motion slows up after a day or so, and the whole change in diameter, for the majority of the variables, does not exceed 3,000,000 miles. But the stars of longest period—for which the rate of motion is found to be greater than the average, alter much more. The extreme range in diameter so far detected amounts to 40,000,000 miles. This sounds—and is—extraordinary; but we must remember that such a star, with a period longer than 40 days, may be 150,000,000 miles in diameter, so that the change, on each side of the mean diameter, would only be 13 percent. The percentage change in size of the smaller stars of shorter period appears to be smaller, and usually less than 10 percent each way. All this is strongly in favor of the pulsation theory—while spectroscopically calculated motions larger than the diameter of the stars would have killed it. Moreover, the percentage changes in diameter and in surface temperature are of about the same size—which makes sense. The changes in size combine with those in temperature and surface brightness to produce the observed variation; but the temperature changes have considerably the greater effect.

UNTIL recently, spectroscopic data of this sort were available for only 29 of the brighter Cepheids. The list has been greatly increased by a long and successful campaign of work by Dr. A. H. Joy, of Mount Wilson, who has just published the velocities of 126 additional stars of this class, including practically all which are accessible to a telescope in the latitude of California. All but two of the variables previously studied are brighter than the eighth magnitude; all but three of Joy's list are fainter than this limit, and some are of the thirteenth, or even the fourteenth magnitude.

This remarkable extension of our knowledge is due not only to the great reflectors but to special spectrographs, giving short spectra which could be photographed in three hours, even for the faintest stars. As the spectra of stars of this sort are rich in strong lines, good



Light curve of Delta Cephei, the typical star and prototype from which the term "Cepheid variable" is taken. The curve is by Joel Stebbins and is reproduced from Russell, Dugan and Stewart's "Astronomy", courtesy of Ginn and Co.

determinations of the velocity could be secured; but, as the velocity varies, at least five, and usually eight or ten observations were made for each star, so that almost 1000 spectra had to be secured—an enormous piece of work.

Every one of the newly observed stars shows regular variations in velocity, of the same type as for the brighter variables, and, for every one, the range is small enough to indicate a pulsation of only a moderate fraction of the star's probable radius. The confirmation of theory is in this particular all that could be desired.

But there is one point where the pulsation theory, attractive as it is, gets apparently into trouble. The stars are brightest, not when they are smallest (and must be hottest inside), but when their surfaces are approaching us most rapidly—that is, when the stars are expanding fastest; and they are faintest when they are most rapidly contracting. This rule, established by the observations of the first few bright stars, is confirmed completely by Joy's extensive work. There is no flagrant exception among all the stars. The time of greatest brightness usually comes a little ahead of the time of most rapid expansion, and the same is true for minimum brightness and contraction, but when allowance is made for this, the deviations for individual stars are not serious.

Another property, shown by the light-curves, is confirmed by the velocities. The rise from minimum to maximum light is usually faster than the fall to minimum again, and for many stars takes less than half as long—though, for a few, the rise and fall are equally rapid. It is found, correspondingly, that the time between the most rapid contraction and fastest expansion—roughly speaking, the interval when the star is smaller than its average size—is less than half the period, while the star is larger than the average for more than half the time.

This last fact is not hard to understand on the pulsation theory. When the star is smaller than normal, all the forces acting on it, and, in particular, the internal gas-pressure, are increased by a larger percentage than the percentage of decrease in the forces when the diameter is increased by the same amount. Hence the oscillations are not like the swings of a pendulum, which is subject to just the same restoring forces at the same distance on the right and left, and so takes exactly the same time for one half of its swing as for the other.

The more powerful forces operating when the star is small produce a quicker effect. (This is a very good example of an explanation which, while sound as far as it goes, omits a great deal of the complications of the real problem. Eddington's careful mathematical discussion of the problem is not easy reading for anybody.)

BUT the lag of maximum brightness, and maximum surface temperature, behind the time of maximum central temperature, is not so easy to explain. In a rough and general way we may assume that it takes some time for the effect of the internal heating to work its way out from the interior to the surface; and it does seem safe to say that a lag in the surface temperature is much more intelligible than a "lead"—as an electrical engineer would call it. But the details have not yet been successfully worked out. There is no reason at all to believe such a solution impossible, and from what one picks up in talking in astrophysical circles, there is good hope that the resolution of the difficulty may not be far off. There is therefore no sufficient reason to discredit the pulsation theory, which accounts for so much, because this complication has not yet been cleared up. —*Princeton University Observatory*, December 4, 1937.

HARMONIOUS HORMONES

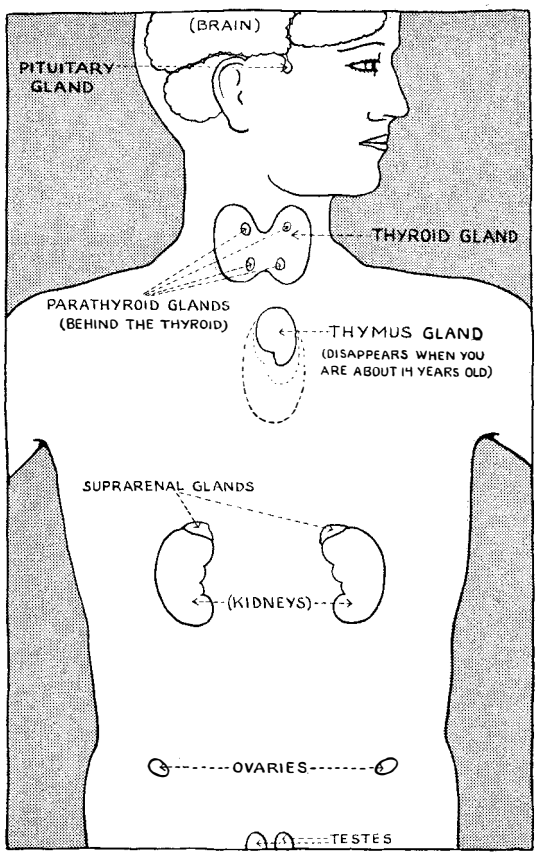
Medicine's Newest, Shrewdest Weapon... Mystery of the Endocrines... Thanks to Recent Discoveries... The Promising Whale Proved to be a Disappointment

By MORRIS FISHBEIN, M.D.
Editor of *The Journal of the American Medical Association,* and of *Hygeia*

HAVE you ever seen a case of "cretinism?" Here is a heartbreaker—a four year old child, dwarfed physically and stunted mentally because he was born with a defective thyroid gland. His blubber lips, thick protruding tongue, and sunken nose give him a bestial aspect; he is, as the great Osler said, "the pariah of nature." But thanks to recent discoveries in endocrinology he can be rescued from drooling idiocy and lifted to a normal plane of life if thyroid treatment is begun at once.

The mystery of the endocrines is not yet wholly bared, but there is already much that can be definitely stated concerning these tiny organs that pour their secretions directly into the blood stream. We know that our physical growth, mental energy and general attitude toward life depend largely upon the concerted activity of a few glands which altogether do not weigh more than three quarters of a pound!

The endocrines manufacture powerful chemical substances called *hormones* which have the power of arousing certain bodily functions and inhibiting others. Thus, when we are confronted by physical danger, our adrenals pour out floods of adrenalin, a hormone which sends towering energy to the muscles of flight and battle. With the onset of winter our thyroid grows slightly larger in preparation for the increased demands that cold weather will make upon us. When soil and water are deficient in iodine, the thyroid visibly enlarges in an attempt to compensate for this lack, and "goiter" results. In the Great Lakes region of the United States a high percentage of female school children were formerly goitrous, but by administering small quantities of potassium iodide twice a year, Marine demonstrated that the disease could be reduced to less than 1 percent. In some American cities the municipal authorities now supply chocolate-coated tablets containing one tenth grain of potassium iodide once a week for 20 weeks. Table salt, slightly iodized, is also a cheap and excellent preventive.



A summary chart of the several endocrine glands of the body. These work in unison

If the thyroid becomes *too* active, a forced draft fans our energy fires. Observe a woman, suffering from a too-busy thyroid; her hands tremble, her eyes pop, her whole body vibrates with purposeless agitation; ultimately she will collapse unless her thyroid activity is halted. Surgical intervention is necessary here; a delicate operation will remove a portion of her thyroid, leaving just enough to maintain the thyroxin level essential to normal life.

The pituitary gland, located as shown in the drawing, is the motor of our sex and also produces the hormone controlling growth. Tadpoles and rats stimulated artificially by this hormone grow to enormous proportions. In normal human beings, however, the growth hormone begins to subside at puberty, and the pituitary then releases its gonad-stimulating hormone. Under its influence, the cells of reproduction begin to ripen, and characteristic sex changes take place. But observe what happens when the pituitary is laggard at this point: here is a fattish adolescent boy with the bodily configuration and voice of a girl. Excessive fat is distributed in heavy folds around his girdle, his breasts are prominent, while his genitals have remained infantile in size. His schoolmates laugh at this sorry creature, and unless his condition can be improved, serious behavior complications will ensue. But when he receives injections made from the fresh pituitary glands of cattle, his fat rolls off, his voice deepens, his genitals attain normal size and function. The injections have stimulated his lagging pituitary and thus supplied him with the hormones essential to his proper development.

THE thyroid loads our nervous system with energy, the adrenals fire it. The adrenals are two in number, riding the upper pole of the kidneys like a triangular cocked hat. Tuberculosis of the outer covering of these glands leads to once-fatal Addison's disease, a malady that can now be controlled by use of cortin—a hormone extracted from the adrenals of cattle. Just as cretins are treated with thyroid extract, sufferers from Addison's disease are supported by injections of cortin, one of the most potent extracts in the modern medicine chest.

Adrenalin, the dramatic stimulator of the heart and nervous system, is now commercially produced by treating the inner portion of the adrenal glands of animals. This powerful extract also has the special property of relaxing the smooth muscle of the bronchial tract, and is therefore of specific value in the treatment of asthma. In women, tumors of the adrenal cortex lead to profound changes in appearance; the bearded lady in the circus is frequently suffer-

ing from an adrenal tumor. Her beard might disappear if the tumor were dissipated by X rays or surgically removed.

A French physiologist once remarked that a woman is but an appendage to her ovaries. This may sound excessively gallic to our sensitive American ear, but the fact is that the entire feminine organism is sadly deranged when normal quantities of the female sex hormones are not secreted. These hormones are now commercially available in standardized units. To relieve many female ailments, including barrenness due to endocrine causes, physicians now prescribe these standardized hormones, and medical opinion agrees that such treatment is strikingly effective.

Nested behind the thyroid are four tiny nodules about the size of a grape seed. These, the parathyroids, provide an efficient mechanism for the mobilization of calcium. Without calcium the body would be in a state of muscular agitation known as tetany, a truly serious disease in which the sufferer is thrown into agonized convulsions by the slightest stimuli. The parathyroids prevent these excessively violent neuromuscular reactions, by keeping calcium at a certain level in the blood; if the parathyroids are damaged or removed, the proper calcium level can be maintained by the injection of the parathyroid hormone, parathormone, combined with a diet rich in calcium and vitamin D.

INSULIN is secreted by the islands of Langerhans, small cells occurring in the pancreas. If these "islands" lose function, sugar and starch cannot be used by the body, and diabetes results. Until the hormone insulin was isolated from animal pancreas in 1922, diabetic patients were doomed to coma or starvation. Today, commercially prepared insulin obtained from animal pancreas enables 300,000 diabetics in the United States to lead lives closely approaching normal.

Few people appreciate the sacrificial rôle played by animals in providing the raw material from which commercial hormones are made. The great meat-packers operate huge laboratories devoted solely to the manufacture of gland extracts obtained from meat animals. The glands are ground and desiccated; secret chemical methods are employed to extract the precious essence in liquid and crystal form. To make a single ounce of insulin powder, 1000 pounds of animal pancreas must be treated. Naturally, the cost of these animal hormones is high. A European pharmaceutical house, rebelling at the price of American cattle glands, attempted to extract hormones from whales, but they found that although the whale has a 750-pound liver and a 100-pound kidney, his pituitary gland weighs just half an ounce!

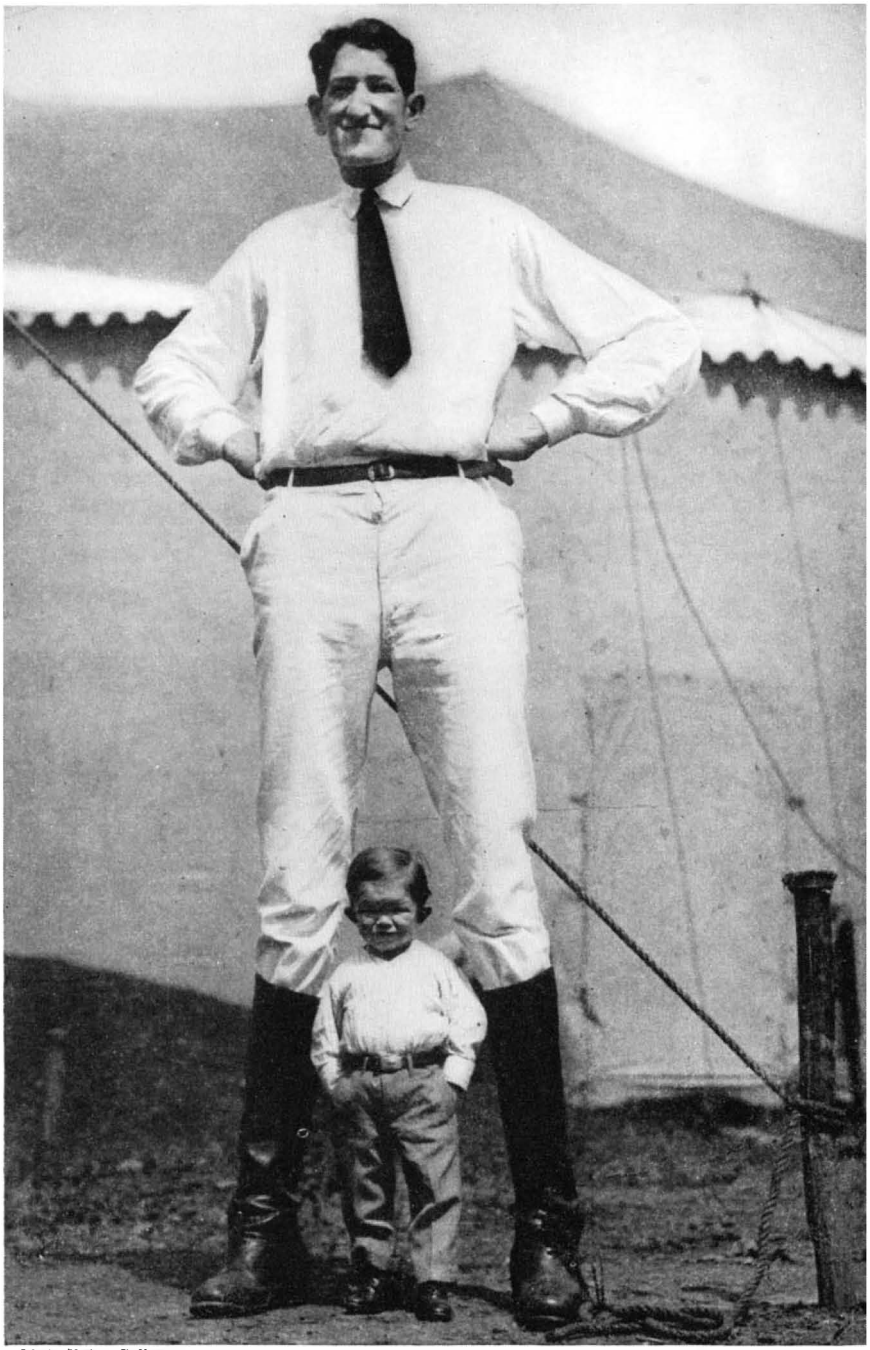


Photo Ewing Galloway

A matter of endocrine gland behavior—or rather, of misbehavior. Jack Earle, eight feet seven inches in height, and Major Mite, standing one foot eleven. In cases of these types the pituitary or growth-controlling gland is involved

The endocrine glands have been compared with an interlocking directorate ruling the affairs of the body. But on this glandular board, unanimity must prevail; if a single dissenting voice is heard, confusion is inevitable. Let the pituitary increase its function by 1 percent, and the other glands violently record the change, registering it in turn on all the organs and tissues of the body. From the therapeutic point of view these interactions create serious problems; one cannot, for instance, stimulate the pituitary without affecting other bodily functions. A few years ago it was suggested that a fraction of the pituitary had the power of growing hair on bald heads. The early rejoicing subsided when it was found that this same fraction might stimulate or disturb sexual functions, and disorder the normal growth of bones—conditions worse than baldness.

Steadily, the fruits of endocrine research come in from laboratories and clinics; some are discouraging, some are puzzling and contradictory. The literature grows labyrinthine; no single mind can encompass the scope and influence of the ductless glands. But, out of the countless researches, a definite unity emerges as the science of endocrinology forges medicine's newest, shrewdest weapon in the unremitting battle against human suffering and disease.

PROTECTION FOR THE PUBLIC

Do We Need New Food, Drug, and Cosmetic Laws? The Accompanying Article, Written at Our Request, Answers This Vital Question

By SENATOR ROYAL S. COPELAND

IT is a ghastly thing that drug legislation waits on a tragedy like the 73 deaths from sulfanilamide elixir. Why is it that legislative bodies deal only with emergencies, rarely in advance of disaster?

For five years I have struggled along, and almost alone, in attempts at congressional action. The appeals of the responsible departments of the Government have been without effective results. Twice the Senate has acted, once the House acted, but for almost a year final action on the latest bill has been deferred in the House of Representatives.

I am not blaming any individual or committee. What is happening is characteristic of congressional inertia. The consumer group is usually voiceless; no public pressure is exerted to pass this bill, the sort of pressure that is extremely active when selfish interests are at stake. This particular measure, the pending Food, Drug, and Cosmetic Bill, is of interest to the public only in the sense that smallpox and typhoid fever are of interest; during their appearance in epidemic form, every citizen demands action by the authorities. Perhaps the unfortunate deaths from sulfanilamide elixir will arouse the public and the Congress. If this should be the case and out of this disaster comes the enactment of a worth-while law, the victims of this needless poisoning will not have died in vain.

Suppose we review the reasons why the Food and Drugs Act of 1906 should be revised. The revision is designed to furnish a more effective weapon than Dr. Wiley's now antiquated statute provides. Modern commercial practices, which Dr. Wiley and his associates did not and could not anticipate, call for new methods of control. Defects in the law itself, as revealed by hundreds of court decisions, must be remedied if consumers are to have adequate protection.

When the original law was drafted, manufacturers depended to a great extent upon the labels of their products to sell the goods. Truthful labels seemed quite enough to protect the consumers; no provision was made for bringing other forms of advertising under control.

Today, most manufacturers keep their labels above reproach. The truth is found there. Unfortunately, however, there is a relatively small group that does not hesitate to make preposterous claims in printed and radio advertising. Such unscrupulous persons know that they run no risk of penalty under the existing Food and Drugs Law.

Other problems in connection with foods and drugs have arisen through changed modes of living. Where most foods were once made ready for the table in the housewife's own kitchen, today more and more foods are prepared outside the home. Thanks to modern scientific methods of processing, many of them are cheaper and even better than the housewife could produce. But in the production of others, I regret to say, there are grave abuses which cannot be controlled under laws that with a few exceptions make no provision for legal standards or for adequate sanitary supervision.

Cosmetics, comparatively unimportant in Dr. Wiley's time, are now produced in such vast quantity as to make the business a major industry. It is one which is related to the health and pocketbooks of millions of consumers. Yet, unless their labels carry medicinal claims for diseased conditions, even poisonous cosmetics do not come within the law.

LIKEWISE, many dangerously potent drugs enjoy an unrestricted sale under labels which give no hint of their harmful character. Because they are not adulterated and their labels, so far as they go, are not untruthful, they are freely sold. Except for a few specifically named narcotics and habit-forming drugs, precautionary labels cannot be required under present laws.

Twelve women in California, in the San Francisco region, naturally anxious to improve their looks, were stricken blind after using a certain fat-reducing preparation. It was a product containing a very dangerous drug, dinitrophenol.

In our hearings before the Senate Committee there were exhibited some horrifying pictures. They were of a person, a handsome young woman, who had gone to a beauty parlor to have her eyelashes dyed. The eyes were burned out and the face terribly disfigured, the effects of a drug to which she happened to be susceptible.

We spend in one year around two or three hundred million dollars for cosmetics. It is indeed a tremendous industry; and fortunately, you will be glad to learn, most cosmetics are harmless. But there have been instances of serious injury, and some deaths, following the use of cosmetics. A cream sold under a trade name was claimed by its promoters to be not only a superior and harmless depilatory—a hair remover—but also of actual benefit to the skin. As a matter of fact, it contained a potent ingredient more appropriately used as a rat poison—thallium acetate. Many who used this product became bald. Others suffered severe muscular pains, nerve impairment, and paralysis.

Among the efforts of the Government to suppress the sale of products for which fraudulent and untruthful claims were made, was that of an attack upon a product containing ammonia, turpentine, water, and egg. It was first sold as a horse liniment, but the enterprising owner found more money in offering it as a remedy for human tuberculosis, pneumonia, and a long list of other serious diseases. Back in 1922 a case was brought against the manufacturer, alleging, in the language of the present law, that its preposterous therapeutic claims were "false and fraudulent." Under this wording of the statute it is necessary for the Government to prove, not only that the label statements were false, but that the manufacturer knew them to be false. Physicians skilled in the treatment of tuberculosis testified that the labeling was false. But the manufacturer, a man of advanced years and the dignity of a patriarch, gave such convincing testimony of his faith in the product that the jury decided in his favor.

Through the ten years that followed, before the Court finally curbed this audacious fraud, Government investigators followed up a long list of its victims. They had been persuaded by the label to treat themselves for tuberculosis and other diseases with this miserable stuff and subsequently died from those diseases. Among the victims were three sisters, Martha, Elizabeth, and Marga-

ret, who were admitted to a well-known tuberculosis sanatorium in 1924. Margaret heard of the product I am discussing. She was not allowed to use the nostrum in the sanatorium, so she left so that she might use it at home. She induced her sisters to leave for the same home treatment. Martha died after using the fake remedy for about four months. Elizabeth used it for about the same length of time and then returned to the sanatorium, only to die three months later. Margaret, whose tuberculosis was only moderately advanced when she went home, depended on the product for an entire year before she returned to the sanatorium, her disease far advanced. It was not long before she died.

But evidence of this kind was not enough to establish a legal case under the Food and Drugs Act. The evidence had to show that the manufacturer *knew* that his product would not confer the benefits he claimed for it.

The mass of other cases investigated included that of a tuberculosis victim in New Hampshire who wrote testimonials for this fraudulent compound, claiming she was cured. The woman was paid for this service, and while she was on her deathbed her son wrote testimonials signed with her name. Her death certificate showed the cause to be tuberculosis.

MORE than 60 certificates were found showing the deaths of users of this extract from maladies which the labeling promised to cure.

For several years the gross sales of this useless thing amounted to more than 100,000 dollars annually. In one year the sales reached a peak of 367,000 dollars. This gives some idea of the number of persons who were using the fake remedy.

Space does not permit the recital of many other instances of failure to deal effectively with similar evasions of the spirit of the law. But surely enough has been said to show what the Government faces under the present Act in its efforts to protect the public against hundreds of dangerous and worthless nostrums. The maker of a fake "cure" who is unaware of the loopholes in the Food and Drugs Law may be promptly caught and brought to book. But another maker of the same nostrum, with the same labeling, who knows how to cover up evidence of his bad faith, may continue in business indefinitely. But the victims of the one fake are just as dead as the victims of the other.

When Eben M. Byers, wealthy Pittsburgh manufacturer and former amateur golf champion, lost his health, he was persuaded to dose himself with "certified radium water." Perhaps he reasoned that if it didn't cure him it wouldn't do any harm. But the medicine killed him; it literally disintegrated the bones of his head in but a short time.

Newspaper editorials were caustic in their criticism of the Government. Why wasn't the Food and Drugs Act enforced? Editors, in common with most well-informed persons, assumed that the Food and Drugs Law prohibits nostrums that are dangerous to health when used according to directions on the bottle or in advertising. Unfortunately, the law does *not* prohibit or restrict the sale of dangerous drugs. Only when the labels of medicines bear "false and fraudulent" therapeutic claims or misrepresent the identity of the ingredients are the manufacturers subject to legal action. The label of the medicine that killed Mr. Byers bore only a simple, truthful statement that the product was a radium-active water. It was sold within the law.

Preparations used for rheumatism, neuritis, and similar disorders may contain cinchophen, a drug that injures the liver. Among many reports in recent medical literature of the deadly effect of this substance is one from the Mayo Clinic, describing five fatalities. In October, 1932, *The Annals of Internal Medicine* reported six deaths from cinchophen poisoning, four of them caused by one proprietary medicine. Such reports multiply as time passes. The present Food and Drugs Law does not require that cinchophen be declared on the labels of preparations containing it.

For many foods the Department of Agriculture has adopted administrative standards based on good household and commercial practices. Such standards are merely advisory, not having the force and effect of law. But if manufacturers can be persuaded to follow such standards or if there is a widely recognized household practice, there is set up a kind of "common law" understanding as to the nature of the product in question and legal actions are taken on that basis. But not always successfully!

Far-sighted manufacturers in most food industries gladly accept such voluntary standards. But, of course, without legal standards the integrity of our foods cannot be assured; neither consumers nor honest manufacturers can be protected against the unscrupulous practices of those who profit by debasing the things we eat.

Many more examples could be given to show the inadequacy of the present Food and Drugs Act, but let us now consider S. 5, the Food, Drug, and Cosmetic Bill that passed the Senate. The bill was written after many and extensive conferences with the enforcement agencies of the Government and with representatives of various consumer groups and associations, professional groups, and the industries to be regulated. Letters inviting suggestions were sent to many persons known to be interested in the proposed legislation. Several volumes of suggestions were received from persons in the groups mentioned, and these were carefully studied. Many of the suggestions were rejected, some were accepted, and others accepted in part or in effect. The hearings held by committees of the Senate and House of Representatives on previous bills in former sessions of the Congress were reviewed and studied. While it is not perfect, of course, the Senate bill lays the foundation for a very complete act after the House has made its changes and improvements.

THE one factor, more than any other, which has withheld action on the revision of the Food and Drugs Act has been the controversy as to whether the Food and Drug Administration or the Federal Trade Commission should enforce the provisions relating to advertising. On the premise that advertisements of foods, drugs, and cosmetics are nothing more than extensions of the labeling, it seems to me that the control should be vested in the Food and Drug Administration which enforces the provisions having to do with adulterations and labeling.

This would not have the effect of depriving the Federal Trade Commission of its jurisdiction to proceed against false advertising in such form as to make it an unfair method of competition. Bill S. 5 specifically provides that it shall not be construed as impairing or diminishing the powers of the Federal Trade Commission.

I fully agree with what Secretary Wallace of the Department of Agriculture said:

"Division of the law to give control of adulterations and misbranding of foods, drugs, cosmetics, and devices to one agency and false advertising of the same products to another will inevitably result in needless expense and inefficiency. Responsibility for control of adulterations, misbranding, and false advertising should be lodged in one administrative agency."

It will be a pity if we let this Congress die without passing effective legislation in the field of foods, drugs, and cosmetics. The health and lives of all our people are directly related to this matter. We want no more "Ginger Jake" tragedies, no more sulfanilamide disasters. We want no more victims of diabetes, Bright's disease, tuberculosis, cancer, and other serious ailments to be enticed to death by the false and fraudulent claims of unscrupulous and ruthless advertisers. We must make an end of worthless foods and those cosmetics that carry dangerous ingredients. We are proud of our country, but we are not proud of its ineffective laws. Surely it is the duty of Government to provide Americans with every possible defense against disease and death.

IDENTIFICATION BY THE TEETH

No Two Mouths Are Precisely Alike . . . Teeth Have Individual Characteristics . . . Universal Recording System Needed . . . Charts and Technique Available

By EDWARD J. RYAN, B.S., D.D.S.
Editor, *The Dental Digest* and *Oral Hygiene*
Past President of the Chicago Dental Society

THE Tomb of the Unknown Soldier symbolizes the unidentified dead. In the Arlington National Cemetery there are buried 5000 unknown dead of the wars of the United States. In the cemeteries of Europe 1600 crosses without names mark the unknown dead of the World War. Many of these soldier-dead could have been returned to their families for burial if identification by the teeth had been universally practiced.

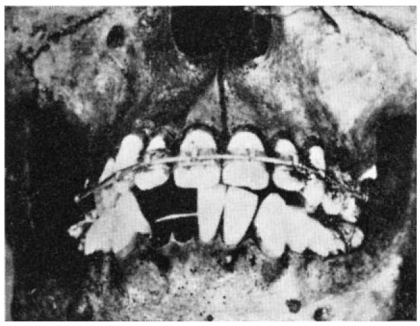
Each year civilian catastrophes take their toll of lives: An airplane hurtles through the night and strikes the side of a mountain; a school bursts into flames; a factory explodes; a steamship sinks—features have been marred beyond recognition, and only the teeth remain as telltale physical structures.

No two mouths are precisely alike. Even after extraction of all teeth the residual bone retains certain X-ray characteristics, and the distinguishing differences and deviations from the normal may be noted on a chart. Teeth have definite individual characteristics; the relationship of the teeth to one another varies with each person, as do the size and shape of the jaws and palate; the relationship between the two jaws is an important determinant of the appearance of the structures of the lower part of the face. Teeth are, anatomically, square, ovoid, and tapering. Generally speaking, the square type of tooth is found in the corresponding type of face. The shape of the upper central incisor, the shape of the arch, and the shape of the face are usually of the same general type: square, ovoid, or tapering. In any classification of dental tissues, therefore, there is opportunity to record individual tooth size, color, and contour; to record arch sizes and types; to record relationships between the jaws; and, finally, to classify facial types. Thus, from a careful dental description, the lower part of the face of a person sought but unknown can be hypothetically reconstructed with reasonable accuracy.

SPECTACULAR cases, some of which are briefly summarized in the following paragraphs, are on record in which identification by means of the teeth was definitely established, both for civilian needs and criminal urgency.

For example, a radio broadcast recently recounted the story of hill-billies in Kentucky who, unable to write, filed their claims to land by biting a piece of paper in two. Thus in the event of a property dispute the rightful owner could be identified by matching the pieces of paper.

Again, in June, 1935, there was reported the case of Miss Ida May Hanson whom Clarence Neal killed and buried on a Colorado mountainside. Two prospectors in search of gold stumbled upon a stockinged leg protruding from the ground. All efforts at identification of the body failed until the sheriff had a dentist take X rays of the mouth and describe technically the artificial restorations found. Copies of these dental characteristics were distributed at a convention of the Colorado State Dental Association. The story was also published in a national dental magazine. A dentist in Nebraska thought this magazine description to be uncannily familiar. His dental records, including a plaster cast made three years previously, confirmed the identity of the victim whose slayer was soon after apprehended.



A universal system of recording dental characteristics would have made possible identification of this skull

When a skull was found near the former home of a rancher who had disappeared four years previously, the teeth were identified as those of William K. Dowling, the rancher who had, it was decided, committed suicide.

On May 15, 1935, in a wood near Middlebury, Vermont, the decomposed bodies of three persons were found. Through each skull was a bullet hole. The bodies were apparently those of a mother and her two children. The woman must have been about 40 years of age and her children were about 11 and 13. They had lain half buried in the ground for two or three years. Presumably they had been of a prosperous family, for in the mouth of the older child was found a tooth regulating appliance of extremely excellent construction. It would seem that people of this economic class, who could afford such skilful and protracted orthodontic attention, would not vanish without being missed by family and friends. The Boston Police Department, the Boston *Globe*, the Federal Bureau of Investigation, orthodontic societies, and the magazine *Oral Hygiene*, all these have made attempts to identify these people. To date no identification of these bodies has been made. The orthodontic appliance remains the one important tangible clue on which identification depends.

A CORPSE had been claimed as that of John Frahm, wealthy Arizona oil operator. An unidentified body was found with an artificial denture. The dentist's dental chart proved which was the real corpse of John Frahm, and subsequently aided in tracing the murderer.

An autopsy of Alphonso Paolillo who was found dead in the driveway of the home of his cousins in an eastern town, revealed teeth marks on his shoulder. The relatives denied any knowledge of the victim's death, but casts made of their teeth showed that the cast of one of the women corresponded with the marks on the dead man's shoulder.

B. H. Humble of Glasgow, Scotland, an authority on forensic medicine, describes cases of murder committed by sex perverts. These sadists often bite their victims. The bite is usually slowly and deeply inflicted and the tooth marks often persist long after death. In Dusseldorf, Germany, a woman was murdered by such a sex fiend. On her breast were the complete marks of front teeth. The alinement of the marks showed an abnormal position of the incisors. Police authorities made a cast from the marks on the woman's skin, similar to that a dentist makes when he constructs a

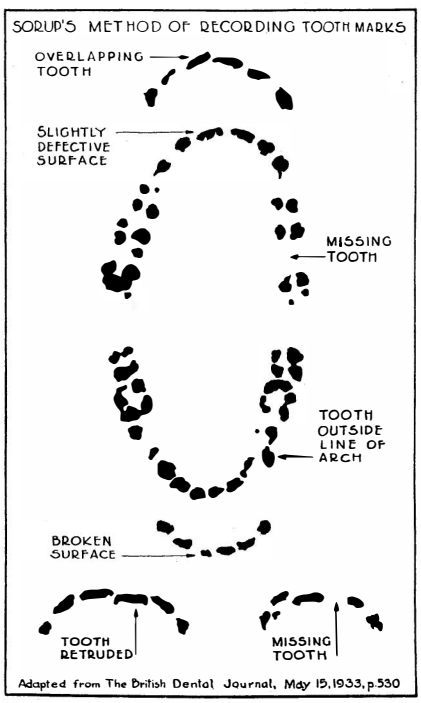
bridge for a patient. This cast was compared with casts made of the teeth of suspects and the identification of the murderer was finally determined from this record.

Sorup, another European interested in this subject, devised a method of recording tooth marks based on the same principle as finger-printing. This method, however, is not practical inasmuch as an ink has not yet been developed to record the tooth impression direct from the mouth; a cast must first be made from which an ink-imprint on paper is obtained.

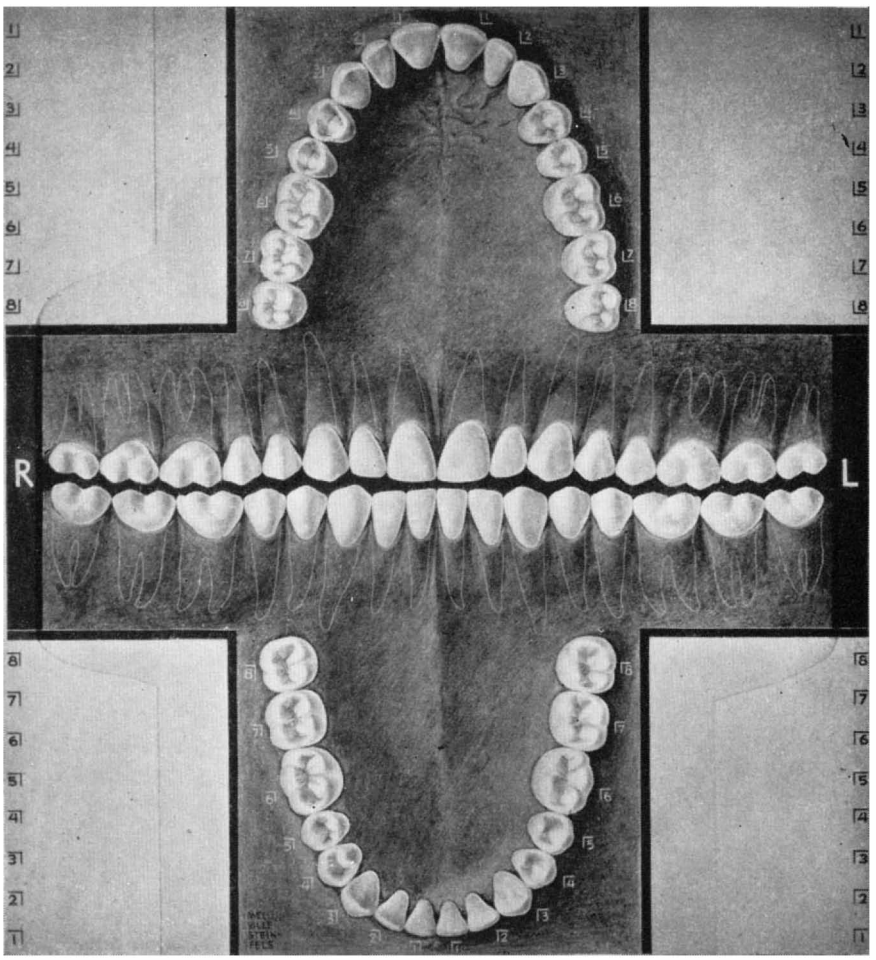
All the identifications cited above were made without the assistance of any universal standardized method of charting the teeth. But if a system of charting, such as that described below, were in wide use, many more unknown dead could be identified.

A record chart, to be generally applicable for such a universal identification system, should have the following characteristics:

1. The teeth should be represented with anatomic accuracy; that is, the size and shape of the teeth should be shown in exact scale and measurement. 2. The chart should show the five exposed tooth surfaces. 3. The teeth should be represented in white on a dark background, so that missing teeth may be recorded by "blacking out" with a soft lead pencil. 4. The chart should be reproduced on a paper that will take colored pencils in order to record metallic restorations of gold and silver amalgam. 5. The chart must be so simplified that it can be filled out and interpreted by non-dentists as well as dentists. 6. The chart must be inexpensive.



Tooth mark record made in ink on paper, from a plaster mouth cast



A standardized chart for recording dental defects and changes

Such a chart has been developed and is reproduced directly above. To date there are at least 100,000 people in the United States who have records of their teeth made on a standardized chart such as is described above. Each one of these persons now has a chart marked in color, in comparatively uniform symbols, showing the following conditions:

1. Porcelain fillings, indicated by a pencil outline. 2. Porcelain jacket crowns and bridge facings, shown by cross-hatching with lead pencil across the corresponding tooth or teeth on the chart. 3. Missing teeth, blocked out with soft lead pencil. 4. Abrasions, represented with soft lead pencil. 5. Cavities, indicated with blue pencil. 6. Advisable restorations, demonstrated with blue pencil. 7. Root canal filling, indicated by red pencil. 8. Pulp involvement, indicated by red at apex of the tooth. 9. Presence and position of an impacted tooth, represented by a red outline. 10. Extraction advised, shown by a red "X" across the proper tooth. 11. Pyorrhea pockets, represented in red along the crest of the gums. (A notation is made at the bottom of the chart if extensive gingivitis is present.)

One would think that the large insurance companies of America, who must have occasional cases in which it is difficult to establish proofs of death because of inability to make positive identification of bodies, would be interested in this subject of accurate and universal charting of the teeth. One would think that these insurance companies would require complete dental examinations as a part of their physical examinations in order to determine the presence of dental disease which might be endangering the heart, the lungs, the kidneys, and all the vital organs. No insurance company in the United States includes a thorough dental examination with the physical examination required, and no dental records are available to aid in establishing the proof of death should other means fail. Such enterprise on the part of insurance companies with their organized facilities for the handling of records would inevitably prove of great value in civilian and criminal identification.

THE chart reproduced above is such that it can be added to at any time. If the patient transfers from one dentist to another, his complete record can be easily transferred also. Already a start has been made. This system is available for routine use in civilian practice with attendant benefits of co-operation between physician and dentist as well as dentist-patient understanding of treatment, in addition to the highly desirable foresight which, in the event of a catastrophe, furnishes a ready means of identification.

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Conducted by F. D. McHUGH

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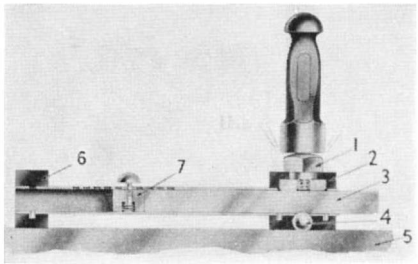
Portable Brinell Tester

A LIGHT weight, portable Brinell instrument that can be carried easily right to the job is said to simplify metal hardness tests around industrial plants and in the field, remote from laboratory facilities. According to the manufacturer it can be used in close quarters and can be applied



Numerals indicate the parts of the Brinell tester described in the text

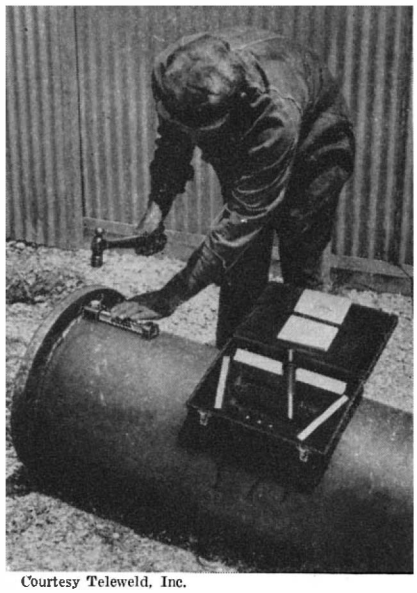
to parts and equipment the size of which have, heretofore, made testing difficult, expensive, and sometimes virtually impossible. It eliminates both the necessity of dismantling equipment to be tested and transporting specimens to the laboratory.

Known as the Telebrineller, the instrument was developed by one of the oldest and largest railroad rail maintenance organizations in the United States to check and control the re-building (welding) and heat treating of rail ends on the right-of-way. Its simplicity, convenience, and the ease with which it can be carried are indicated by the fact that the combined weight of the outfit and carrying case is only 6½ pounds. According to the manufacturer it is not affected by hot or cold weather and is built to stand hard use. No training or previous experience, it is claimed, is necessary to operate it accurately.

In addition to its more obvious uses in many types of plants throughout the metallurgic industries where it is used both in receiving rooms to check deliveries of raw materials with specifications ordered, and in routine production control, it also has a number of uses in plant maintenance work. Besides its use to test rail ends, it is being used, for example, wherever an accurate knowledge of metal hardness is a factor in safety and continuous operation.

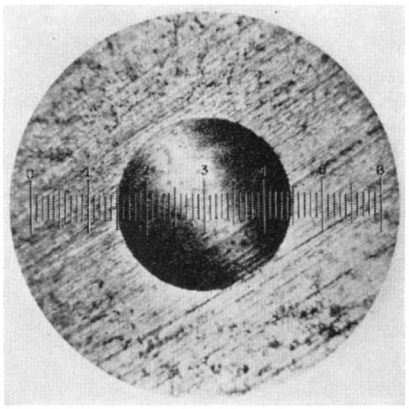
The outfit is composed of the Telebrineller instrument proper, a bar of known hardness, a microscope with a scale etched in its focal plane, and a slide rule, packed with extra test bars and impression balls in a small case. The instrument itself consists of a metal tube supported in a soft rubber head and a rubber spacing block, the tube holding the bar of known hardness. An anvil in the top of the rubber head rests directly on the bar. Below the bar an impression ball, secured in a narrow aperture in the base of the head, comes in direct contact with the metal to be tested.

To make a test the instrument is held against the specimen and the anvil is struck a sharp blow with a three- to five-pound hammer. The impact is transmitted through the anvil to the bar, then to the ball and on to the specimen. Force of the blow is said not to be a factor, the diameter of the impression in the bar and in the specimen being,



Courtesy Teleweld, Inc.

Operation of the hardness tester does not depend on power of blow



A microscope measures the diameters of the impressions; hardness of the material is found by calculation

in any case, relative to their individual Brinell hardness number (BHN).

The diameters of the impressions are then measured in 1/10 millimeters by placing the microscope over each in turn and reading the scale. Figuring the BHN is then a simple matter, using either an arithmetical formula or the slide rule.

NO LYIN'

THE roar of a lion is 100,000,000 times more powerful than the smallest sound that may be heard by the human ear.

A New Synthetic Refractory

FIRE brick and similar refractory materials to withstand high temperatures ordinarily fail in glass-melting furnaces because of the corrosive attack on them of molten glass and slag. A new series of super refractories, recently developed at the Mellon Institute of Industrial Research, has been shown to be as much as six times as resistant to corrosive action of molten glass at 2700 degrees, Fahrenheit, as the best refractories hitherto available. The new materials are cast from a melt produced in the electric furnace at extraordinarily high temperatures. The problem of casting and work-

ing these bricks has been solved by the development of unique methods and the materials are now commercially available. Large-scale applications of "Monofrax," the new material, have already proved it to be outstandingly successful in furnaces for melting glass and for handling molten slag.—*D. H. K.*

FOR FUTURE USE

ALTHOUGH the chemical industry now produces about 10,000 different substances for sale, scientists know definitely of an additional half million substances for which there is no present use.

Boxing the Elements

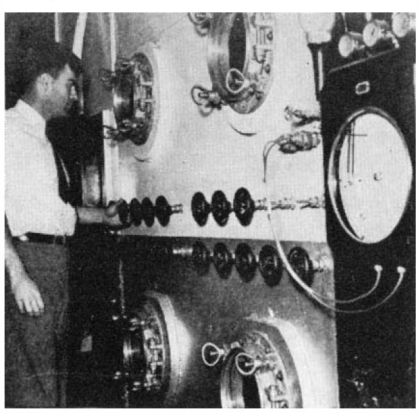
THE effect of wind, rain, sleet, snow, arctic and tropical temperatures, six-mile altitudes, and power dives upon aeronautical transmitting radio equipment can all be duplicated within a few hours by radio engineers at the General Electric Company, in two new rooms recently completed for radio test purposes.

The walls of the two steel rooms where the tests are carried out are 18 inches thick, supported by 12-inch steel beams. Half-inch steel plate covers the exterior with a sheet steel interior protecting insulation of cork and glass wool. Large port holes of one-inch glass permit operators to study the equipment without being subjected to the same strains as are placed upon the apparatus being tested.

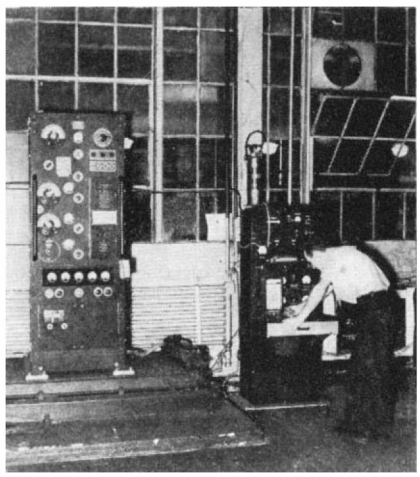
The temperature in the "flight room" may be dropped to 40 degrees below zero and raised to 160 degrees above zero. An automatically controlled humidity plant permits the injection of live steam into the room where the effect of a relative humidity from 30 to 100 percent upon the transmitters may be observed.

The air pressure at 30,000 feet elevation is about four pounds per square inch, as compared with 15 pounds at sea level. This high-altitude pressure is created by the use of vacuum pumps which reduce the pressure as desired. The outside air pressure against the room, when the interior has been set to duplicate an altitude of 30,000 feet, is 370 tons, necessitating the heavy, thick steel walls. A pressure of 25 tons is forced against the doors, two feet thick, leading into the rooms.

The effect of wind velocity upon apparatus



Simulated extremes of weather are controlled from this switchboard



A shaking table tests radio equipment for resistance to vibration

is duplicated by two large fans which generate a wind velocity equivalent to 30 miles per hour.

A dry-ice plant provides cold air for the rooms and high temperatures are supplied by five electric heaters with a total capacity of 30 kilowatts.

By being able to maintain temperatures, pressure, and humidity in the rooms, and at the same time being able to change them rapidly, engineers are able to subject apparatus to the same changes it would undergo in a five-mile power dive.

Near the "flight room" is a newly-constructed "shaking machine" for testing the effects of vibration upon aviation radio equipment. The new machine, one of the largest ever built for such purposes, affords precision adjustments of both frequency and amplitude of vibration.

A stroboscope is used with the machine in the vibration tests. By synchronizing the light with the vibration, various parts of the radio apparatus can be studied while in motion.

Such facilities have given radio engineers a new conception of electrical and mechanical designs for radio equipment in filling the need for improved and more efficient apparatus.

Carbon Dioxide Preserves Fruits

BY using carbon dioxide mixtures with air as a preservative atmosphere, such perishable fruits as Australian passion fruit have been shipped to England. The original experiments have proved successful and it is expected that other Australian fruits, including pineapples, may be later shipped around the world in this way.—*D. H. K.*

Diver Descends 420 Feet

MAX E. NOHL, diver, who descended to a depth of 420 feet in Lake Michigan recently, withstood a pressure on his body of 320 tons more at that depth than he did at the surface, *Science Service* estimates.

Atmospheric pressure of 15 pounds to the square inch adds up to about twelve tons when all of the 3500 square inches of the average man's skin are considered. At 420 feet the pressure is about 197 pounds to the square inch.

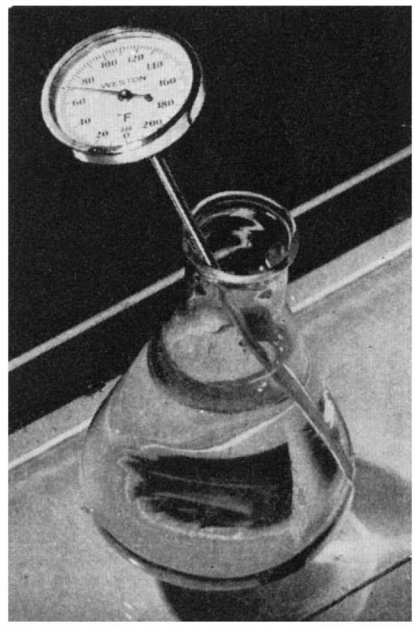
Dissolved gases in the human blood stream and body cells enable us to resist the pressure of the atmosphere. At shallow depths, compressed air helps a diver to resist water pressure, but as the pressure increases, nitrogen from the air dissolves in the blood stream, causing trouble if the diver comes to the surface too rapidly.

"Bends," or caisson disease, a common and serious illness of divers, is caused by nitrogen bubbles collecting in the capillaries. These bubbles act as blood clots. Diver Nohl, to prevent this, used an atmosphere of oxygen and helium, which causes fewer bubbles in the capillaries on ascending to the surface. If he descends to a depth of 500 feet, as he plans to do in another dive, the pressure will be 380 tons more than at the surface.

Stainless Steel Thermometer

AN entirely new type of laboratory thermometer, provided with a dial-and-pointer scale encased in stainless steel, mounted on top of an eight-inch stainless steel stem, is being introduced by the Weston Electrical Instrument Corporation.

The unit is said to be the first dial-type thermometer with an all-metal temperature element sufficiently accurate for scientific use. The pointer is actuated by means of an internally balanced double coil of thermostatic bimetal sealed in the lower 1½

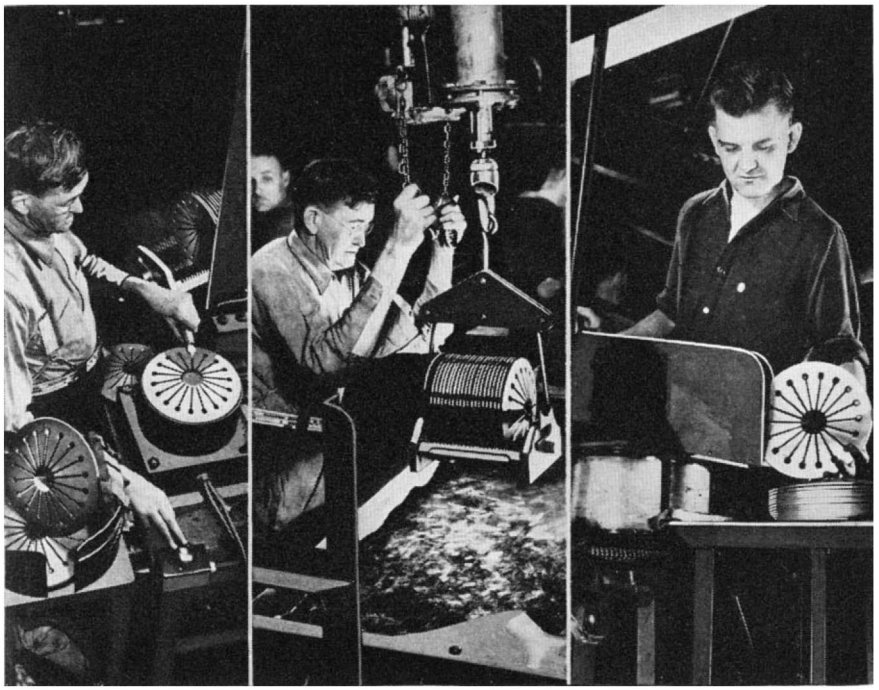


A dial-reading thermometer

inches of the seamless stem. When the stem is immersed to a depth of 1½ inches in a liquid (three inches in gas or vapor) the dial reads temperature values accurately without the necessity for stem correction.

Accuracy of the unit is guaranteed to ½ of 1 percent over the entire scale. In practice, the location of the dial at the top of the stem, removed from the liquids or vapors under measurement, encourages a further increase in the accuracy with which readings are made. Dial markings are spaced for maximum readability on the metal scale plate, and are not subject to obliteration from the solutions under test, as is the case with stem graduations. The low temperature values are not obscured in dark-colored solutions.

Initial models of the unit are being offered



Invisible cracks are hunted with magnetism in the rigid tests applied to Chevrolet's new disk-type clutch spring. At the left an operator is magnetizing a clutch spring by placing it in a powerful magnetic field. In the center picture a rack of magnetized springs is being dipped in a bath containing iron dust in suspension. When the rack is removed the springs are washed and inspected by the operator at the right. Fine iron dust will adhere to the edges of any crack, showing up as a thin line on the surface. If the spring is perfect, it is rolled down a chute, where powerful magnets create another field that demagnetizes the disk. By this method it is possible to locate small checks and cracks that are invisible to the unaided eye

in the following scale ranges: 0 to 220 degrees, 50 to 300 degrees, and 50 to 500 degrees Fahrenheit; and 0 to 100 degrees, and 0 to 150 degrees Centigrade. Applications include temperature measurement in educational and industrial research laboratories, in control laboratories, in hospitals, and in general scientific use.

A Truck Fortress

EXPRESSING the ultimate in safety and protection is a new armored car just delivered to the Union Bank and Trust Company of Los Angeles. With a body of new type construction, this vehicle, built by Mack, has an outer shell of ordinary soft body steel. Beyond this is a two-inch layer of special insulating material under which is special bullet-proof steel. The hood is afforded good protection by an inner bullet-proof shell, and gun ports are protected from the inside by bullet-proof sliding doors. By the use of soft steel on the outside of the body, bystanders are protected from ricochetting bullets, and the shot also loses part of its power before coming into contact with the insulation. All windows are protected by special multiplate bullet-proof glass, one and one-half inches thick.

An unusual feature of this unit is a conning tower at the rear which enables the guard there to have a 360-degree range of fire. Firing down and alongside the truck is possible through a gun port in the lower corner of the glass frame of the conning tower; hence there are no blind spots. A brake lever and an ignition switch in the conning tower give its occupant partial control of the truck from that point.

Divided into three compartments—that of the driver, the center one where money and securities are stored, and the rear conning tower—all of these compartments have intercommunicating telephones and are air-tight, thereby making it possible for the occupants of the vehicle to resist a gas attack for at least a half hour before suffocating. Equipment for this unit includes two electric fans, sawed-off shotguns, high-powered rifles, hand grenades, and gas bombs.

Cyclohexylamine

WHEN aniline, familiar as the parent of dyes, is treated with hydrogen in the presence of a catalyst it is converted into a very different compound known as cyclohexylamine. Although this fact has been known for more than 40 years it is only now becoming commercially important. Lately this compound and many of its derivatives have been shown to be valuable in industry. One important group of derivatives has been found to include valuable insecticides. Another group contains important plasticizers for use with synthetic resins. A third group prevents corrosion by alcohol solutions in automobile radiators. Still other derivatives are useful in rubber compounding, as dyestuffs, and as soaps, particularly for use in dry cleaning.—*D. H. K.*

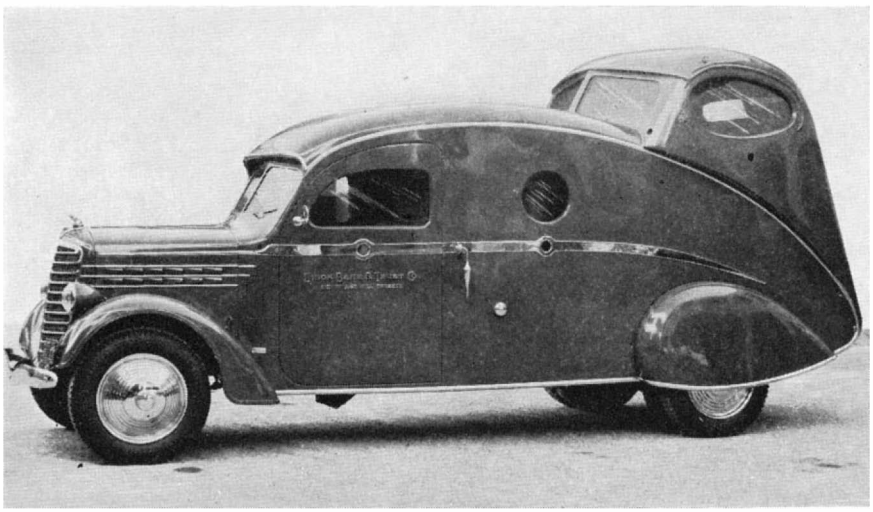
CHIPS

RANCIDITY in potato chips is checked by dusting finely ground oat flour over the surface of the chips.

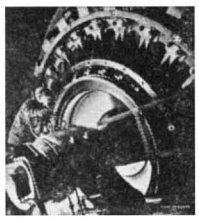
Brunettes Should Spray Tar—with Cellophane Masks

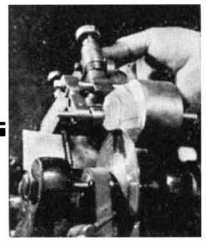
TAR sprays used in controlling certain pests that attack fruit trees are caustic to the skin of men and horses, and precautions must be taken to avoid injury. The causticity varies with conditions and individuals. In general, blondes are more susceptible to injury than brunettes, and hence brunettes should comprise the spray crew whenever possible. Again, tar sprays produce a severer irritation in sunlight than in shade, and hence night spraying or spraying on overcast days will avoid some injury. Sprayers should protect all parts of their bodies from the spray. Spray coats, gloves, and hats should be worn, and the face should be protected with a sheet of moisture-proof Cellophane wedged under the hat band. As the spray covers the Cellophane and clouds the vision, additional clear space can be pulled out of the hat. Usually a fresh piece of Cellophane will be needed for each tank of material. Attempts to protect the face with creams and greases have proved unsuccessful. Some sprayers, however, claim that protection is obtained by the use of such materials.

There is a tendency among sprayers to discard protective clothing and masks on the basis that they hamper their vision and action, or that such protection is unmanly.



This fortress on wheels is virtually bandit-proof





Industrial Prospects Come Thick and Fast

When Appealing to the RIGHT Guiding Executives and Research Technicians

EVEN your star salesmen are blocked again and again because they fail to reach the influential people who decide on Industry's purchases.

But even your average salesman can get the top-notch orders with carefully planned "behind-the-scenes" selling, done before he reaches his prospects.

An advertising campaign in Scientific American lays the ground work for such selling technique, does wonders by making a difficult sales task a simple one. It penetrates to the ideal reader combination:

To those who make the purchase recommendations—the industrial executive heads, the key research technicians in the mechanical and chemical laboratories, engineers, chemists, physicists, metallurgists, and so on.

Those men are your RIGHT customers. They are the ones who focus their undivided reading in Scientific American to get first knowledge of the developments in industry and science—obtaining valuable information which they use in the development of their own products.

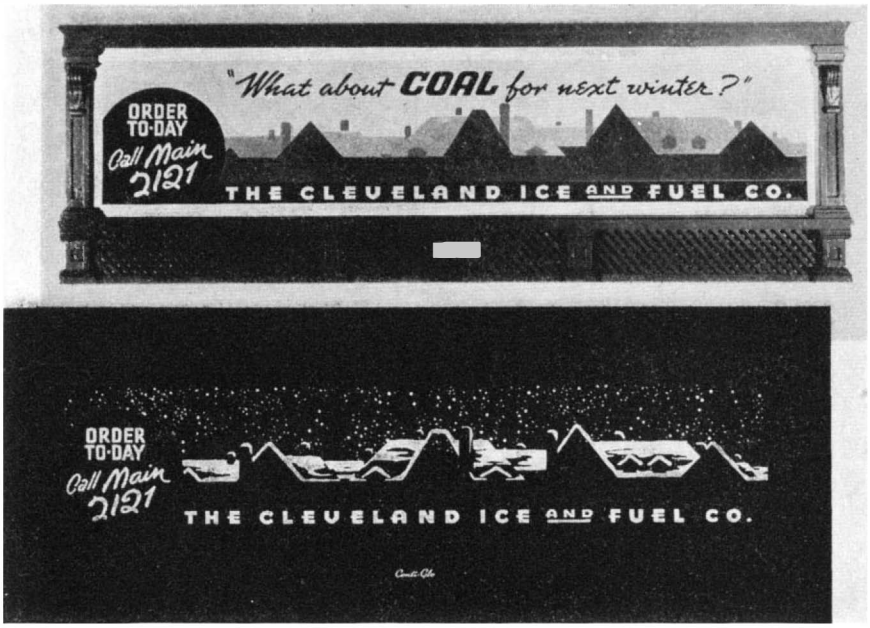
Therefore, Scientific American readers, observing technical improvements which benefit them, read Scientific American advertising pages too . . . purposefully.

Here's one example of results: $1,688.50 of industrial scales sold through a $100 advertising investment in Scientific American—a small 6% selling cost!

If you are selling to industry, large or small, whether your prospects are few or many, Scientific American can help sell your product. Let us give you further facts.

SCIENTIFIC AMERICAN

"A Compact Circulation of Leaders in Industry, Research and Science"



Day and night views of a signboard painted with fluorescent colors

This is a serious mistake. The possible injury from tar sprays should not be taken lightly. The writer has seen several men severely burned, and one required hospitalization. The fact that one man experiences no difficulty is no clue to the susceptibility of his co-workers. Each man should determine to his own satisfaction whether or not he is susceptible. It should be borne in mind that the burning sensation does not arise immediately after an application of tar to the skin, but rather will reach a maximum some two to four hours later.—*Dr. Leslie M. Smith.*

Fluorescing Outdoor Signboards

DURING the past several years the question has been asked frequently whether fluorescent materials, applied to outdoor advertising and activated by ultra-violet light, are feasible and practical, in view of their appeal to the American's well-known desire for novelty.

In discussing this question recently, G. R. LaWall, of the General Electric Company, says that hitherto the lack of suitable ultra-violet sources and also the lack of fluorescent materials had prevented this application but adds that such interesting effects seem now within reach of the outdoor advertising world.

Suitable ultra-violet lights are now available and a line of fluorescent inks and lacquers in white, blue, and green has been developed by the Continental Lithograph Corporation. Tests have shown that in actual use outdoors no appreciable deterioration has taken place though this new medium is recommended only for bulletins at the present time.

These fluorescent inks and lacquers offer new animation possibilities without complicated mechanism. At night, ordinary incandescent lamps in shielded reflectors display a sign as a whole. As these flash off and ultra-violet lights go on, that part of the sign which has been picked out with the new fluorescent materials will glow in brilliant hues while the remainder of the sign cannot be seen. During the day, the fluorescent materials are invisible and do not interfere in any way with the sign as a whole.

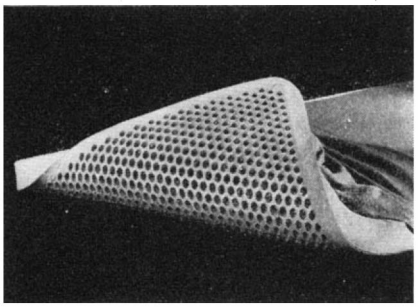
This development offers a new field for the creative designer and has a new nighttime appeal where the advertiser desires the unusual, the distinctive, and the novel.

Now the Sleep-Cushion

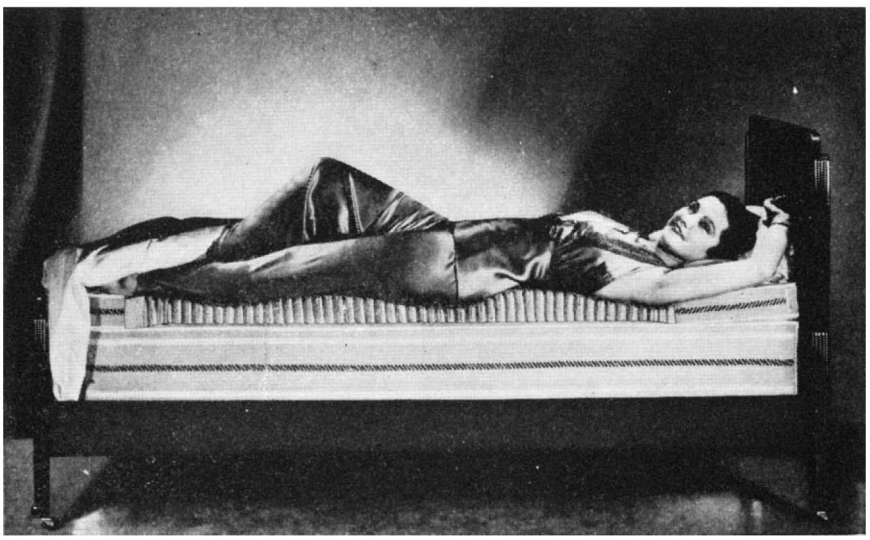
A NEW and entirely different type of mattress, to be known as the Red Ball Sleep-Cushion, was announced recently by the Mishawaka Rubber and Woolen Manufacturing Company.

This new mattress is formed of sponge rubber made of latex, the milk of the rubber tree, whipped to a foam and vulcanized in a single piece. It is made in bed sizes, is about five inches thick, and for additional springiness and ventilation is pierced by finger-sized holes in an all-over pattern. The Sleep-Cushion is actually about 85 percent air and 15 percent pure rubber so that it weighs only about half as much as the ordinary mattress.

This new type of material eliminates padding, springs, wires, tufts, or buttons, and has a perfectly smooth surface. A cloth cover fits smoothly over the cushion. Since the material used is much softer than the body, the mattress conforms perfectly to all sleeping positions, shaping itself to every contour. When compressed, its tiny air cells release their air and then fill again as the pressure is changed or lifted, so that the mattress virtually "breathes."



Above: **Note holes in the latex sponge-rubber Sleep-Cushion.** ***Below:*** **The all-rubber mattress conforms to body shape and position**



SMOKE

SMOKE in the atmosphere costs each person in the United States from 10 to 30 dollars annually. This expense is due to clothes cleaning, disfigurement of buildings, damaged merchandise, injuries to grass and plants, and the loss of visible and ultra-violet light.

Blueprinting through Ordinary Paper

BY treating ordinary typewriter paper with a solution of diethyl phthalate (a synthetic material used to soften cellulose acetate and as a fixative in perfumes), it can be rendered transparent enough to allow blueprints to be made through it. Letters, drawings, and handwritten documents can be easily copied by the blueprinting process after they have been treated in this manner.—*D. H. K.*

Lightning Behavior

LIGHTNING may strike a tree, travel to the ground, but if the soil happens to be of gravel or of a poor conductor type, it is likely to bounce out again and do further destructive work until it finds a ground of less resistance. This announcement was made recently by K. B. McEachron, in

The Editors Recommend

Best Sellers in Science

1. SCIENCE EXPERIENCES WITH HOME EQUIPMENT—*By C. J. Lynde.*
A book of 200 simple home tricks based on physical laws, each experiment being illustrated and its principle explained.—**$1.35** postpaid.

2. NEW FRONTIERS OF THE MIND—*By J. B. Rhine.*
In plain, straightforward, and entertaining style, the experiments at Duke University (ESP) are discussed in this volume. Plain science, no mysticism.—**$2.65** postpaid.

3. THE HANDY MAN'S HANDBOOK—*By C. T. Schaefer.*
Fourth edition of a very popular book—a practical manual on the use of tools and how to do all sorts of odd jobs around the home.—**$1.15** postpaid.

4. ALL THE WORLD'S FIGHTING FLEETS—*By Pay-Lieut. Commander E. C. Talbot-Booth, R.N.R.*
A chunky book of nearly 700 pages, giving the details of world navies with many pictures. A fine reference giving all manner of details.—**$3.20** postpaid.

5. ABC OF AGROBIOLOGY—*By O. W. Willcox, Ph.D.*
A treatise on plant culture, laws of nutrition and quantitative growth, soil fertility, and soil science.—**$2.90** postpaid.

6. AIR CONDITIONING IN THE HOME—*By Elmer Torok, M.E.*
Fundamental principles of air conditioning. Various kinds of equipment and what each will do, and how the equipment is installed and operated.—**$3.20** postpaid.

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Theory, aerodynamics, and propeller design of model airplanes. Professor Klemin says that even the well-informed aeronautical engineer can learn something from its pages.—**$1.15** postpaid.

8. OUT OF THE TEST TUBE—*By Professor Harry N. Holmes.*
A popular and most readable exposition of chemistry in relation to modern life and industry. Equally as interesting to the layman as to the chemist.—**$3.20** postpaid.

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9. CYCLOPEDIA OF FORMULAS—*By Albert A. Hopkins.*
A standard reference indispensable in the laboratory, shop or home. Over 15,000 formulas covering every conceivable field of work.—**$5.50** postpaid.

10. AMATEUR TELESCOPE MAKING—4th Edition (1935)—*Edited by Albert G. Ingalls.*
A thoroughly practical, home instruction book which tells the amateur how to make astronomical telescopes capable of doing serious work at about 10 percent of the purchase cost of finished instruments. At least 10,000 amateurs have made their own telescopes from this standard manual and guide.—**$3.00** postpaid.

11. AMATEUR TELESCOPE MAKING—ADVANCED—1st Edition (1937)—*Edited by Albert G. Ingalls.*
A sequel to "Amateur Telescope Making," for especially enthusiastic followers of the hobby who already have A. T. M. and now seek new worlds to conquer, such as special tests, eye-piece making, camera obscuras, sidereal clocks, astronomical micrometers, chronographs.—**$3.00** postpaid.

12. THE FINGER PRINT INSTRUCTOR—Revised Ed.—*By Frederick Kuhne.*
Taking finger impression, comparison of prints, methods of filing, and so on, are here presented in a logical sequence, just as they would be used in actual practice. Indispensable to detectives, criminal lawyers and criminology students.—**$3.25** postpaid.

13. NEW WAYS IN PHOTOGRAPHY—*By Jacob Deschin.*
The whole range of amateur photography including such things as trick photography, photomurals, retouching, infra-red, and a number of other divisions that will not be found elsewhere discussed in as clear and concise a manner.—**$2.90** postpaid.

14. MAKING PICTURES WITH THE MINIATURE CAMERA—*By Jacob Deschin.*
Packed solely with how-to-do-it material—no frills, all meat and bones. Tells exactly how to handle your camera under varying conditions. Light, composition, and technique are stressed. 49 full-page photographs.—**$3.15** postpaid.

15. ZERO TO EIGHTY—*By Dr. E. F. Northrup.*
A great scientist discusses with much imagination but with a solid scientific foundation a trip to the moon, his own experiments, and inventions made to prove his theory. Many scientists have called this an enthralling volume.—**$3.20** postpaid.

16. RADIO CITY STAR AND CONSTELLATION FINDER—*By James S. Andrews.*
Not a book but a cardboard, printed, rotating device which automatically shows the stars as seen at any hour in the year. A help in learning the constellations. (Formerly 85 cents)—**60 cents** postpaid.

17. WALKER ON PATENTS—*Deller's Edition.*
Completely rewritten and enlarged by Anthony William Deller, this 4-volume set tells just about all that one may desire to know concerning patents and patent litigation.—**$50.00** a set plus shipping charges.

18. WILD FLOWERS—*By Homer D. House.*
This superb book has 364 color plates and 340 pages of text. Hundreds of wild flowers in all parts of the United States can be identified through the pictures and the descriptions which were written by this noted authority. Formerly $7.50. Now **$4.45** postpaid.

19. THE NEW MAGICIAN'S MANUAL—*By Walter B. Gibson.*
Contains over 100 complete and easily followed instructions for tricks of parlor magic. A bound-in envelope contains all the actual apparatus needed for these tricks.—**$3.25** postpaid.

20. THE ART OF CONVERSATION—*By Milton Wright.*
Inarticulate people will be tremendously helped by the reading of this book by a man who is a brilliant conversationalist. It will help remove that inferiority complex.—**$2.65** postpaid.

21. THE BIRDS OF AMERICA—*By John James Audubon.*
For the first time, about one hundred years after their first publication, Audubon's extraordinarily beautiful paintings of the birds of America are collected in one volume. Contains 500 plates, faithfully reproduced in original colors and a brief discussion of the range, habitat, and identification characteristics of each bird shown. Each plate is on a separate page 9 by 12½ inches and the volume is bound in attractive, strong buckram. Packed for shipping, weighs 7½ pounds.—**$13.00** postpaid.

22. FREEHAND AND PERSPECTIVE DRAWING—*By Herbert E. Everett and William H. Lawrence.*
An explanation of the perspective of simple forms and more complicated ones such as, for example, a many-gabled house, elaborate column capitals, and floral designs.—**$1.65** postpaid.

23. PHOTO-MARKETS (Seventh edition).
A "make money with your camera" book of 112 pages telling what to shoot, how and where, with directions for submitting photographs to magazines. Over 1800 markets listed.—**50 cents** postpaid.

24. SHIPS OF THE WORLD'S BATTLEFLEETS—*Edited by Pay-Lieut. Comdr. E. C. Talbot-Booth, R.N.R.*
Essential facts regarding the principal ships in the navies of the important powers, with details of construction, silhouette drawings, and a large number of photographs.—**$1.65** postpaid.

25. MATHEMATICS FOR THE MILLION—*By Lancelot Hogben, F.R.S.*
A book by a scientist not primarily a mathematician, intended as a help to millions who have "forgotten their mathematics". For laymen who would like to remember easily.—**$3.95** postpaid.

26. THE MYSTERIOUS UNIVERSE—*By Sir James Jeans.*
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charge of General Electric's artificial lightning and high voltage laboratory, who has observed several occurrences of this character in connection with his recent investigation of lightning. In one of these cases, lightning came down a 90-foot pine tree and plowed up a furrow in the ground until it reached a pole supporting telephone wires. It went up the pole, leaving some splintered wood behind, and finally found its ground connection after passing through the telephone wires.

In another case, in New Hampshire, lightning followed down a tree, traveled a distance of approximately 50 feet over the earth to pass up another tree, then jumped approximately one foot to a 110-volt lighting circuit, from which it dissipated itself in lightning arresters connected to the power circuit.

The three main hazards of standing under a tree during a storm are: (1) the discharge may side-flash from the tree; (2) the discharge in passing through high-resistance soil at the base of the tree may pass considerable current up one leg of a person and down the other, often the reason why cattle are killed under trees; (3) the tree may explode and a person may be injured by the flying debris.—*Journal of Applied Physics.*

FOR GOATS?

A FATTENING food for livestock, consisting of bran middlings soaked with edible palm oil, is produced by steel mills as a by-product of tin plate manufacture. —*Steel Facts.*

Synthetic Perfumes Excel

THE synthetic perfumes of modern ten-cent stores excel those for which perilous sea voyages and hazardous caravans probed the Orient in the Middle Ages, Dr. Charles F. H. Allen, of the Eastman Kodak Company, declared at a recent meeting of the American Chemical Society.

America's beauty bill, he added, annually runs to over 200,000,000 dollars, even when a most conservative estimate is taken. Much of this is profit; for, said the scientist, the jar containing the cosmetic may well be the most expensive part. For example: jar, six cents; contents, two cents.

Synthetic perfumes duplicate natural perfumes in everything but cost. Natural oil of rose costs 175 dollars a pound, while the same product, made in the laboratory, costs only $22.50 a pound.—*Science Service.*

Dyes Test Bay Currents

FOR the purpose of determining the extent and the location of the sewerage field from the proposed sewerage outfall of Treasure Island, site of the 1939 Golden Gate International Exposition on San Francisco Bay, novel and interesting tests were made with aniline dyes.

In tracing the currents, uranin, a little used German type dye now manufactured in limited quantities in this country, was used to color the water. So penetrating is red uranin that one pound of this powder will color 10,000,000 pounds of water. Originally

this dye was used in Germany to trace the course of underground currents. Recently uranin was used by California sanitary engineers in making sewerage tests at Monterey, Santa Cruz, and Santa Barbara.

During tests, one pound of red uranin released from the engineers' boat on the ebb tide colored an area of several acres a light greenish hue which could be readily distinguished from the San Francisco-Oakland Bay Bridge, a distance of several miles. Several other markings were made on both the outgoing and incoming tides.

Tests were started at 10:00 A.M. on the ebb tide with a one-pound release of uranin. The next marking, a two-pound release, was at 11:15 on the slack just before the flood tide. Half pound quantities were released at 11:30, 11:45, and then every half hour until two o'clock. Currents were plotted by observers located on the cantilever span of the bridge.

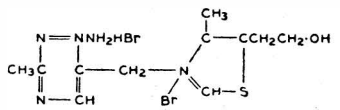
In charting the course of these colored areas it was noted that the 20,000,000 cubic-yard fill of the Exposition site, the world's largest man-made island, had considerably altered the currents of San Francisco Bay. Location of the Exposition's outfall sewers will be determined by the tests.

COTTON

ONE thirty-second of an inch is barely discernible to the eye, but just that much added to the average staple length of cotton should mean in excess of 8,000,000 dollars more in the pockets of the growers in one year.

Synthesis of Beri-Beri Vitamin

AFTER 26 years of constant research, the vitamin preventive of the disease beri-beri has been isolated, its chemical constitution determined and the vitamin itself synthesized at a cost far lower than that of recovering it from bran. The chemical formula of the vitamin as given before the American Chemical Society by Dr. R. R. Williams, to whom credit is largely due for this accomplishment, is:



In describing the significance of a bountiful supply of this pure vitamin, Dr. Williams said, in part:

"Now that the vitamin is abundantly available, what uses will it serve? First, we should mention the knowledge it will bring of the physiological function of this substance which is required for the growth and well-being of all living things, both plant and animal. Yeast, bacteria, mushrooms, peas, tomatoes, beetles, birds, goats, monkeys, rabbits, rats, mice, and men have all been shown experimentally to use it as part of their normal processes. . . . A better knowledge of its behavior will broaden the new science and in many ways assist in the mastery of constitutional diseases, notably neuritis, arthritis, and gout.

"Certain practical and immediate uses

are already evident. Although we have known for more than 20 years the cause and means of preventing beri-beri, relatively little has been done in the Orient to curb it except perhaps in the Dutch East Indies. Until the sale of polished rice is prohibited or restricted in the East, as has often been proposed by sanitarians, the disease will flourish and there will be need for treating it. . . . The number of people who are partly incapacitated by beri-beri is much larger than the number who die. One authority estimates the total number of current cases in the Philippines at 150,000."

SUPER-NOVA

A SUPER-NOVA discovered early in September by Dr. Fritz Zwicky is so distant that it appears to the eye as only a faint telescopic star of magnitude 10.5, despite the fact that it is actually five hundred million times brighter than the sun.

AIRCRAFT AND THE MERCHANT MARINE

BEGINNING his aeronautical career as Chief Engineer to the Wright Brothers, Grover Loening has passed from one success to another, as a designer, constructor, and manufacturer of outstanding land planes and seaplanes. His recent report to the Maritime Commission, entitled "Aircraft and the Merchant Marine," lives up fully to this background, analyzes the whole situation admirably, and lays the foundations for a real policy in the use of the aircraft in transoceanic service.

Thirty years have elapsed since the *Mauretania* established its Atlantic record of 5 days and 2 hours. The *Normandie* has succeeded in lowering that time by only 24 hours. If the horsepower of the *Normandie* were doubled, at prohibitive expense, the time of crossing the Atlantic would be reduced only 11 hours.

Against this practical limitation on surface vessel speed, there is the certainty that, in the immediate future, we shall have flying boats of 120,000 pounds gross weight, carrying 40 to 50 passengers at an average speed of 175 miles per hour, and with a 5000 mile non-stop range.

The question of safety immediately enters the discussion. The report makes a fair and well-founded presentation, summarized below, of the argument that the safety and reliability of the flying boat are such as to make its service entirely practicable:

1. Pan American Airways have completed a year of operations between San Francisco and Honolulu—an over-water jump of 2400 miles—with a record of 96 percent completion of previously announced schedules.

2. The elimination of intermediate landings in the Atlantic will make for a reduction of take-off and landing risks, and will give a wide choice of routes to find the best weather or the shortest air distance.

3. During the winter, ice conditions may hinder take-offs and landings in New York so as to require operation from Baltimore or Norfolk, but the flying boat needs so little in the way of ground facilities that seasonal shifting of bases is entirely practicable.

4. In foggy weather, the take-off need not

be delayed because a quick climb to clear air can be made safely from a patrolled section of the water. Once above the thick weather, radio and celestial navigation make it possible to continue the voyage with safety.

5. The high cruising speed makes a gale of little importance; continuous head winds of 40 miles an hour can be overcome, thunder-storms are an ineffective commonplace to fast aircraft, and weather reporting makes hurricanes avoidable, or, in some cases, actually helpful.

6. With flying boats of the large size, ocean landings and take-offs under calm conditions are practicable. In a storm, landings can be made with injury to aircraft but none to personnel. Moreover, with four or even six motors, the possibility of forced landings becomes remote.

With flight at a height of only 10,000 feet, bumpy air over the ocean is unlikely. In the matter of space, accommodations, quiet, the overland airliners are already equal if not superior to Pullman trains. In the large flying boats, future designs offer passenger comforts almost equal to those of the *Normandie* or the *Queen Mary*. With overnight runs instead of four or five days on the sea, air travelers are not likely to demand swimming pools, though Igor Sikorsky is quite certain that a dinner dance will be an appropriate accompaniment of flying-boat travel across the Atlantic!

The Maritime Commission has made a fine study of our Merchant Marine problems, and there is no doubt that the nation is in sympathy with its objectives, even though there may be differences of opinion as to methods. One of the problems which the Maritime Commission has considered is: Shall we build superliners, or airships, or large flying boats to maintain our competitive position in ocean travel and service? Mr. Loening approaches this problem in realistic and factual fashion.

We can plan for one superliner making one crossing per week; two airships making 1½ day crossings on seasonal schedules of two to four per week; or six flying boats making daily crossings both ways.

The superliner will cost 50,000,000 dollars. The construction cost of an equivalent passenger capacity in dirigibles would be about the same. The cost of equivalent passenger capacity in flying boats is estimated at 1,800,000 dollars. The items of depreciation, fuel, and crew cost of the three major methods of crossing the Atlantic give an equally interesting comparison. The superliner figures out to $67.58 per passenger, the dirigible to $131.83, and the flying boat to $73.10.

Therefore, in addition to its superiority in speed, the flying boat adds lesser initial cost, and not much greater operational cost than that of the superliner. But will the flying boat attract sufficient sources of revenue? The volume of transatlantic first-class mail is approximately 8000 pounds per day, and the average number of first-class passengers paying something like the proposed airplane fare of 450 dollars is 20,000 a year. There will be no difficulty in securing revenue. The temptation of a week-end in Paris, let us say, will certainly increase the volume of passenger travel. Mail would, of course, increase enormously and perhaps cut in quite seriously on cable communications. To quote Mr. Loening's own words:

"It would appear, therefore, that these services (one day to Europe by airplane and 2½ days by dirigible) may in the near future be operated at a cost and a fare equal to or possibly less than that of a superliner. Such faster services, with ample capacity for a large part of the passenger, mail, and express traffic, will cause superliner service to lose much of its appeal and justification for a large class of traffic."

There is a well-founded warning to shipping companies in the report: "If the shipping companies are not to add aircraft to their fleets, they will undoubtedly lose considerable traffic to independent airline companies. The ocean-going flying boat or dirigible is nothing less than another vessel—a very much faster vessel—and eventually cheaper to operate. For shipping companies not to make use of this new vessel on their trade routes may prove quite short-sighted."

Space will not permit us to review the discussion of airships as an alternative to flying boats, but it is clear that Mr. Loening's well considered and unbiassed opinion rules the airship out from serious consideration.

To date Pan American Airways have done very well without much government aid, except in the matter of mail charges. But if aircraft are to have a definite place in our over-seas trade, and if we are to meet the liberal subsidies of the British to their Imperial Airways, of the Germans to Luft-Hansa, and so forth, then an extension of the Merchant Marine Act of 1936 to include aircraft is legitimate and desirable. For the large flying boats discussed above, the initial engineering and development costs are enormous. The risk assumed by the manufacturer in taking an order, and by the operating company in giving an order, are very high.

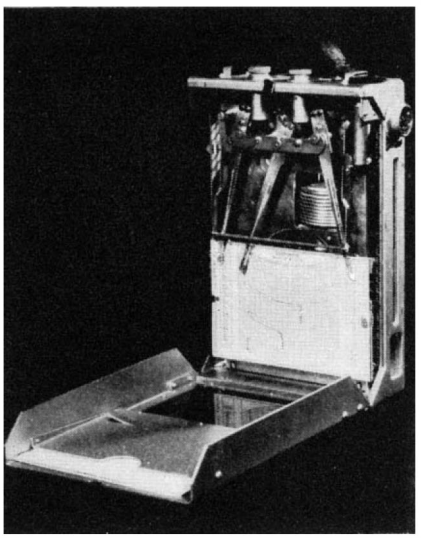
The Merchant Marine Act should be modified to permit 75 percent construction loans on aircraft for the foreign trade. This would give our transatlantic air services just the encouragement they need. And while European surface vessels cost less to build than American surface vessels, the situation is reversed in the case of flying boats, owing to our better production methods. With initial help in the form of construction loans, our flying boat constructors and our splendid operators would know perfectly well how to withstand all foreign competitors. The importance of this matter from the point of view of national trade and national defense is so obvious that it needs no argument.—*A. K.*

POTSHERDS

IT is undoubtedly true that the pitcher that goes too often to the well is the one that is broken, but it is also true that it is the one that is saved for posterity.—*C. K. Wilkenson, of the Iranian archeological expedition of the Metropolitan Museum of Art.*

FLIGHT ANALYZERS AT WORK

CONCEIVED by Major R. W. Schroeder and developed by the Julien P. Friez Company, 60 flight analyzers are now in service on United Air Lines. The charts of the flight analyzer give a check on the pilot,



Interior of the flight analyzer that keeps careful and accurate check on the operation of transport planes

particularly as regards the observance of the rule that flight shall be at a minimum of 2000 feet. From these charts also, dispatchers, chief pilots, and other operators will be able to reconstruct the history of any flight and learn much about the efficiency of operation.

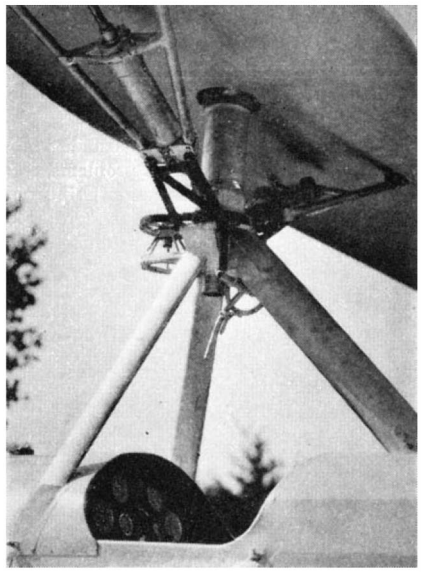
The flight analyzer is housed in a small case made of duralumin and weighs only three pounds. The charts are three by five inches in size. Prior to a flight a fresh chart is placed on a special rack, which is geared to a clock mechanism. The chart is thus moved at such a rate that the recording pens move across the time divisions of the chart in exact ratio to the actual passage of time. Pens are carefully adjusted and the device is placed behind the express compartment near the tail of the plane. The range of the analyzer is eight hours, which covers the longest over-land flight undertaken.

The barographic part of the analyzer will give a record of altitude against time, so that rates of climb and descent can be checked, and will also serve to indicate gustiness. The barograph will also indicate whether the 2000 feet rule has been observed. Certain recording arms actuated by electric impulses chart the length of time that the automatic pilot is in use, and the number and duration of radio contacts with ground stations.

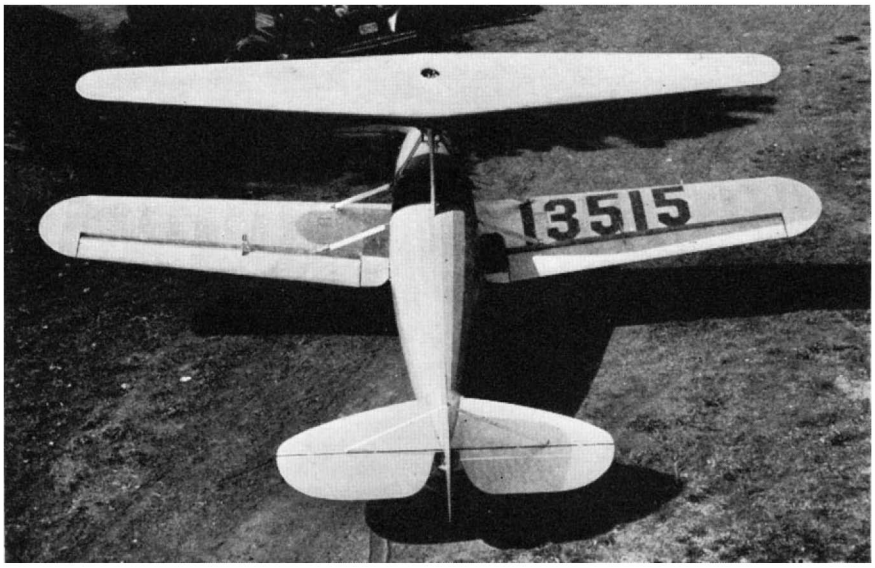
It will be readily agreed that the analyzers will provide a wealth of useful information for the air transport operator.—*A. K.*

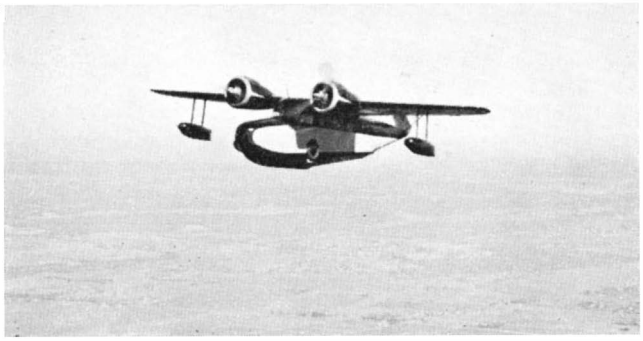
The Herrick Vertaplane

THE airplane wing is at present and is long likely to remain the most efficient form of lifting surface, far more efficient than any rotary wing or system. On the other hand, the rotary airfoil has such enormous lifting capacity that it robs emergency landings or landings in restricted territory of their terrors. It is the ingenious idea of Gerard P. Herrick to combine the efficiency of the fixed wing with the ideal landing characteristics of the rotor. A good many years of patient research work and skilled engineering and construction have resulted in highly successful tests of the Herrick Vertaplane, as the new type of aircraft is termed. The upper wing of the Vertaplane is a special, symmetrical airfoil—that is, with the leading edge identical with the rear edge. This wing is mounted on a horizontal

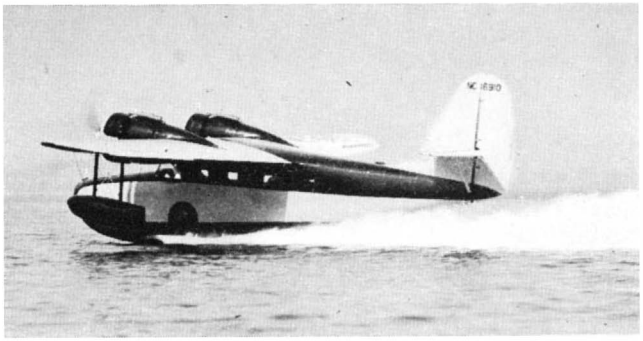


***Above:* Releasing mechanism of the upper wing of the Vertaplane. *Below:* The Vertaplane on the ground, showing the symmetrical airfoil design of the rotatable upper wing**





One of the new amphibians for private flyers, many of which were bought from drawings



The Grumman amphibian about to take off from the waters of Long Island Sound

hinge, placed at the top of a strut mounting. When the pilot so desires, certain of the struts are released and an electric starter and suitable gearing rapidly set the wing into rotation, giving it all the characteristics of the rotor. Shock absorbers take up the initial moments that are developed.

The Vertaplane has been converted in flight some seven times at heights of one foot, ten feet, 20 feet, 50 feet, 100 feet, and 1500 feet from the ground. The starting of the rotor and the conversion generally occur so rapidly as to be scarcely noticeable. While this particular ship was built to demonstrate the simplicity and practicability of conversion in the air, and is therefore subject to considerable refinement as to weight and parasitic drag, it has shown quite satisfactory performance as a fixed wing biplane, with a maximum speed of approximately 100 miles per hour. Its landings have been very slow.

The general characteristics of the Vertaplane HV-2A are as follows: Span of rotor wing, 24 feet; lower wing span, 28 feet; area of upper wing, 70 square feet; area of lower wing, 100 square feet; disk area, upper wing, 452.4 square feet; airfoil of upper wing, Herrick 7-11; airfoil of lower wing, Clark Y-15; engine, Kinner B5 of 125 horsepower; gross weight, 1700 pounds.—*A. K.*

THE MURDER DISEASE

THE germs of typhoid, paratyphoid, typhus, undulant and scarlet fevers, smallpox and diphtheria combined took fewer lives in this country in 1935 than did homicide.

BUYING OFF THE DRAWING BOARD

THERE are many commuters by air from Long Island estates to the foot of Wall Street on the East River. When some of these modern commuters grew dissatisfied with their flying equipment, they saw nothing on the market which would meet their needs. So they turned to Grumman Aircraft whose reputation in building amphibians and other craft for the Navy is deservedly very high. L. R. Grumman, president, and "Bill" Schwendler, chief engineer, soon laid out the preliminary drawings of a twin-engined amphibian which was just what these wealthy and sportsmanlike Long Islanders wanted. From these few drawings, they immediately received an order for four of these large and expensive machines; then an order for six more. Hence the title of this note.

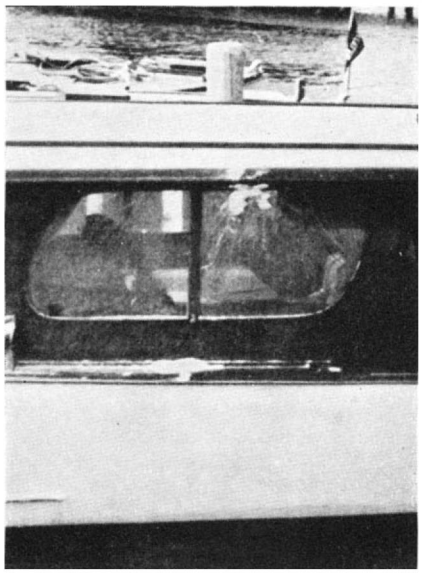
The "buyers off the drawing board" were not in the least disappointed, because the Grumman G-21 Amphibian has met all its tests with perfect satisfaction. The ship, equipped with two Pratt & Whitney Wasps of 400 horsepower each, will have a gross weight of 7500 pounds, with a useful load of 2180 pounds, providing for a pilot, co-pilot, four or five passengers, and 220 gallons of gasoline. The equipment is of the most complete and luxurious type, with reclinable chairs, a full-length davenport, ample baggage space, toilet facilities, soundproofing, lighting, and a splendidly laid out pilot's compartment. In fact, the G-21 offers everything that is to be found in an airliner of the latest type. In aerodynamics, structural design, stability, control, and performance the flying yacht also takes the highest rank. Thus, top speed at 5000-feet altitude is 205 miles per hour; the service ceiling is 24,000 feet; take-off run at sea-level is only 796 feet and requires but 11 seconds; landing speed with flaps down is 60 miles per hour; and flight on one engine is readily accomplished.

Entrance is on the right side of the cabin immediately behind the pilot's compartment, with an emergency hatch on the other side. The retractable landing gear is of the well-known Grumman design which is remarkable for its simplicity and complete reliability. The all-metal structure is on lines which have again and again proved acceptable to the critical Navy Department, and the sides and bottom of the hull are so strongly designed that the keel girder is dispensed with.

There are many luxurious seaplane or flying boat hangars on Long Island now in use, with splendid accommodations for the aircraft, fine beaching facilities, cranes to lift the boats out of the water if necessary, and everything that the heart of an air yachtsman can desire. Perhaps the day is coming when it will no longer be fashionable just to own an ocean-going yacht. It will be more "chic" to own a flying yacht! —*A. K.*

The Sport of Amateur Bombing

CREDITED with having started the Tennessee evolution trial some 12 years ago, the latest idea of George W. Rappleya, of Wheeler Shipyard, while of lesser national importance is more amusing. Mr. Rappleya organized a mock bombing contest between a number of private airplanes and a number of small cabin cruisers in the waters of Long Island Sound. The cabin cruisers were armed with cameras whereby "direct" hits on the airplanes could be registered; the airplane pilots were armed each with a dozen one-pound flour bags, which represented the bombs to be hurled on the doughty vessels below. The official score was five to three in favor of the airplane pilots. The fliers struck five of the competing motorboat cruisers with their one-pound flour sacks. The yachtsmen brought down three planes with their "anti-aircraft" camera guns. The new sport proved tremendously exciting, there were no collisions in the air or on the water, nothing was proved, and everyone had lots of fun.—*A. K.*



Above: **A camera "gunner" makes a direct hit on a plane. Note cross indicating accuracy.** ***Left:*** **An aerial "bomb" containing flour theoretically put this boat out of action**

The New Civil Air Regulations

AUTOMOBILISTS often complain of the complexity of traffic regulations, of misleading signs, of rules that change with every city or town or even village. We wonder how they would like to use the new Civil Air Regulations which contain such delightful notes as the following: "60.105. Green Zone of Intersection. A green zone of intersection is a zone of intersection on a green airway in which through traffic on a green airway continues through such zone at a constant altitude, and in which zone traffic on the intersected amber or red airway shall proceed as outlined in CAR 60.58310 and 60.58320." Opinion differs. Some people think that in their new Air Regulations the Department of Commerce has done a splendid job likely to promote safety greatly, and in particular to ensure freedom from collision in the air. Others say that this new piece of bureaucratic regulation will most certainly promote the safety of private flying by making private flying impossible!

That the new regulations are complex is demonstrated by the fact that *American Aviation* has issued a simplifying booklet which has attained immense popularity in the space of a few weeks. The rules of the Air Commerce Bureau have been reduced to English as we know it, and clever illustrating diagrams have been produced.—*A. K.*

Why not Fly Above the Mountain Tops?

THE recent crash of an airliner into a mountain at some 10,000 feet altitude has led laymen to ask: "Why, when flying near mountain ranges, do not pilots fly higher than any peak." Here is an intelligent question to which the answer appears to be: "They should."

But Dean Smith, veteran pilot of a transcontinental airline, puts the matter in a different light. Let us quote him: "The layman immediately asks, in particular about crashes such as the last one, why the pilot does not fly at an altitude that will clear all the mountains? The answer is that he does when he can, but there are times when to do so is more dangerous than to fly lower. All that goes up must come down and as the airports are lower than the tops of the mountains he must know his exact position when he does descend. There are times when flying higher

than all mountains means a sure loss of position, when snow-static, ice, and so on, affect him at that altitude but not at a lower one, places where swinging beams and lack of cross checks mean a greater hazard in flying high with the aid of instruments than flying lower in visual contact with the ground. In these areas pilots by necessity grow to depend on their individual skill and judgment as they lack exact means of navigation. Under such circumstances it is impossible to expect all the pilots to have infallible judgment at all times." And sometimes when the pilot has, with apparent justification, lowered his altitude, a crash may result.—*A. K.*

See Your Pitch

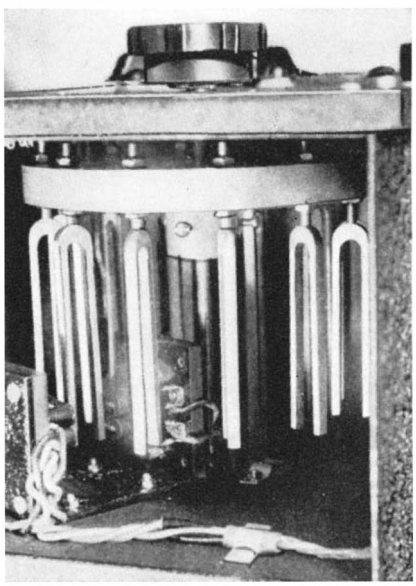
PITCH is no longer dependent on a musical ear; a new electronic device permits one to *see* the pitch of any note, whether sung or played, as well as its timbre and volume. And since the eye is a far more critical judge than the ear, it becomes possible for anyone to pitch either voice or musical instrument to a degree of accuracy quite unheard of by former methods.

The resonoscope, as the new device is known, a development of the Allen B. DuMont Laboratories, is simple to operate. Also, it is self-contained and portable, operating from the nearest electric socket or outlet. To use it, one merely turns on the current, places the main dial to the desired note of the scale, and flips a switch. The bullet-shaped microphone now serves as a loud-speaker, emitting the pure note called for. By means of this note or tone, singer or musician can proceed to pitch the voice or instrument. Meanwhile, the uniform wave form of the note appears on the cathode-ray screen just above the main dial.

So far, so good. We have a pure tone or note. We have an image of that tone or note. It now becomes possible to check our pitch by visual means. For this purpose, a switch is thrown to convert the microphone from its loud-speaker rôle to that of a true microphone. It now picks up the sung or played note. The cathode-ray screen instantly reproduces that note in visual terms, so that it may be compared with the pure tone produced by the master tuning fork within the resonoscope. If the note is sharp, its wave form slips off to the right; if flat, to the left. The rate of movement in either direction indicates the degree of sharpness or flatness respectively. If the wave form remains practically stationary, the pitch closely matches that of the master tuning fork. Meanwhile, the smoothness of the wave form indicates the quality or timbre of the note. The more jags and irregularities, the more overtones are present.

The resonoscope combines a set of 12 master tuning forks, electrically actuated, with microphone, amplifier, loud-speaker, and cathode-ray tube. The tuning forks are mounted on a wheel which is rotated by the main dial knob, so that any fork corresponding to the desired note can be brought in position between the electromagnets.

Recently introduced, this device is already being used in broadcasting studios, by some of the musical instrument manufacturers, and by schools for voice training.



Left: **A singer testing the pitch of her voice by watching the wave form on the cathode-ray tube screen.** ***Above:*** **The tuning forks and driving solenoids in the resonoscope**

Fat from Coal

IN Germany's search for substitutes for materials of food value the latest development is a soap made from a fat produced from German coal. The product, said to be quite satisfactory as a cleaning agent, is more expensive yet than soap from fats, but lower prices are expected to be realized through increased production. Fortunately the United States has plenty of fats to make its soap.—*D. H. K.*

Poison Hazard in Spraying Fruits and Vegetables

"POISON—Do not eat." It may be that such a label should apply to ordinarily harmless cabbage if producers use lead arsenate or other arsenical sprays to kill the insects that attack that vegetable during growth.

The hazard from sprayed farm products is unfortunately not limited to the eating of spray left on vegetables. Water supplies, cattle feed, and the soil itself are contaminated. Vegetation grown on the contaminated soil gradually takes up the poisons. In some regions, stock raisers have been forced to go out of business.

In an editorial, the *Journal of the American Medical Association* says: "One valley

in the Pacific Northwest has received as much as 7,000,000 pounds annually of lead arsenate for the past 20 years. Therefore perhaps 50,000 tons of lead arsenate have permanently contaminated the soil. Some assume that the spray residue is washed away by rains or is blown away by winds, but the evidence available at the present time indicates that this is not the case."

Here are three rules that the physicians feel should be enforced legally on the producer, pending the elimination of all poisonous sprays:

1. Remove spray residues as completely as possible from apples and other such fruits, preferably by hydrochloric acid rinse.

2. Do not use skins of sprayed fruits in making cider, vinegar, jelly, or other products.

3. Never use lead arsenate or other arsenical sprays on vegetables such as cabbage, cauliflower, Brussels sprouts, broccoli, spinach, kale, celery, and snap beans that are eaten whole.

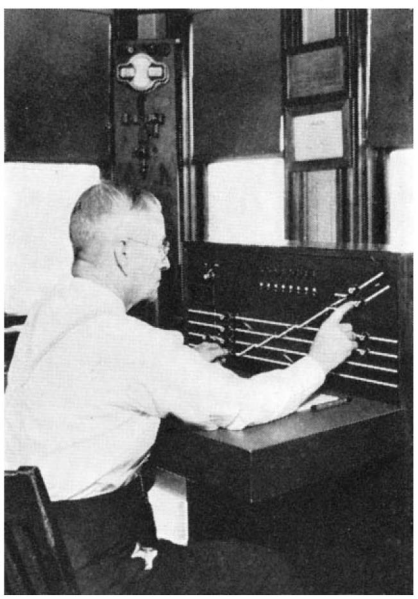
The housewife, in addition, is urged to wash thoroughly all fruits and vegetables that may have been sprayed.—*Science Service.*

Latest Train Directing System

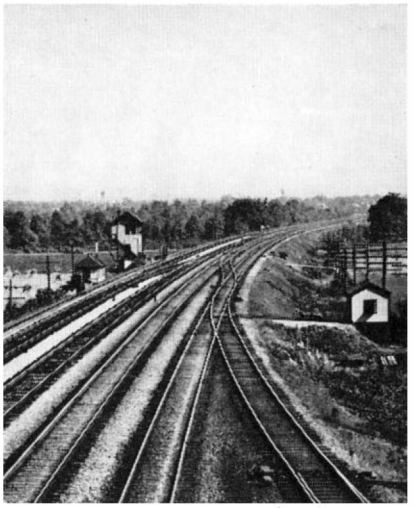
A NOVEL train directing system was recently installed on the New York Central Lines West at Girard Junction, 17 miles west of Erie, Pennsylvania. This system now simplifies train directing at this busy junction through which pass over 100 trains per day.

Movements through a junction or terminal are made by trains traveling over clearly defined "routes." When an operator lines up a route, he usually thinks of it as having an "entrance" and an "exit." This basic concept of route entrance and route exit is closely related to the means the operator uses for lining up routes, such means being "entrance knobs" and "exit buttons," explained below. The system is called "NX Route Interlocking," from the first syllables of "en-trance ex-it."

In the control room of Girard Junction tower, a small desk-type control machine is used to control the entire interlocking plant.



The train-directing control board



A track layout through which trains are directed by the system described

On this machine is a control board which looks like a map or diagram of the entire track layout. The tracks are represented as white lines on the black panel—the switches and crossovers by indicators which are moved to the desired positions.

At each entrance of every possible route through the plant is an entrance knob which turns clockwise or counter-clockwise, 90 degrees from a neutral or normal position. A small white dot, which turns with the knob, indicates the position of the knob. The arrow in the knob remains stationary, pointing out the direction in which the train is to enter the route.

At each exit of every possible route through the plant is an exit button. It is the usual spring-return type of push-button. The arrow etched on its surface indicates the direction in which the train is to leave the route.

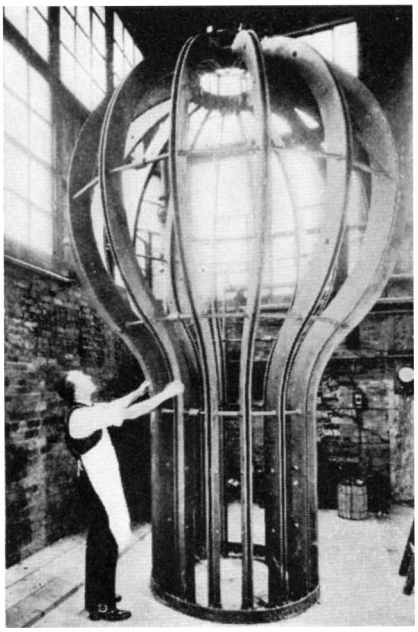
Small indicator lights, inserted at intervals in the white track lines, are illuminated whenever a train is occupying the track. Above the track diagram and in about the center of the control board is a group of "test keys," so called because they are used only when the switches need to be moved one at a time for individual testing.

When a train is approaching the junction, an approach indicator light is illuminated on the track diagram. The operator telephones the dispatcher, who informs him where to direct the train. Upon receiving this information, the operator turns the entrance knob corresponding with the point where the train will enter the plant. He next pushes the exit button corresponding with the point where the train will leave.

Within a few seconds, the route lines up in the field (the switches operating into positions called for by the route) and the signal clears. On the control board, the movable route indicators snap into position called for by the route, thus producing a vivid picture of the route lined up. A light in the entrance knob appears when the signal clears in the field.

As the train passes the signal, the light in the signal changes to red, and the light in the entrance knob is extinguished. The successive illumination of the track occupancy lights indicates the movement of the train through the plant. These are extinguished as the rear of the train leaves the various sections of the route.

The system has been enthusiastically re-



The steel skeleton of the titanic incandescent light bulb memorial

ceived by railroad officials in the United States and abroad, and promises to do much towards simplifying train directing in the future. A large and complicated terminal layout can now be handled with comparative ease and speed, thereby giving the operator more time for his regular duties such as recording trains, receiving and transmitting calls, issuing train orders and other important messages.

This system is to be installed at both ends of the San Francisco-Oakland Bay Bridge to handle the train-a-minute schedule over the bridge. It was chosen because of its simplicity and flexibility of operation.

Lubricating Resin Bearings

SYNTHETIC resins are coming into wide use abroad as bearings for machine parts to replace brass and other bearing metals. Because of their very different characteristics, the lubrication of these bearings has become quite a problem. Water is the ordinary lubricant but it has been found that, in many cases, an emulsion of oil in a soap solution must be used to reduce corrosion of the metal part of the bearing and to cool the resin bearing surface. These bearings are most widely used in Germany, but their advantages are being recognized in other countries as well.—*D. H. K.*

14-Foot Light Bulb

A GIANT electric light bulb, 14 feet high, which will glow as a land beacon atop the 100,000-dollar Edison Memorial tower at Menlo Park, New Jersey, was recently completed by the Corning Glass Works. A crew of expert glass-workers took eight months to complete this emblematic diadem for the tower, the job of laying out the model into curved sections consuming the greater part of the elapsed time.

The 150-foot beacon tower will commemorate the invention of the incandescent electric light by Thomas Alva Edison who, in 1879, sent a rough sketch of his idea to Corning, asking that a bulb of glass of definite dimensions be blown. This original glass bulb, enclosing Edison's carbon filament, became the world's first practical electric light. Corning's contribution to the memorial commemorating the event is likewise notable since the 14-foot bulb is the first circular cast job in the glass industry.

In preparing the bulb for shipment, more than 6000 pounds of amber-tinted Pyrex glass were fitted over a steel skeleton fashioned in a Bronx iron works and shipped to Corning. The bulb itself consists of 164 pieces of cast glass in a two-inch diamond pattern and is nine feet, six inches in diameter. The combined bulb and steel skeleton weigh six tons.

When finally set up the giant bulb will be transformed into a gleaming tower at night, casting its rays for miles about the surrounding Jersey countryside. The inside of the bulb will be outfitted with 960 incandescent electric lights with a 24-inch reflector to be utilized as an airplane beacon.

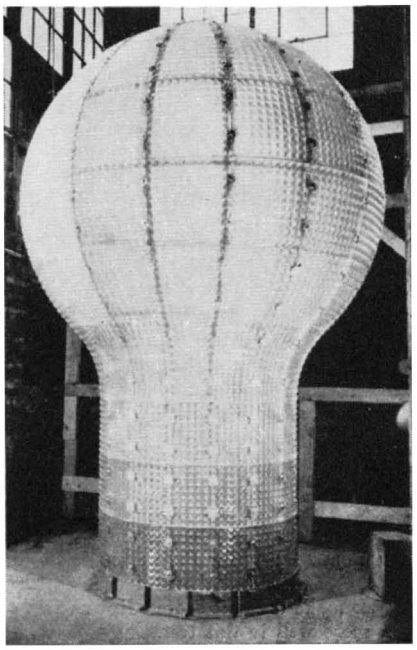
"Air Fed" Fountain

WATER taken from the air flows today in the lobby of the newly air conditioned Cine Riviera in Havana, one of Cuba's leading motion picture theaters.

A fountain in the form of a lion spouts forth water condensed from the air by the new Carrier air-conditioning system recently installed. A line from the drip pan under the dehumidifier on the air-conditioning equipment connects with an outlet on the inside wall of the lobby.

Our Chemical Senses

THE senses of taste and smell, which are used in the detection of flavor, are often called the chemical senses, because they are stimulated directly by the chemical attributes of foods and other substances. The sense of taste is delicate. A single teaspoonful of sugar or of salt is enough for many tastes, and yet some substances are hundreds of times more stimulating to the taste than either of these foodstuffs. Whatever we taste has to be in solution in water, or must dissolve in the saliva, before it can be tasted.



More than three tons of Pyrex were fitted on the bulbous steel framework

Only watery solutions can diffuse through the protective membranes of the taste "buds" on the tongue to act on the special nerves therein. Sweetness is best tasted near the tip of the tongue, where the sweetness buds are crowded closely together. Saltiness and sourness are best tasted by the front and sides of the tongue, but bitterness only well back, on the top of the tongue. Bitterness tends to be detected rather slowly, because of the far-back position of the bitter-sensitive nerves.

Most of the interesting flavors we delight in are really not tasted, but are *smelled*. In the moisture and warmth of the mouth, the aroma is released and travels to the smelling area through the back way. This is the part of flavor perception that fails us when we have a cold, which condition interferes with smelling far more than it does with true tasting. Inspectors of foods have long since learned that they can do far more work when they smell rather than taste the article. A baker smells the interior of a loaf of bread to learn about its flavor. A sample of every carload of wheat is smelled to see that it is not musty. Testers of tea, coffee, spices, tobacco, butter, cheese, and liquors depend upon smelling for their first gradings and evaluations. Only for check purposes do they find it necessary to take any into the mouth. The sense of smell is so extremely sensitive that the quantity of material consumed in using it is negligible, and smellings may be repeated frequently.

The reason why smelling is so extraordinarily delicate is that it is done with the "raw" ends of free nerves. Molecules of vaporized materials drawn into the brush of smelling nerves by the operation of sniffing seem to be able to impart sensations to the nerves directly. There have been many theories as to how smelling is done, some involving the need of chemical reaction with the nerve fiber, to produce the odor impression, but now a theory is proposed that the nerves are stimulated by the atomic vibrations within the molecules of the aromatic substance, perhaps by the electromagnetic waves therefrom acting on the electrical system of the nerve ends. It is interesting to speculate a bit while awaiting definite proof that the quivering molecules, through their electrical radiations, are able to impress their vibrations and hence their chemical configuration upon our consciousness. Chemists have long been aware that odor depends upon chemical constitution, but only now has even a feasible theory been found to account for the action.

An interesting party pastime is the "smelling game," in which each participant tries to identify a dozen or so odors in small, dark-colored bottles that bear only numbers and offer no clues as to their contents. In one set, the following substances were used: four perfumes—rose, lilac, jasmin, and violet; four flavors—clove, peppermint, wintergreen, and vanilla; four "drug-store" articles—camphor, carbolic acid, witch-hazel, and tincture rhubarb; and three liquors—Scotch and rye whiskies, and gin. Most people were able to identify outright only four or five of the fifteen. The list of identified odors from such a range of subjects comes close to being an experience rating for the person; naturally good observers and those of wide interests in life make the best scores. Housewives often score well in this test.

The smelling game shows that most people are really very sensitive to odors, but that their associative powers are weak. It is the same type of weakness as the connecting of names with faces or voices. Once a person recognizes an odor, or is helped to recognition by a name or a color, he can do well in noting details of quality. Most people do appreciate flavor, in spite of their usually poor showing in its identification, or, even more poorly, in its description.—*Industrial Bulletin* of Arthur D. Little, Inc.

Chemicals Useless to Improve Coal Burning

CHEMICALS added to coal to make coal burn better have little effect on the combustion of fuel, the United States Bureau of Mines has learned through exhaustive tests, reports *Science Service*.

Spurred by continual inquiries about alleged "fuel savers," the Bureau investigated, both alone and in mixtures, all the chemicals known to have been marketed for this purpose, and many others, including water and chlorine. None, it was stated, was found to produce the effects claimed.

Results of the experiments are contained in a bulletin by members of the bureau's staff, and published by the Government Printing Office.

Six-Day Rider's Muscle Power—75 Cents

PEDALING a bicycle for six days appears a most gruelling test of muscle power, yet a single rider if he were able to keep going night and day without a stop would exert but 20 horsepower-hours of energy, equivalent to the energy which 75 cents worth of electricity would buy. This was revealed when some of the racers at Madison Square Garden, New York, tested their strength on a special bicycle, built by General Electric engineers, which accurately measures the muscle power of the rider.

Lake Mead, Largest Man-Made

IN the desert of the southwest, a new and major lake is forming, Lake Mead, created by Boulder Dam. Named for the late Dr. Elwood Mead, Commissioner of Reclamation during the period of construction of Boulder Dam in Black Canyon of the Colorado River, Lake Mead is by far the largest man-made body of water in the world.

It extends up the Colorado River 101 miles at this time (autumn, 1937) and eventually will reach a maximum length of 115 miles. It will be eight miles wide at the widest point and, when filled, will have a maximum depth at the dam of 589 feet.

Lake Mead will store 30,500,000 acre-feet of water, sufficient when expressed in terms of gallons to supply 5000 gallons for each and every person on earth. Today it is slightly more than half filled. It now has a depth of about 460 feet and covers more than 91,000 acres.

Prior to 1935, there were few localities in the world more forbidding or more difficult of access than the bed of what now is Lake Mead. In the midst of a desert and desert mountains, the Colorado River

then flowed through this area principally at the bottom of tremendous canyons. Only a few parties of daring explorers had ever traversed the length of the future Lake Mead, and many of the side or branch canyons, now coves in the lake, were unexplored.

When the diversion channels were closed at Boulder Dam February 1, 1935, Lake Mead immediately began to form. One year later, it held 3,000,000 acre-feet of water. Two years later, it contained 9,000,000 and was extending far up the river, through the sheer-walled Boulder Canyon, through Virgin, Iceberg, and Travertine Canyons and was beginning to reach into the lower and unvisited end of the Grand Canyon itself. It can safely be navigated now over this entire reach of river.

The Colorado River was a fluctuating stream. It still is variable above Lake Mead, although Boulder Dam has made it a reliable, perennial watercourse downstream. When the snows of the mountains at its headwater melt in the spring, great floods move down the Colorado. After they have passed, the flow drops erratically to little more than a creek. The floods do not pass Boulder Dam, but are caught and stored to fill in the valleys of the flow in the summer and fall to protect the water users downstream.

As a result of these periodic floods, Lake Mead grows by fits and starts. It rises rapidly from March to July, but will decrease in size between August and February. During three or four months, the inflow into Lake Mead is greatly in excess of the outflow through Boulder Dam. But during the remainder of the year, the inflow and outflow are about equal or the outflow exceeds the inflow.

During 1936, 5,634,425 acre-feet of water were allowed to pass Boulder Dam. In the future and until the states of the upper Colorado River basin are prepared to use the water allotted to them, this diversion may increase to the normal flow of the river, or about 15,000,000 acre-feet a year. The amount of water diverted through the dam, of course, has a definite bearing on the speed with which Lake Mead fills. Another factor is the total amount of run-off in the river above the dam. This varies with the rain and snowfall over the watershed. If normal conditions prevail, Lake Mead may be filled in three years.

Paper from Black Gum

IN the development of Southern woods for paper making, the black gum tree has been found to yield a high-grade printing paper. Its usefulness for this purpose has been investigated as a supplement to the fast growing pines of the Southern coastal plain. Black gum is so plentiful that it is estimated to add as much as 40 percent to the wood pulp resources of the South. —*D. H. K.*

Mankind May Strive to Save Insects

BEFORE New Year's Day of the year 2000, man may very possibly reverse his present militant drive against insects, and actually strive to save many of the species he is now indiscriminately destroying with a grim determination.

This picture of the future, quite the opposite of the conventional present concept of inevitable, implacable war to the death between man and the insects, was presented before a gathering of members of the American Association for the Advancement of Science by Dr. Edith M. Patch of the University of Maine, president of the Entomological Society of America.

This swing of the pendulum, in the relations of mankind to insects, may be expected as the result of present strenuous efforts to meet an immediate emergency. There is no question but that at least a few species of insects are so dangerous to man that they merit all the serious hostility he bestows on them. Nor is the analogy of war much overdone, when it comes to man's efforts against insects, for in this strife man employs almost as much ingenuity as he does in his military efforts to destroy his fellow-man. Poison sprays, dusts, fumes, gases, flame, scalding steam, plowed trenches, tars and other sticky traps, luring lights, X rays, electrocution, ingenious espionage, alliances that turn insect against insect—all these tricks and more are in man's armamentarium against the opposing six-legged hosts.

But a dilemma arises through the very efficiency of modern methods of insect destruction, particularly such wholesale barrage effects as the use of airplanes for laying down of poison dusts by the square mile, over forests, cotton plantations, and mosquito-breeding marshes. These wide swathes of death sweep down not only the few insect species that are man's enemies but also the many that are his friends, or at most merely neutral and harmless.

Complaints of beekeepers are already loud in the land. But honeybees are only one species; there are many other wild kinds, like bumblebees, carpenter-bees, and others that are of equal value with honeybees as pollenizers of orchards, garden plants, and ornamental shrubs and flowers. These also are poisoned, but they die unnoticed except by professional entomologists. It may be necessary some day to set aside insect refuges, where spraying and dusting will be prohibited, to insure the transfer of pollen among the flowers we value for beauty or use, Dr. Patch suggested.

Birds, too, need insects for food, at least when they are young. It may also be necessary to insure that the trees and brushlands of their refuges shall be left in a nourishingly "buggy" state, for the sake of the hungry nestlings. And though it may sound a bit fantastic now, it is even conceivable that as present-day America has big-game sanctuaries for the benefit of the students of nature, future nature students may have to resort to "little-game" sanctuaries when they crave to swing a collecting net in the air, or grub in the ground for grubs.—Copyright, *Science Service.*

Radio on Pitcairn Isle

A COLORFUL throw-back to the days of the history-making mutiny of the British frigate *Bounty* is to be found in the life of the natives of lonely, mid-Pacific Pitcairn Island, which is inhabited by the descendants of Fletcher Christian, his band of mutineers, and their Polynesian wives.

PITC, the island's only radio station, is in charge of Andrew Young, chief operator, and a group of assistants, all of whom are self taught in Morse code and radio tech-

nique. Alan Eurich, writing in a recent issue of *QST*, recounts that even the children of Adamstown, the only village on the isle, are proficient Morse experts, sending messages to each other in the code with whistles.

Young's amateur radio station has been in operation since the early 1920's, and previous to its present modernization operated with one storage battery, which had to be sent to New Zealand to be recharged when its power ran low. Now, however, a number of radio manufacturers, including RCA, are coming to the rescue by providing sufficient parts to permit the building of a complete new radio communications system.

Leadleaf Paint

METALLIC LEAD is making its *début* as the main ingredient of a protective paint, says the *Industrial Bulletin* of Arthur D. Little, Inc. Traditionally, lead has been used in oxide forms as a chief pigmentary component of many common industrial and marine paints. "Metalead" paint, however, is made from thin lead foil broken up to fine flakes. When spread out upon a surface in the form of a paint film, the individual tiny flakes of lead form a "leaf" or interleave into a film.

The adhesion and ductility of the lead-leaf paint film are dependent on both lead and the vehicle; at present the vehicles employed are the new synthetic resins and Chinawood oil (tung oil) and mixtures containing phenolics such as Beckacite, Durez, or Bakelite. Linseed oil has not proved satisfactory.

The new paint is offered chiefly as an undercoater or primer on structural frame work and general construction and may also find eventual use in the chemical, oil, and transportation industries. Other uses are indicated by its unusual properties of resistance to high temperatures up to 500 degrees, Fahrenheit, and its chemical resistance to the fumes of common acids and to noxious industrial vapors, such as those of hydrogen sulphide. Its adhesion is illustrated by its application to galvanized iron, on which it may be applied directly without special pre-treatment of the metal surface. As offered to manufacturers, the lead is in paste form with only 10 percent vehicle and weighs about 40 pounds to the gallon. In this condition it is almost as bright as aluminum paint, but in the painted film, after drying, it dulls to a dark gray.

Metalead paint is being groomed chiefly as a competitor to red lead wherever the latter is used. At eight pounds per gallon it may thus have advantage in price over red lead, which may run to 25 pounds per gallon. It cannot compete with aluminum in cost, although greater film flexibility is claimed. Exposure tests reported as carried out near Great Salt Lake have shown excellent resistance and adhesion.

Metalead paint is claimed as suitable for waterproofing or sealing concrete, which then becomes more resistant to mild acids and alkalies, oils and greases, and salt brine solutions. Similarly, wood may be coated, as the paint metallizes the outside cellular structure.

A paint manufacturer on the Pacific Coast has reported the successful adoption of this paint in special locations. Developments are understood to be under way in the laboratories of some of the large paint companies where experiments on vehicles for this paint specially adapted to particular uses in industry and in construction are being carried on.

Motorized Pole-Hole Augur

TWO new earth-boring machines, delivered recently to an eastern railroad, are making impressive dents in the railroad's right-of-way. Designed for heavy-duty work in the railroad's construction program, the trucks are FWD vehicles, manufactured by the Four Wheel Drive Auto Company. They enter the railroad right-of-way from the highway, and dig 14-foot holes for transmission towers which will carry power lines.

The construction of the trucks enables them to go almost anywhere off the right-of-way. With drive to all four wheels, the trucks can negotiate steep grades and deep cuts with ease. Their maneuverability is increased by power steering. This mechanism gets its hydraulic power from a power take-off on the transmission which operates a pump furnishing the pressure required.

Sinking pole holes with the new motorized augur

A close-up of the augur blades

Dual tires, front and rear, enable the vehicles to work directly on the right-of-way. Up or down the steep grades, and within the steep cuts, the trucks can operate in very low gear, provided by a special two-speed clutch.

With a tower 18 feet high, and an augur shaft 20 feet long, the machines are the largest of their kind ever built. Furnished with both 30-inch and 36-inch augurs, the machines can dig 14-foot holes within a fraction of the time usually required by manual labor.

The huge digging tower is raised by two large coil springs of the anti-gravity type. This type of spring cuts tower-raising time to a minimum, and helps assume the weight of the tower in the raising operation.

The boring machine mechanism is mounted on a turntable, so that the operator may dig holes on either side of the truck, or behind it.

From Where, Hither?

ONE of the two pieces of the largest meteorite ever seen hitting the earth has just been added to the meteorite collection of the Smithsonian Institution. This "shooting star" exploded in the air near the town of Paragould, Arkansas, at 4 A.M., February 17, 1930. It is believed to have broken into three pieces, two of which were recovered. The largest, weighing approximately 300 pounds, is now in the Field Museum in Chicago. The second, 70 pounds in weight, comes as a gift to the Smithsonian from Stewart Perry, Michigan publisher and meteorite collector. The third, which may have been the largest, has never been found.

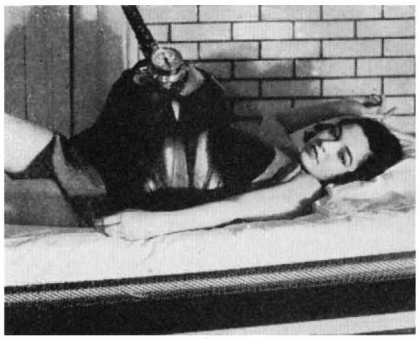
Not only was this the largest meteorite of any kind ever seen to hit the earth, but it is the largest stony meteorite of which there is any record. Some of the iron meteorites are very much larger, one in South Africa weighing approximately 60 tons. Most stony meteorites, which probably constitute the bulk of shooting stars, are very small when they strike the earth's surface, and the great majority of them are entirely consumed in the upper atmosphere, fortunately for mankind.

This particular fragment is of singular mineralogical interest and will be subjected to intensive analysis. It seems to be a fusion of two distinct bodies, as if they had crashed together and the smaller was driven into the larger by the force of the impact. Such a collision might have taken place in their flight through space or it might have occurred in the original cosmic catastrophe, perhaps the breaking up of a planet in the distant past, which may be responsible for all meteorites.

Rubber "Lung"

WHEN infantile paralysis has paralyzed the muscles of a patient's chest and abdomen, he must lie enclosed in that cumbersome chamber which has come to be known as an "iron lung." Because his chest muscles are useless, the rhythmic application of a partial vacuum to the outside of his body is necessary to expand and contract his lungs at regular intervals. This the "iron lung" does, for the whole body is enclosed while the head is outside. A patient might lie in this contrivance for months stretched out and inert, lacking massage and necessary treatment of body tissues except that which can be administered by several nurses working at great disadvantage through small holes in the walls of the "lung."

Dennis R. Scanlan, respirator expert and member of a famous surgical instrument firm in Stockholm, Sweden, had been studying this problem for months since young Fred Snite, Jr., was returned from China in an "iron lung" some months ago. Mr. Scanlon had definite ideas regarding a new type of artificial lung and accordingly he took his problem up with officials of the General Tire Company. With the assistance of research engineer Herman Kraft and others, there was evolved an apparatus which has been called a "rubber lung." It is much smaller and lighter than former metal "lungs" and, instead of enclosing the entire body of the patient in the respirator, it encloses only the patient's thorax and abdomen, leaving all four limbs and the perineal region free for nursing care. It has been called the Stille-Scanlan respirator.



Smaller, lighter artificial lung

The Stille-Scanlan respirator consists of a cuirass of aluminum, which is made to fit closely to the upper part of the patient's body by rubber fittings which taper in hardness from hard rubber down to the softest of sponge rubber which lies directly against the patient's body and which seals the partial vacuum which lifts and lowers the helpless chest of the patient. Only the thorax and abdomen are covered by the cuirass, enabling the patient to rest comfortably and to require no more care than any other severely ill person.

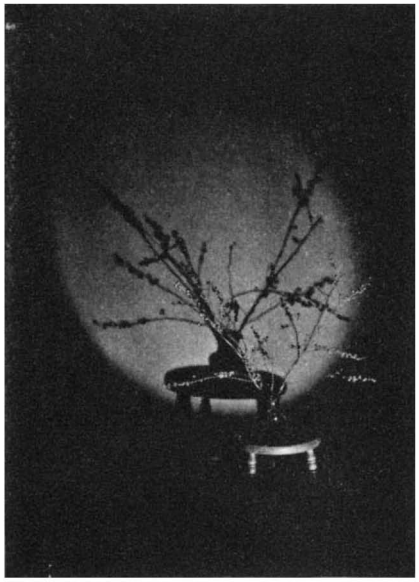
CAMERA ANGLES

Conducted by JACOB DESCHIN

Your Camera Lens

THERE are still a great many camera users who take their camera lens for granted, but the number is growing smaller all the time as the fact is realized that, after all, it is "the glass eye" that makes it possible for "the little black box" to function. This month we will devote a little space to some elementary lens facts, so you fellows who learned it all a long while back may consider yourself duly warned if you prefer to "skip it."

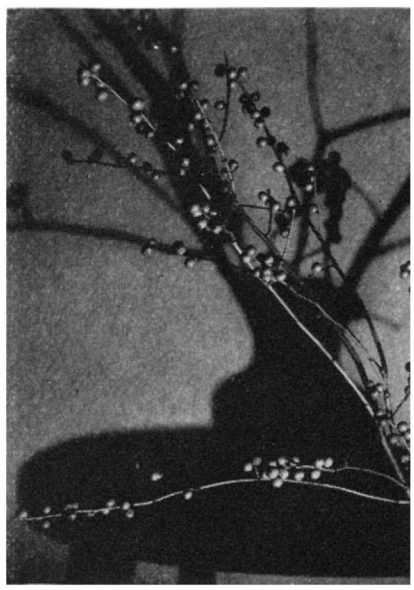
Have you ever examined all the letters, words, and numbers that appear on the front of the lens mount? It is packed full of essential information. The particular lens we are examining at the moment, and this is typical of all lenses, shows the name of the manufacturer of the lens and the location of the factory. This is your guarantee of quality. Following it is a seven-figure number, the so-called "serial number" and the lens' sole identification. This number is highly important. First established at the lens factory, it is recorded every time it changes hands. It furnishes the clue to the age of the lens and its entire manufacturing and commercial history. If the lens is lost or stolen, the serial number is the means by which it is traced. The owner of a camera will do well to make a note of the serial number of both the camera and the lens and keep these numbers among his valuable records "just in case."



9-cm lens—4½ feet

The next piece of information we read as we make the circular tour of the lens mount is the name of the lens. This, like the manufacturer's name, has also come to be a guarantee of quality and certain characteristics. Thus, one lens will be known for the sharp negatives it produces, another for its portrait quality; that is, a tendency to give a slight softness to the image. Next, we come upon a curious thing and one that bothers many novices. We read, "1 :3.5." What this actually means is that the diameter of the lens measures 1/3.5 of the focal length of the lens (which we will take up soon).

15-cm lens—4½ feet



27-cm lens—4½ feet

Just Turn the Page to See the

WINNERS

in the Second Scientific American

PHOTOGRAPHY CONTEST

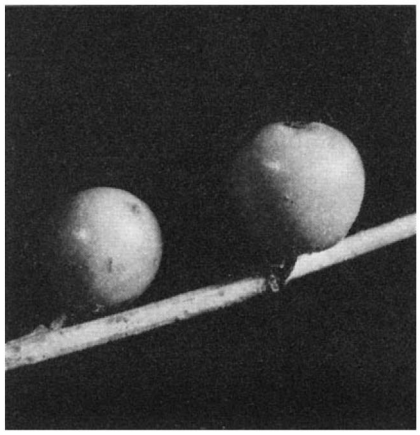
Thus, if the focal length is three inches, the diameter of the lens measures a little less than one inch. This is the lens "speed" you hear about. The greater the diameter of a lens of a specific focal length, the "faster" it is said to be, which means that the larger the glass the more light is permitted to enter the camera at the full opening of the lens. This may, perhaps, explain the "Big Berthas" you see on some miniature cameras. They look very imposing and some prefer them for this reason, even though they are quite expensive, but many fellows who buy a camera equipped with an F:2 lens, for example, may never use a lens opening wider than F:2.8. Yet they will pay 100 dollars more for the faster lens just because of a vague notion that they may some day, some time, find a use for it. Actually, we suspect that in many cases it is a matter of sheer camera vanity. And think of the added weight!

Incidentally, the relative speed of one lens as against another may easily be determined by squaring the diameter of each of the lenses being compared and dividing one by the other. Thus, 2.8 multiplied by itself comes to 7.84, and the square of 2 being 4, the F:2 lens has practically twice the speed of the F:2.8.

One more piece of information the lens mount affords is the focal length of the lens. This reads "*f*=7.5cm." The cm stands for centimeters, the figure being equal to 3 inches. The symbol *f* stands for focal length. It is generally agreed that the proper focal length of a lens is the diagonal of the negative size it is used to cover. Thus, a 3-inch lens is generally employed in cameras delivering 1⅝ by 2¼ or 2¼ by 2¼ negatives; a 4-inch lens is used for the 2¼ by 3¼ camera and a 2-inch lens for the 35mm camera.

In addition, where the lens mount of the camera will permit interchangeability of lenses, one may use as extra lenses, objectives (the highfalutin term for lens) having a shorter or longer focal length than that of the normal lens used for average subjects. The shorter lens is called the "wide angle" lens because, from the same distance, it covers a greater area than the normal lens, and the longer lens is called the "telephoto" because, still from the same distance, it cuts down the angle of view and therefore covers less area, producing a larger image on the negative.

The illustrations show a comparative study of the effect of using the three different types of lenses while photographing bayberries all from the same distance, namely, 4½ feet. A fourth illustration is included to show the close-up effect that may be obtained by using the wide angle lens and a very long camera extension. In order to get this particular close-up, the lens was placed 4½ inches from the subject. The reader will



Wide-angle lens—4½ inches

undoubtedly notice the admirable selective effect resulting from the employment of a telephoto lens.

In some future issue we hope to have more advanced dope on the subject of lenses.

The Contest is Over

FROM stack after stack of photographs varying in size from 3¼ by 4¼ up to 16 by 20, the judges of the Second Scientific American Photography Contest finally, by a process of elimination, selected the prize-winning prints and those that were awarded honorable mention. Over 1000 entries were received for the contest, coming from all over the world; judging was no easy job, in view of the fact that so many of the photographs were of excellent quality. We feel, however, that the judges deserve unstinted praise for the results of their labor, and that those who did not win prizes can console themselves by the fact that they were up against possibly the stiffest competition that could be found in any contest for amateur photographers.

The Board of Judges consisted of Robert Yarnell Richie and Ivan Dmitri, well-known commercial photographic artists, and Karl A. Barlaben, F.R.P.S., Dean of the New York Institute of Photography and noted writer on photographic subjects.

The prize-winning photographs are reproduced and described on the following pages. Those photographers who were accorded honorable mention are as follows:

L. A. Geddes, New York City
C. Haeberle, Elmhurst, Long Island, New York
Stephen Harris, Dover, Massachusetts
Clarence B. Lober, Fort Lewis, Washington
Harrison N. Mucher, Reading, Pennsylvania
Dan Napoli, New York City
G. L. Osmanson, Morris, Illinois
Arthur J. Sainal, Haddonfield, New Jersey
William H. Siebrecht, III, Great Neck, Long Island, New York
L. A. Styles, San Francisco, California
Peter Jean Vest, New York City

Inasmuch as there was such a large number of other excellent photographs sub-

(*Please turn to page* 116)

FIRST PRIZE

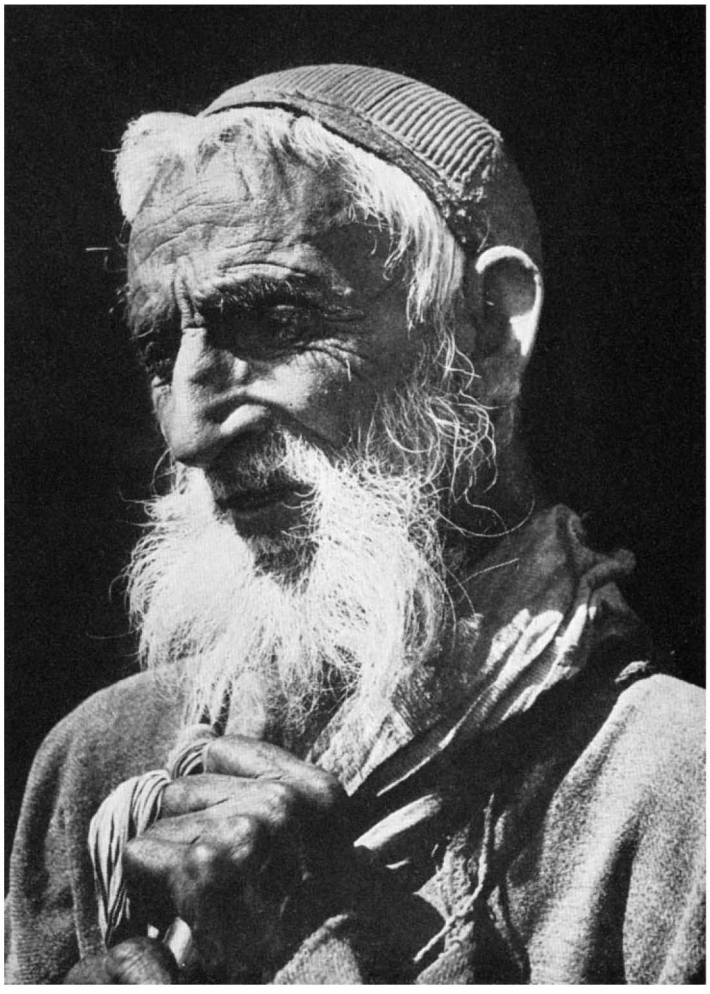
By
FRANK FISHER, Jr.

First prize of 75 dollars in the Second Scientific American Photography Contest was awarded for this print submitted by Frank Fisher, Jr., 11431 Colfax Street, Hollis, L. I., N. Y. It was taken with a Contax camera on Eastman Super-X film

SECOND PRIZE

By CARLYLE F. TREVELYAN

Second prize of 50 dollars went to Carlyle F. Trevelyan, 161-19 59th Avenue, Flushing, L. I., N. Y., for the print reproduced above. Taken on Agfa SS Pan film with a Voigtlander Avus camera



THIRD PRIZE

By Z. D. BARNI

This interesting portrait study received third prize of 25 dollars. It was taken by Z. D. Barni, Ghulam Hasan Street, Lahore, India, on Panatomic film with a vest-pocket Kodak

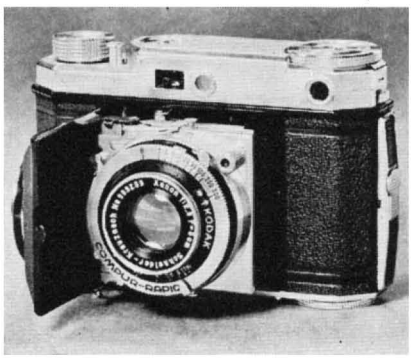
(*Continued from page* 113)

mitted, it is not possible to list here those whose prints survived through a large part of the judging. We can only express our sincere thanks to all those amateur photographers who made our competition such a success. We hope that every one of them will be represented in our next contest, for which plans are now being made and which will be announced in a future issue. Watch for the rules. They are being drawn so that there will be a larger number of prizes, there will be various divisions in which prints may be entered, and there will be more chance of winning.

Kodak Retina II

A NEW 35-mm miniature camera, the Kodak Retina II, similar in size and styling to the original F:3.5 Kodak Retina I, incorporates a number of technical advances, particularly in lens speed, flexibility of operation and "error-proofing." It offers a choice of high-speed anastigmat lenses, either F:2 or F:2.8; is equipped with coupled range-finder focusing, Compur shutter speeds from 1 full second to 1/500, body shutter release, and double-exposure-prevention device. Lens and shutter are mounted on a focusing helix, moved by means of a large milled knob.

Shutter plunger and film-winding knob are coupled so that once the shutter is tripped, the film must be wound before the shutter



New—35-mm film—range finder

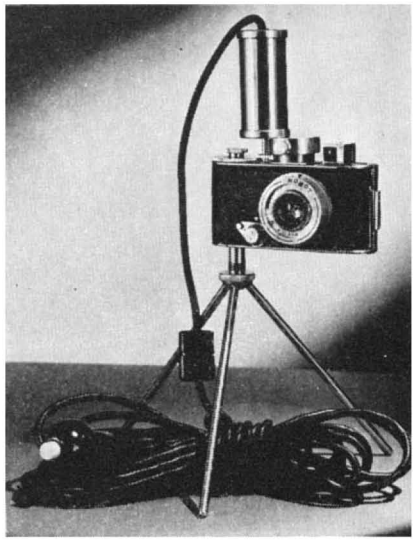
release will operate again. This gives positive protection against double exposures. The film winding knob is halted automatically by a dead-stop device when the proper amount of film for another exposure has been wound into place.

The range finder is of the double-image or coincidence type. As the lens-focusing knob is moved, two images are seen in the range-finder field and when these two images coincide perfectly, the object imaged is automatically in sharp focus.

Remote Control Release

SEQUENCE shooting by remote control, a method particularly suitable for naturalists and others desiring to take candid pictures while remaining unobserved at some distance from the camera, is now made possible with the Robot Remote Control Release. Designed as an accessory for the Robot camera, this helpful device should open the way to new camera adventuring in several fields.

"This new and simple accessory," the distributors, the Intercontinental Marketing



Remote release for Robot

Corporation, announce, "contains a plunger actuated by an electric magnet which activates the release. The operation is controlled by economical flash-light batteries and a push button which are connected to the camera by a wire of any required length. Due to the automatic film transport and automatic shutter release, a feature of the Robot, up to 24 pictures may be remotely shot."

CURRENT BULLETIN BRIEFS

IT is probably an idle question, but have you ever investigated the columns of the Current Bulletin Briefs section in the back part of every issue of Scientific American? Brief reviews are contained there on pamphlets and booklets relating to various subjects, including items of particular interest to amateur photographers. Make it a practice to look at this section every month; you'll find it a good habit.

KENT STATE PHOTOGRAPHY CONTEST

A COMPETITION in news and pictorial photography is announced by Kent State University of Kent, Ohio, in connection with a Short Course in News Photography to be held at the University March 3, 4 and 5, under the direction of the Department of Journalism. The closing date for the submission of prints to either the news or the pictorial competition is February 5. Prints are preferred in 11 by 14 or 8 by 10 and not smaller than 5 by 7 inches, preferably mounted on 16 by 20 mounts. It is requested that the name of the photographer does not appear on the front of the print; the name and address of the owner, however, should appear on the back of each print, which should also be accompanied by exposure data, including kind of camera, aperture, shutter speed, lights, time and brightness of day, and so on.

The rules of the News Photography Competition are as follows: Eligibility: open to news photographers, workers on newspapers, students and instructors in schools and departments of journalism, correspondents for newspapers; entry fee: 50 cents for the first print entered, 25 cents for each

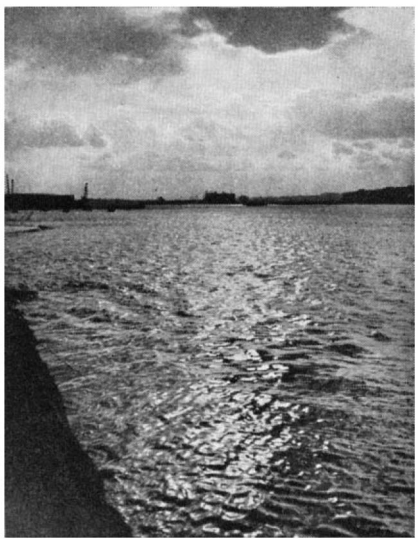
additional print titles or cutlines: each print must be accompanied by a brief statement of the news situation covered; awards: ten dollars first prize, five dollars second, and five honorable mention awards; judging: by standards that usually determine whether or not a print is a good news picture.

The rules of the Pictorial Photography Competition are: Eligibility: without restriction and as many prints may be submitted as desired; each print must have a title; awards: a purchase prize of 25 dollars (first prize), and 10 dollars second prize, plus five honorable mention awards; entry fee: one dollar, for the first print entered, 50 cents for each additional print; judging: by the usual standards governing the awarding of honors to pictorial photographs—composition, subject matter, approach, photographic excellence, and similar points. Judges of the Pictorial Photography Competition will be Frank R. Fraprie, F.R.P.S., and the staff of *American Photography Magazine*.

Entry blanks may be obtained by writing to Professor A. Clarence Smith, Kent State University, Kent, Ohio.

Sunlight on the Water

SOME folks may think differently, but here is the way we like to photograph sunlight on the water—not the sunlight direct, but sun diffused by a thin cloud curtain. The highlights which here possess a beautifully smooth, soft quality, would be



"Sun and Clouds"

glaring and paper-white under the direct sun. Here the sunlight is spread over a wide area, instead of being limited to a narrow path. The composition is arranged to give prominence to the water, which here is obviously the most striking element of the picture, and the tones and masses of the cloud formations are suitably arranged in the general composition.

Beginners' Dark-Room Outfit

ALL that it takes for a beginner in photography to develop his film and make prints from the resulting negatives is contained in a "rookie" dark-room outfit just announced by Eastman Kodak Company. The complete kit, which is extremely inexpensive and serves for negatives up to and including 3¼ by 5½ inches, contains the following items: Brownie dark-room lamp, model A; a four-ounce graduate; three 4- by 6-inch developing trays; one ½-pound package of Acid Fixing Powder; three tubes of Universal Developer; two dozen sheets

To start you off

of Velvet Velox paper, Contrast No. 3 grade, size 3¼ by 5½; two film clips; a glass stirring rod; printing frame and glass; and an instruction booklet giving complete information for developing and printing negatives. In short, the ABC Darkroom Outfit, as it is called, contains all that it takes to make the first step a success. If the beginner means business, the ABC outfit will whet his appetite for something better and if it does only that it will have completely served its purpose.

The Minicam Market

A STATEMENT of editorial needs has been isued by *Minicam*, the new magazine devoted to miniature camera photography. The magazine's editors invite all comers who have anything to say photography-wise and can illustrate their points with pictures. And "don't worry about literary style," they add, "as the final wording will be worked out at our editorial offices."

The editors invite prospective contributors to submit a brief outline or synopsis before actually writing the article; say they prefer 8 by 10 glossy prints but can use prints that are larger or smaller and ask that "each photograph be accompanied with a detailed description of how it was composed, lighted, posed, exposed, and so on." They suggest that the description include the circumstances and problems involved in the taking and printing processes. The magazine's address is: *Minicam*, 22 East 12th Street, Cincinnati, Ohio.

Pay as You Shoot

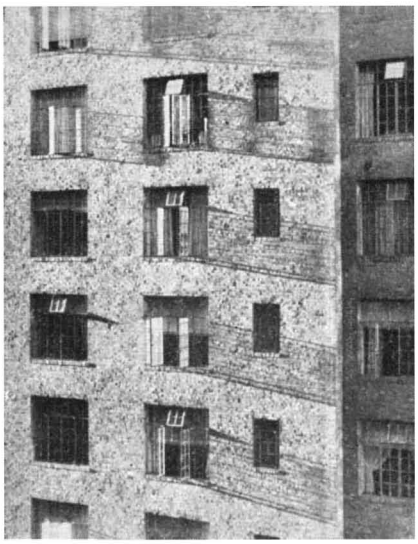
THE time-payment plan idea as applied to the purchase of cameras seems to be making some headway in the United States, following the recent leadership in this connection by E. Leitz, Inc., who with their "Pay for it as you use it" idea have started something that already has brought others into the field. We know that in England the plan has been in vogue for a long time and the fact that the plan seems to be going over in that country has evidently inspired the introduction of the idea here.

It seems no more than fair, when good cameras come as high as they do, that a prospective buyer should be given the same opportunity for paying while using that he has when purchasing a typewriter, a radio, an automobile, or other expensive item. The

idea will prosper, we believe, but there is a danger that the low initial payment may induce many to purchase who have only a vague idea of where they are going to get the balance of the payments as they come due. However, common sense will, in the main, guide enthusiasm and desire. The time-payment plan has many good points to commend it, one of which is that it gives the fellow with little money in his jeans but lots of ideas about how to make some, if he can only get hold of a camera, a chance to get out of the red by making pictures that sell and that, eventually, will more than pay for the camera and the expenses involved in using it.

Rhythmic Patterns

OF course, it was quite accidental that some windows were open and others, fortunately those at the left, were closed when we looked out of our window one Sunday morning. Probably there's nothing specially startling about the picture but it appealed to our camera sense because of the regularity of the shadow patterns, the "feel" of the sunlight on the brick wall, the



"Across the Way"

atmosphere of domesticity in the scene as a whole. Rhythmic shadow patterns are always a delightful subject for the camera and there are few subjects, humdrum though they be, which are not made picture-worthy through the employment of this pleasant device. Patterns of this sort may be created in one's home by artificial light, but perhaps it is more pleasant to meet a "ready-made" subject while strolling in the streets. However achieved, it is an enjoyable photographic exercise.

Film Chest Negative File

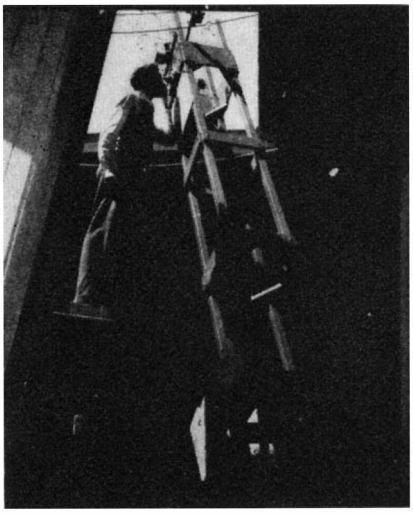
A NEGATIVE file having a capacity of 3600 35-mm. negatives or a corresponding number of other size negatives up to 2½ by 4¼ inches has been placed on the market by the Central Camera Company. The file is a metal box measuring 10½ by 6½ by 4⅛ inches and contains 100 envelopes, each holding a folded transparent sheet accommodating six strips of negatives. A humidifier pad and a bottle of humidifying solution come with the file.

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

THERE is only one star whose actual image we can see, the sun. What we see of the others is only diffraction patterns —none of the surface detail. This follows from physical optics. Because the actual appearance of the stars is forever hidden from us we have much curiosity concerning them, but what we learn about their behavior must be had by indirect methods



Tombaugh and his sun telescope

such as the one Professor Russell explains on another page. Anyone, however, can look at the sun; it is the biggest thing in the sky. That may possibly explain in part why so few of us do look at it. Below we describe Clyde Tombaugh's sun telescope, with its unusual details for sun study.

Most amateurs know the rather romantic story of Clyde Tombaugh, the Kansas farmer's son who, from one of the earliest editions of ATM, made a telescope, then went to Flagstaff, Arizona, and applied for a place at the Lowell Observatory. Something about his enthusiasm must have impressed the Director, for Tombaugh was given a job examining plates in the search for the undiscovered planet which Lowell had predicted years previously, and it wasn't more than a few weeks before he discovered the image of what turned out to be the planet Pluto. Tombaugh thereafter spent part of his time at Lowell and the remainder in college, and is now at Lowell hunting for more planets. While he is now a professional astronomer, the professionals can't entirely have him! At least, we amateurs will keep one hand on his coat-tail. (Incidentally, three former amateur telescope makers are now working as professional opticians: Daniel E. McGuire, ATM, page 380, slit test, who has been with Fecker some months, Lew Lojas, patron saint of the New York telescope makers, who has been with Mogey for some time, and Kieffer of Pittsburgh, now employed in the finishing room of Bausch and Lomb, making flats and prisms.) Here is a part of a letter from Tombaugh.

"The views I have had through my solar telescope the past few months have been marvelous. Since we are in the midst of an extra rich sunspot maximum, a brief description of my instrument may interest some of the amateur telescope makers.

"I made a 12-inch mirror having a focal length of 148½", and left it uncoated for use as a solar telescope. A 1⅛" right-angled prism was used for a diagonal, but was mounted in a reverse position—that is, the diagonal face was slanted toward the concave mirror and eyepiece. This allows some 93 percent of the light reaching the diagonal to be transmitted out through the other faces in directions away from the eyepiece. Thus, from the two glass reflections, the light from the sun is reduced to about 1/300 of that falling on the concave mirror. I carefully selected a good pair of neutral-tint drivers' glasses, the darkest I could obtain, from a dime store. The lenses were removed and mounted just in front of the eyepiece (toward the diagonal). Each one probably transmits about 20 percent of the light—perhaps less, as they are quite dark. Therefore, the two together transmit only 1/25th of the incident light. Hence, altogether, the solar light is cut down about 7500 times. Anyway, with the mirror diaphragmed down to 6", and using a magnifying power of 200 diameters, the solar image, or surface of the sun, appears only about one third as bright as a bright cumulus cloud to the naked eye.

"From experience with daytime seeing, I have found that apertures larger than 6" are not practical. Also the steadiest seeing occurs between 8 and 9:30 A.M. I observe the sun about one day in two or three, on the average—picking the better days. On about half of the days the seeing is too unsteady to see the 'rice-grain' structure of the sun's surface. About one morning out of 15 or 20 the definition is really fine—6 on a scale of 0—10. At those times the structure of sun-spots, faculae, and rice-grain background is seen to be intricately delicate and marvelous to behold. On several occasions I have seen white, narrow bridges, filaments and tongues which were less than one second of arc in width, in the umbra of some of the big spots—resembling in appearance the famous drawing of a sunspot by Prof. Langley.

"The long focal length and the 6" diaphragm make my solar telescope an *f*/25. The long focal ratio and small angle permitted me to place the prism diagonal off the axis just enough to clear the 6" beam of light, and next to the eyepiece. I habitually use a power of 200 diameters, and when the seeing is good the details of sunspot structure are very sharp and well defined.

"The heating of the mirror when exposed to the sun evidently does not affect the figure seriously, as I have obtained very fine definition during a period of 20 minutes' continuous exposure to the sun. Possibly the 3" outside zone of the mirror which is shielded by the diaphragm serves to hold the figure from distortion. The 12" mirror was made from polished plate glass, and is only 1⅛" thick. I suppose an 8" mirror, uncoated, diaphragmed down to 5", and having a focal length of 75" or 100", would be a practical combination. Unless the cone of reflected light is very slender, I would not then advise setting the diagonal prism off the principal axis.

"I hope that some of the amateur telescope makers will be interested enough to make a solar telescope, as the optical set-up is simply a Newtonian with the mirror unsilvered, a right-angled prism placed in a reverse position, and some dark glasses in front of the eyepiece. However, an unsilvered flat for diagonal will not do, as it would give an offset, overlapping image from the back surface.

"The photograph was taken from outside of the dome—looking in through the door. I was standing on a 6' movable platform, and looking into the eyepiece of the chroluminized mirror at Venus that forenoon. The telescope tube is 13½' long. The dome is one that formerly housed a 9" telescope used in the search for Planet X some 20 years ago."

Another letter from Tombaugh, written later, reads:

"Recently I saw a large group of huge, irregular-shaped umbras with nearly a continuous background of penumbra, and these passed off the sun in about two days. Bright 'tongues' and 'bridges,' of coarse and very delicate proportions, were seen in great profusion. There was also a very large spot attended by a host of minute ones following the great group by about 8 minutes of arc. 200 X used."

Langley's rice-grain drawing

LAST month this department was stowed to the scuppers with hard-to-read brain stuff about the Special-purpose RFT, so we compensate this month by unloading a collection of levity that has been accumulating for the past year or two.

Some months ago we published a sketch by Russell W. Porter, showing the precautions that are being taken at Pasadena to

prevent those connected with the work on the 200″ mirror from bringing in grit on their shoes. Their shoes have to be discarded at the doors and special indoor footwear substituted, just as American tourists (if any go there now) have to do before entering Japanese sacred temples. At that time we said to Mr. Porter that, when the actual polishing on the 200″ disk was begun, we supposed there would be a microscopic examination of everything down to the grit in the workers' whiskers, and suggested a cartoon depicting the grand clean-up to come. It takes only a suggestion to start Porter making a drawing, and the result is on page 122—the final search for about two lost, lonely, little sub-microscopic particles of potentially trouble-making grit.

NEXT item was drawn by Maxfield Parrish, Jr., 3140 Holmes Ave., Minneapolis, Minn., who regularly reads this column, even if he hasn't yet admitted making anything more telescopically tangible than awful caricatures of himself. Parrish probably inherited his ability with the pen from his famous father.

COMES next a cartoon, not of himself but of his older brother, a TN, drawn by Harvey L. Hinshaw, aged 11 years, 935 N. Oakland Ave., Pasadena, Calif.—a future Maxfield Parrish, it would seem, also one with a proper understanding of the typical Telescope Nut.

AND now for three poets. First poet, R. W. Porter who has evidently been reading roadside rhymes advertising Burma Shave:

Si am de man
Who t'inks he can
Make 'scopes from
Readin' ol' Sciam.

And another:

From { Waukesha, or / Saskatoon
To { Far Siam, or / Alabam'

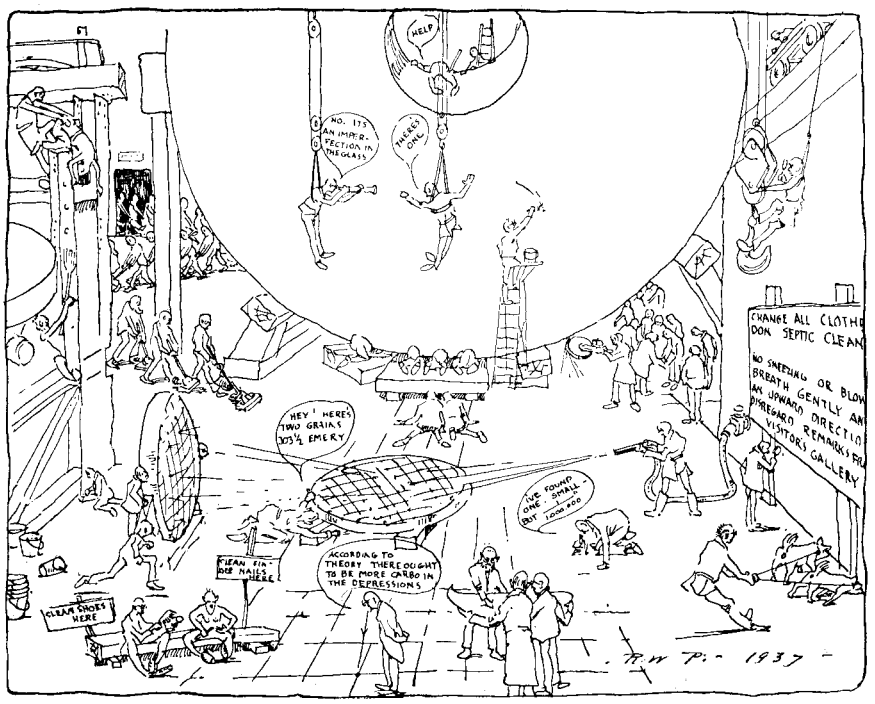
You'll find 'em / The Nuts are } readin'

Ol' Sciam

Here's one that comes nearer home:

She threw up her hands
And let out a "Damn!"
"You've ruined my kitchen.
A curse on Sciam."

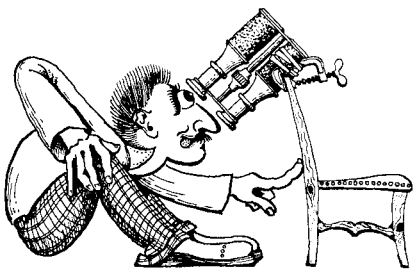
WAY down on the Gulf Coast, at Biloxi (pronounced Bluxy), Miss., lives the Fred ("Amos") Ferson who wrote the chapter on molding and casting telescope parts, ATMA, page 349. Ferson is a personable red-head who knows the common working negro of the Deep South and the twists of his language from way back. The following is his "Soliloquy of Cotton-Pickin' Sam." Perhaps the northern reader will find it more difficult to follow Ferson's rendition than the more familiar but less accurate sort used by us northern writers; the same is true of Joel Chandler Harris's Uncle Remus stories. The late S. H. Sheib of Richmond used to assert that most northern writers evidently obtain their idea of negro dialect from other northern writers, as it is not accurate. For example—and the same



Preview of the world's fussiest housecleaning job, as drawn by R. W. P.

example appears in the second line of Ferson's verses—the word "till." Writers often render this as "twell," but with the Deep South negro of the cotton-field type it is plain "to." Similarly, "they" is not "dey" but "dee."

Ah is sho worri'd de boss-man's los his mine.
He polishin glass to hit git slick en shine.
Den he say he gwine gib hit er figgah
Ez purty ez a gal—mebbe mo biggah.
En see de stahs, en see em double.
Hit sho ez meant er heap er trouble
To see dem stahs.



Self-portrait, by M. Parrish, Jr.

De cellah am red—an so am us.
Dat rouge am spead in bright red dus
To de omelet look ez red ez blood,
En mo lak dish-yer Alabama mud.
En de wash watah show de same red, too.
Boss, whyn't yo use somepin blue
To see dem stahs?

He talk er laps er rosin en terps.
Hit sticky ez one er dese yaller cur purps.
He talk er tools en read de book,
En stiddy and stare wid a vacant look.
Hit allus too hot, too wet, er too cold.
He keep dat up, he nevah git 'nuff old
To see dem stahs.

Mah fun doan costes no starin' ter see
De gals, er mah banjo on mah knee.
Hit jes raise up in de great big bubbles.
Ob cose de gals kin be de troubles,
(En de hoe er misery in dat long cotton).
But mah situashun ain't so rotten—
Why look at stahs?

Ah nevah thunk ah'd lib ter see
De boss-man stang wid sech a bee,
Er dat he'd stop cussin us niggahs
Fer laps en tools en crazy figgahs.
Ah sho hopes he be hissef soon
En red er de eetch fer planets en moon,
En ter see dem stahs.

THIRD poet, Leo Cotton, is also an artist. He is a member of the Turned-edge Brotherhood of the Los Angeles Astronomical Society, and is with the Art Department of the *Los Angeles-Examiner*. The sketches are his.

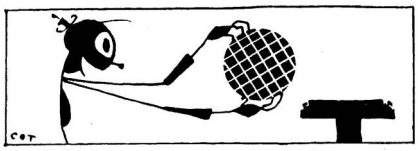
Pyrex, elbow-grease and smear;
A run-around—you have a sphere.

If center deepens, you must hedge—
Shorter strokes will work the edge.

Another way that edge to drop,
Is using tool a while on top.

When pencil marks and depth agree
You switch to number two, sez we.

In a younger brother's opinion



Number eighty's now a pest,
Clean up well and scrape your vest.

Go round and round, nor call it quits
Till scratches leave, and ditto pits.

One third stroke should be the rule.
Watch zonal contacts, juggle tool.

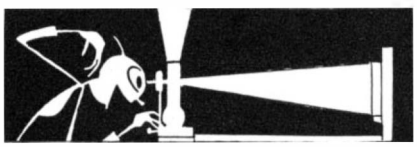
Half below and half on top,
Middle's up when edges drop.

Remember that a finer grade
Erases what a coarser made.

Round and round, an endless tread,
Work foot and arm, and so-called head.

After number seven, switch
To polishing by using pitch.

Pour it; facet; press and wax.
Time 'twill take and patience tax.



Then the treadmill, round and round,
Rouge will polish where 'twas ground.

Scan anon with 'Foco' test,
To spot out where your mirror's messed.

Strive to get that doughnut look,
Don't ask me how—go buy a book—

The 'bible' of the scopers—them
What's in the know calls ATM.

And when 'tis finished, friend and brother,
You'll soon be making you another.

And if it turns out not so good,
Join the Turned-edge Brotherhood.

AN embargo on doggerel, rhymes, verse—yea, even poems—is hereby declared for the year 1938, and longer unless there is evidence that the readers have fully recovered from the above fits of frivolity. Even now, your scribe fully expects his hide will be nailed to the barn door by some of the readers, not those of this department but of the magazine in general. Once an old "Sciam" reader did this because, *horror horribilis*, he saw, right in Scientific American, "a *cartoon!*" Hence, to non-telescope-making readers we explain: This amateur telescope-making hobby is scientific but it is also human; dive in and enjoy some of the sport yourselves.

CURRENT BULLETIN BRIEFS

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

BETTER PHOTOGRAPHY MADE EASY is a 62-page spiral bound book with heavy cardboard covers that gives many hints as to how the amateur photographer may improve the technical quality of his photographic product. Essentially elementary, it presents many phases of photography that will be of interest to every camera owner; it is replete with excellent photographs, many of them illustrating the right and wrong way to do a particular job. *Willoughbys, 110-114 West 32 Street, New York City.—10 cents.*

THE MONTHLY STAR FINDER is an eight-page pamphlet, issued every month, which presents a star map for the current month, information on eclipses, interesting short articles on various phases of popular astronomy, and so on. Of value to all amateur astronomers. *The Monthly Star Finder, Observation Roofs, 30 Rockefeller Plaza, New York, N. Y.—10 cents a copy, $1.00 a year.*

PRIMACORD BICKFORD DETONATING FUSE is the title of a 20-page pamphlet describing the construction and use of a new detonating fuse for modern blasting. The advantages of this new fuse—speed of the explosive wave, efficiency, economy, and ease of handling—are put forth in the illustrated text. *Write for Bulletin 238A, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THE FORMATION AND CHARACTERISTICS OF PENNSYLVANIA ANTHRACITE has been prepared to answer numerous questions which are frequently asked regarding the production, distribution, and utilization of anthracite. It is in the form of a 34-page pamphlet, well-illustrated, and will be of particular interest to those who use anthracite in home heating plants; it gives many hints for efficient operation that otherwise might never be found. *Anthracite Industries Laboratory, Primos, Pennsylvania.—15 cents.*

LIGHT-GAGE FLAT-ROLLED STEEL IN HOUSING, by F. T. Llewellyn, is a technical publication which describes the use of steel in building construction and shows by means of comprehensive drawings and photographs just how it is applied. *Write for Bulletin 238B, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

PART-TIME FARMING IN THE UNITED STATES is a statistical analysis of a problem which has a definite bearing on agriculture in general. It includes a large number of maps and data presented in tabular form. *Superintendent of Documents, Washington, D. C.—50 cents (coin or money-order).*

THE NEED FOR INCREASED RAILROAD REVENUES is an 18-page pamphlet that gives the essential facts regarding the railroad's place in the United States at the present time. Based upon the premise that prosperous railroads are essential to a prosperous nation, it presents data showing that while other prices have been increasing, railroad rates have been decreasing and that the margin between income and outgo is too thin for satisfactory operation. Statistics and facts are included. *Write for Bulletin 238C, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

DEVELOPING AND PRINTING MADE EASY is a comprehensive primer on the subject that will enable any amateur photographer, no matter how unskilled, to produce satisfactory negatives and prints if he will only follow the specific directions given. It is lavishly illustrated with beautiful examples of photography. Included are a list of defects in negatives and prints and how to remedy them, as well as a series of recommended formulas. *At your photographic dealer or from Agfa Ansco Corporation, Binghamton, New York.—25 cents.*

NICKEL ALLOY STEELS FOR HAND TOOLS deals with the various types of tools which can be improved by the use in manufacture of the correct type of alloy steels. Illustrated with photographs and with charts showing the mechanical properties of various nickel steels. *Write for Bulletin 238D, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

MACHINES AND WORKING HOURS is an argument against shorter working hours as a result of industrial mechanization. It shows how mechanization creates more jobs than it destroys, how increased production demands increased man-hours, and how the work week is being reduced out of all proportion to increased output per worker. The plea is essentially for a better balance between the workman and the machinery which he controls. *Machinery and Allied Products Institute, 221 North La Salle Street, Chicago, Illinois.—Gratis.*

MOLYBDENUM TODAY is a beautifully prepared booklet, 9¼ by 10½ inches, which presents in picture and text the story of molybdenum and its industrial applications. *Write for Bulletin 238E, Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

THE WARM SPRINGS OF GEORGIA, Their Geologic Relations and Origin, is a summary report, by D. F. Hewett and G. W. Crickmay, which includes several large folded maps and a separate color map of the Warm Springs Quadrangle. *Superintendent of Documents, Washington, D. C.—25 cents (coin or money order).*

THE ORIGIN AND DEVELOPMENT OF RADIOTELEPHONY, by Lloyd Espenschied, is Monograph B-1021 of the technical publications of the Bell Telephone System. It gives a highly interesting and informative background of radiotelephony, dips briefly into the future of the science, and includes an excellent bibliography. *Bell Telephone Laboratories, Inc., 463 West Street, New York City.—Limited Free Distribution.*

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

Still Fighting

THE far-reaching consequences of the World War and its effect upon our political and economical life have been discussed so frequently that everyone is familiar with the subject. Few people realize, however, that the World War is directly responsible for some of the litigation pending in our courts at the present time.

A rather interesting case growing out of the World War was recently decided by one of the Federal District Courts. The plaintiff brought suit to recover several patents and a patent application from a dye manufacturer on the grounds that the subject matter of the patents and patent application were seized during the World War by the Alien Property Custodian and assigned to the plaintiff.

The facts in the case are somewhat complicated. It appears that a German invented a new dye and applied for patents in Germany and France in 1914 and in the United States in 1915. The French patent was granted in 1916. However, probably due to the difficulties caused by the World War, the United States patent application was abandoned in 1917. Subsequently, in 1918 the patent attorney for the German inventor filed a new application in the United States, signing the inventor's name to the application without his authority.

Under the Trading with the Enemy Act, the Alien Property Custodian seized the patent application which was signed by the attorney, and the Alien Property Custodian in turn assigned the application to the plaintiff. Due to various difficulties, no patent was ever granted on this application.

In the year 1921, the so-called Nolan Act was passed by Congress which permitted the filing of patents on certain inventions which had been developed during the period of the World War or just prior thereto even though the inventions had been patented in foreign countries.

Under this statute, the German inventor filed a new application in the United States in 1922, and this application resulted in the two patents and in the patent application which formed the subject matter of the suit.

The plaintiff contended that since the patents and patent application owned by the defendant related to the same subject matter as the application which was seized by the Alien Property Custodian during the World War they really belonged to the plaintiff.

The Court rejected this contention, stating that the application which was seized by the Alien Property Custodian during the World War was a nullity and that he actually acquired nothing. In support of this conclusion, the Court pointed out that the application seized by the Alien Property Custodian was not signed by the inventor as required by our statutes but was signed by the attorney without authority. The Court also pointed out that at the time that the seized application was filed, a patent had issued in France on the same invention and this was a bar to the American application. Since the Alien Property Custodian had seized a patent application which was a nullity, the plaintiff had acquired no rights by assignment and, accordingly, the German inventor had a perfect right to file a new application under the Nolan Act and dispose of it as he saw fit.

Pep

SLANG was accorded judicial recognition in a case decided by the Circuit Court of Appeals for the Fourth Circuit.

It appears that the plaintiff in the case under consideration manufactured a soft drink under the trade mark Pepsi-Cola, and he brought suit against a competitor who was using the name Pep-Ola to designate his soft drink. The Court enjoined the defendant from using the name Pep-Ola because of its similarity to Pepsi-Cola. Thereafter the defendant designated its soft drink by the name Pep, and the plaintiff sought to restrain this on the grounds that it was confusingly similar to its name Pepsi-Cola. The Court rejected this contention, however, and permitted the defendant to continue using the name Pep on the grounds that the name was a slang expression which had acquired a well-known meaning and was descriptive of the defendant's product. Because of this, the Court concluded that the defendant had a perfect right to use the word Pep to designate its product.

In reaching this conclusion, the Court stated: "'Pep' is a slang word that has come to have a well-known and generally accepted meaning in our language. Presumably derived from the word 'pepper,' it is in use generally as denoting vim, vigor, energy, or anything that will impart those or similar qualities when a food or drink is used. It is defined in Webster's Dictionary as 'effective energy or power.'"

All the Same

A MAP is the same as a book from the standpoint of copyright registration. This is the substance of a recent ruling by the Federal Court for the Southern District of New York. In that case the plaintiff was the owner of a copyright on a guide pamphlet containing a map of New York City and also certain guide material and directions. The defendant published a guide booklet consisting of an aerial photograph of New York City and guide material and directions which were similar to the material and directions in the plaintiff's booklet. In registering its copyright plaintiff had classified its booklet as a map. Defendant contended that the copyright only protected the map and that accordingly defendant was not guilty of copyright infringement, because his photograph was not a copy of plaintiff's map and the printed guide material and directions were outside the scope of the copyright. The Court agreed that defendant's photograph of New York was not a copy of plaintiff's map, but rejected the contention that the copyright did not protect the guide material and directions. The copyright afforded full protection to everything contained in the guide booklet, the Court held, and should not be defeated by the technicality that in registering the copyright it was classified as a map. In this connection the Court stated:

"It will not do to be over strict as to the technicalities of the Copyright Act. The Act itself, in Section 5, as amended, provides that error in classification shall not impair copyright protection. If the statute is substantially and in good faith complied with by a person seeking copyright protection and if others have not been misled into thinking that the work is not copyrighted, it is enough."

Helpful Controversy

INVENTORS usually feel injured when innumerable references are cited against their patent applications, and the injury turns to insult when the applications are placed in interference. However, if it is able to weather the storm, a patent resulting from an application having a tortuous and difficult history in the Patent Office is frequently accorded much more respect by the courts.

In a recent suit for patent infringement decided by the Circuit Court of Appeals for the Sixth Circuit, one of the patents in suit related to an automobile piston. While the application for patent was pending in the Patent Office, most of the pertinent art was cited and considered by the Patent Office. The application was involved in interference and the patentability of the invention was questioned during the course of the interference proceedings. The Court held that where the invention was so thoroughly considered by the Patent Office tribunals the presumption of validity which normally attaches to a patent was strengthened. Partially on this basis the patent was adjudged to be valid. In reaching its conclusion the Court stated:

"Where, as in this case, substantially all pertinent prior art has been cited against the patent, where, in hard fought interferences, novelty and invention have been challenged, and where priority of conception has been finally adjudicated only upon repeated review in both administrative and judicial forums, the patent should not be stricken down except upon very clear and convincing proof of invalidity."

The reason underlying this attitude is that the considered opinion of the patent-office tribunals, formed of experts in their fields, should not be lightly disregarded.

Books SELECTED BY THE EDITORS

THE DIARY OF A SURGEON

By John Knyveton

AN odd book. Based on the discovery of an 18th Century diary of a doctor in England, which gives a ghastly, gory picture of the horrors of being ill in those days of filthy hospitals and ignorant medical treatment, it sets the reader straight down in the smelly atmosphere of those lovely (?) times. For example, the young medical student writes in his diary on December 13: "Dissected the trunk this morning and was greatly edified to find the Guts full of Worms." His accounts of public hangings are really choice, as are those of the medicos' creepy midnight body-snatching for dissection: January 5: "Was up all last night Corpse Taking. We found the hanged wench and dragged her out and put into the sack, which Mr. Pope and I did then carry between us all mired and sweaty." And so on through 322 lugubrious pages. Grand reading, but not for the squeamish—$2.65 postpaid. —*A. G. I.*

MANUFACTURE OF WHISKEY, BRANDY, AND CORDIALS

By Irving Hirsch, LL.B., LL.M., Chemical Engineer, Technical Consultant

FOR the distiller, either expert or apprentice, this volume will prove a mine of information. It covers the manufacture of whiskey, brandy, and cordials completely from the preparation and combination of ingredients to the final blending and bottling. Some of the chapter headings, which indicate its scope, are as follows: Whiskey; Treatment of the Grain; Distillation; Equipment and Appliances; Manufacture of Brandy, Applejack, Pear Brandy, and others including miscellaneous liquors; Blending; Maturing of Spirits; Artificial Maturing; Clarifying; Coloring; and so on. A chapter is devoted to government regulations and a long section is devoted to useful tables. Printed by the photo-offset process, the text appears only on right-hand pages, the back of each sheet being left blank. This provides for a page of memoranda opposite each text page.—$10.20 postpaid.—*F. D. M.*

THE NEW MODEL AIRPLANES

By Elmer L. Allen

HERE indeed is a practical manual on the construction of model airplanes. The text tells how to build and fly gliders, exhibition models, scale flying models, and about miniature motors for model aircraft. Complete designs are given for various models including a gas-powered monoplane. A separate chapter is devoted to propeller carving. With no other instructions than those contained in the book a model builder could easily construct any one of the miniature planes described.—$3.15 postpaid.—*A. P. P.*

EXPERIMENTAL SET FOR TESTING EXTRA-SENSORY PERCEPTION

NOW that Prof. J. B. Rhine's Duke University card-matching experiments, apparently proving the validity of telepathy and clairvoyance, have been verified by a number of psychologists at other universities—though not by all—and his book "New Frontiers of the Mind" which explains these tests has become a best-seller, people all over the nation are trying the tests themselves. This is simple to do. This test set contains (1) Stuart and Pratt's 96-page "Handbook for Testing Extra-Sensory Perception" containing direct instructions for making the tests, with a foreword by Prof. Rhine; (2) a record pad for accurate scoring; and (3) two packs of the same ESP cards that are used at Duke. These tests are disproving the old belief that extra-sensory perception is confined to professional psychics; in some of Rhine's experiments plain ordinary people have out-psychicked the pros.—$1.90 postpaid.—*A. G. I.*

ATOMIC ARTILLERY

By John Kellock Robertson, Prof. Physics, Queen's University, Canada

A MEDIUM size book which tells in plain language the story of electrons, protons, positrons, photons, neutrons, and cosmic rays; as well as the methods used in the transmutation of the elements and manufacture of artificial radioactivity.—$2.40 postpaid.—*A. G. I.*

WILDCAT

By William Heyliger

FICTION founded on fact is the keynote of the present book. Essentially the story deals with two young oil-field workers who "poor-boy" an oil well—successfully, of course, as in all fiction. The story is easy reading, gives an authentic background of modern seismological prospecting and of oil-well drilling methods, and will in this reviewer's opinion hold the reader fascinated until he reaches the last line.—$2.15 postpaid. —*A. P. P.*

SOUND

By Arthur Taber Jones, Prof. Physics, Smith College

AN all-around textbook on sound, suitable for readers who have covered elementary physics. The chapters deal with the production of various noises, vibratory motion, simple tones and combinations of tones, musical scales, transmission of sound, free vibration, forced vibration and maintained vibration, hearing, musical instruments, speech and song, and the commoner technical applications of sound. Anyone desiring to work up a thorough grounding in the science of sound will find it here in compact form.—$3.95 postpaid.—*A. G. I.*

EXPLORING THE HEAVENS

By Clyde Fisher, Ph.D., LL.D.

THE Head of the Hayden Planetarium in New York and Curator of Astronomy at the American Museum of Natural History has set down in this book the substance of most of the public talks on astronomy given at the planetarium, but not in lecture form. It deals with the earth, sun, moon, seasons, comets, meteors, origin of the solar system, stars, nebulae, aurora and the constellations at some length—a fair cross-section of popular astronomy. Very popular, of course —a book for your mother, sister, or son, and for you if you have never read any book on astronomy.—$2.65 postpaid.—*A. G. I.*

SCIENCE AND MUSIC

By Sir James Jeans

TEXTBOOKS of physics usually include short sections on the science of musical sounds—short but not too sweet. What Jeans has now done is to expand such accounts into a 259-page, non-mathematical, illustrated book, at the same time sweetening it by detailed, explicit explanations which anyone of high school mental age can follow. Such a book has long been needed. He starts at the very beginning and the attentive reader will feel at the end like a Bachelor of Harmonics, a Master of Sound Analysis, a Doctor of Piano and Organ Tone,

and a Professor of Musical Scales, and be able to out-talk most of his musical friends on the underlying *reasons* for many things musical.—$2.90 postpaid. —*A. G. I.*

COLLISIONS IN STREET AND HIGHWAY TRANSPORTATION

By Barry Mulligan

WHAT is to be done about safety on the highway? The problem is one that revolves largely around collisions; a study of collisions and their causes makes possible pertinent suggestions as to remedies. This is just what the present author has done, and he has presented his findings in textbook form which is nevertheless entirely readable and interesting for the layman. In addition, the carefully worked out and segregated sections can render invaluable aid to public officials, highway engineers, and everyone directly or indirectly concerned with highway transportation.—$3.15 postpaid.—*A. P. P.*

COMMON NEUROSES OF CHILDREN AND ADULTS

By O. Spurgeon English, M.D., and Gerald H. J. Pearson, M.D.

A CLINICAL professor of psychiatry and an assistant professor of pediatrics at the Temple University Medical School are the authors of this detailed practical treatise which should assist perplexed parents in understanding emotional peculiarities in their children and in adults—such things in children as nightmares, phobias, nail biting, speech disorders, refusal to eat, bed wetting, involuntary movements, "scrappiness," stealing, perversions, and in adults the typical neurotic traits. It is written understandably and clearly.—$3.65 postpaid.—*A. G. I.*

TRICKS, TOYS, AND TIM

By Kreigh Collins

FROM a model of a flat-bottom sailboat to a realistic working "six gun," from a model water-powered elevator to magicians' tricks, this book runs a gamut of fun for anyone who likes to use his hands. If you have a youngster from 6 to 16 years of age, you might purchase the book for him. If you do, there is very little doubt but that you yourself will do most of the reading and a lot of the construction.—$2.15 postpaid.—*A. P. P.*

A BEGINNER'S STAR BOOK

By Kelvin McKready

AN old standby newly and thoroughly revised. Objects to be seen, learning to observe, instruments, star maps—this is the general scope of the book, which is excellently suited to the needs of the amateur either with opera glasses or with two-inch or three-inch (or somewhat larger) telescopes, and the objects to be seen are arranged in these categories for each month. It contains a catalog of telescopic objects with description of each, also compact data on general astronomy though it is not a textbook. The charts facilitate systematic survey of the show-features of the heavens and learning the constellations. —$3.70 postpaid.—*A. G. I.*

MAKING PICTURES WITH THE MINIATURE CAMERA

By Jacob Deschin

NEW in conception, new in its treatment of various phases of photography, new in its physical makeup, comprehensive in every sense of the word, is this latest addition to the rapidly growing literature of amateur photography. The editors may be permitted a certain amount of pardonable pride when pointing out that the author is conductor of the highly successful and widely read column "Camera Angles," which appears every month in Scientific American. We are as proud of Mr. Deschin's new book as we are of his work in bringing "Camera Angles" to its present popularity.

Mr. Deschin's latest book is compacted to the last degree—all bones and red meat, no excess fat. It takes the reader by the hand and tells him specifically how to do certain things with his camera. It takes nothing for granted, giving complete directions, accompanied by comprehensive illustrations. The introduction tells something of the general art of photography, whereupon the text plunges directly into how to make portraits, animal pictures, street scenes, and all other things photographic. The author then deals with the work in the darkroom—developing, printing, enlarging, in all their phases. The all-inclusive text is topped off with a gallery of 45 full-page prints, many of which illustrate some specific point that has been dealt with in the forward part of the book. 6¼ by 9¼ inches.—$3.15 postpaid.—*A. P. P.*

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By G. Van den Bergh

A RATHER elementary exposition mainly of the more elementary parts of astronomy—in fact, it sounds written down and school-teacherish in tone (which, however, is just what many readers who are willing to admit their difficulties—introverts—frankly want). It covers the science of astronomy from the earth to the universe, with more emphasis on the difficulties of understanding the homely phenomena of motion and position and things within the solar system than on current advances in astrophysics.—$3.70 postpaid.—*A. G. I.*

HOW TO MAKE ELECTRIC TOYS

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YOUNGSTERS old and young will find in this 200-page book a wealth of information about how to make simple little electrical gadgets that will afford hours of pleasure. Secret magnetic locks, experiments with coils, an electric alarm, an electric chair for bugs, magic magnetic boats, a shocking coil, and a dozen or so other and equally interesting gadgets are described. Fully illustrated with drawings and photographs of the things about which the author writes.—$2.15 postpaid.—*A. P. P.*

THE PAGEANT OF THE HEAVENS

By Frederick Warren Grover, Prof. Union College

A NEW elementary star book. In addition to six seasonal constellation charts, also two circumpolar charts (all these are white on black background —probably the clearest method), there are 157 pages of mixed elementary descriptive matter on the constellations, the solar system and the universe. Pages 8 by 10 inches.—$3.20 postpaid.—*A. G. I.*

AN INTRODUCTION TO THE PHILOSOPHY OF SCIENCE

By A. Cornelius Benjamin, Asst. Prof. of Philosophy, University of Chicago

A TEXTBOOK treating of the problems in the logic of science (symbols, perception and so on); problems in the analysis of the concepts of science (order, number, quantity, space, time, law, course); and speculative problems (free will, reality and so on). It largely lacks reader appeal and will be slow going except for the industrious.—$3.70 postpaid.—*A. G. I.*

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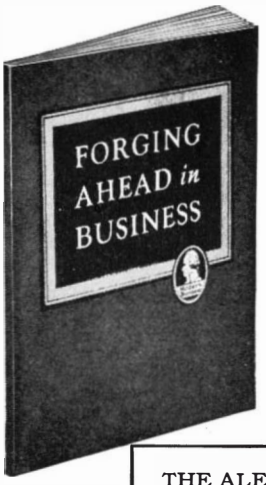

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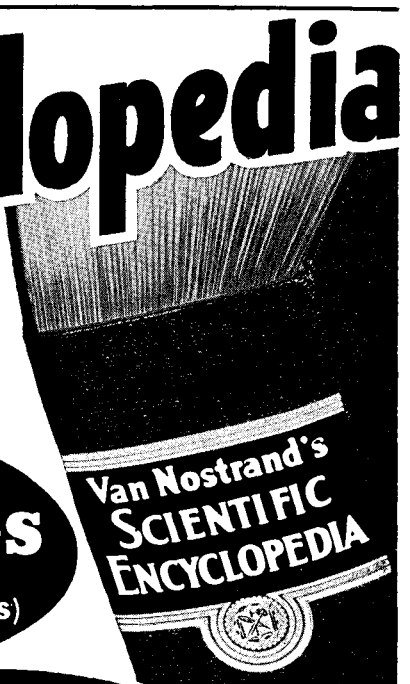

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