MAN'S FUTURE

How Long Will Our Earth Survive?

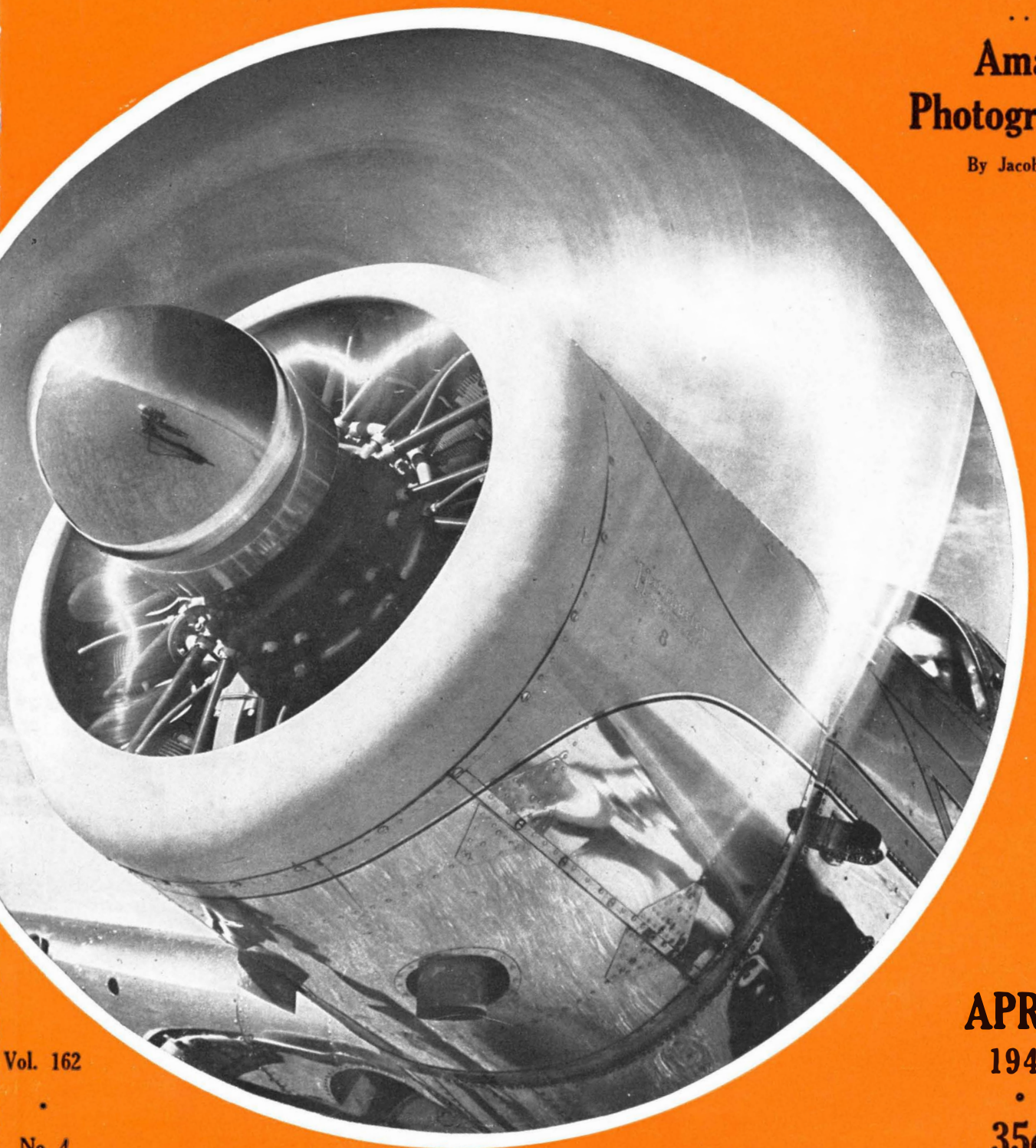
SCIENTIFIC AMERICAN

Including:
A DIGEST OF
SCIENCE & INDUSTRY

. . also . .

Amateur Photography

By Jacob Deschin



Photograph by
ROBERT TARNALL RICHIE

Vol. 162
•
No. 4

APRIL
1940
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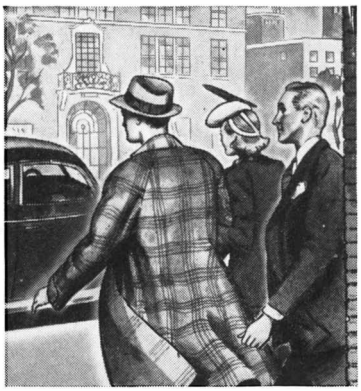
"Well, what are you going to do about it?"

1. Three months ago Gladys and I plunked down almost a thousand dollars for the car we've always wanted. So you can't blame me for giving the car dealer a piece of my mind when it didn't come up to our expectations. "I'm left behind at traffic lights; the car 'pings' on hills; it uses too much gas! *What are you going to do about it?"* I bellowed.

2. But instead of getting mad he calmly said, "Mr. Rogers, everything you say may be true, but there's one question I want to ask you before I let you condemn the car we sold you. *Are you using a good gasoline?"*

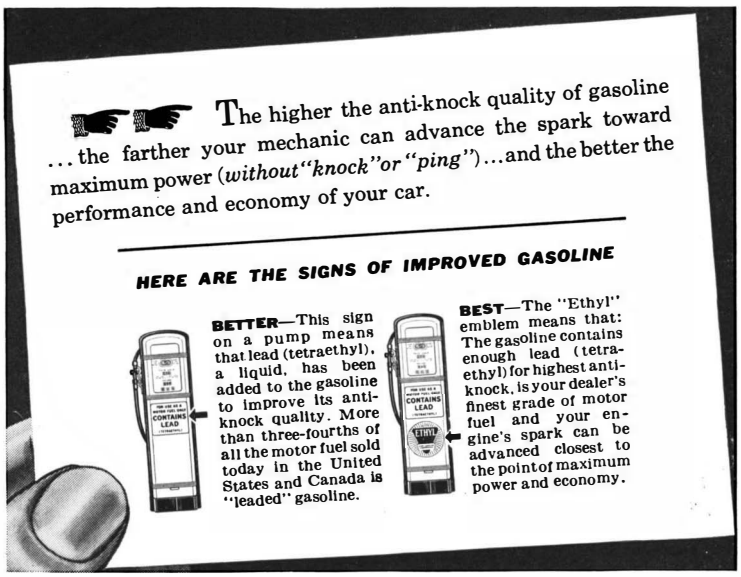


3. "What's gasoline got to do with it?" I asked.

"Let's take a look under the hood," said the car dealer. "I want to show you the spark adjustment . . . the device that controls the power of your car." So we stepped outside.

4. He lifted my car's hood and pointed to a device on the engine.

"There's the spark adjustment," he said. "Your spark is *advanced* for top performance with the best gasoline. But when you use inferior gas, the engine 'pings' and loses power. By *retarding* the spark we can stop the 'ping', but then you'll lose even more power . . . See this chart?"



5. I read the chart he handed me—read it very carefully. "You mean that my engine can't be better than the kind of gasoline I use?" I asked.

"That's right—the better the gas, the better your car," he answered. "If you'll change to top-grade gasoline I'm sure your troubles will be over. Remember, modern cars are designed to give their best performance with the best quality motor fuel."

6. My dealer told me the truth. Gladys and I are more than satisfied now! With the best gasoline in the tank and the spark advanced, our new car now does everything that was claimed for it—and then some. *(How about your car? Maybe you are missing something, too. Read the chart again!)*

The better the gas— the better your car!

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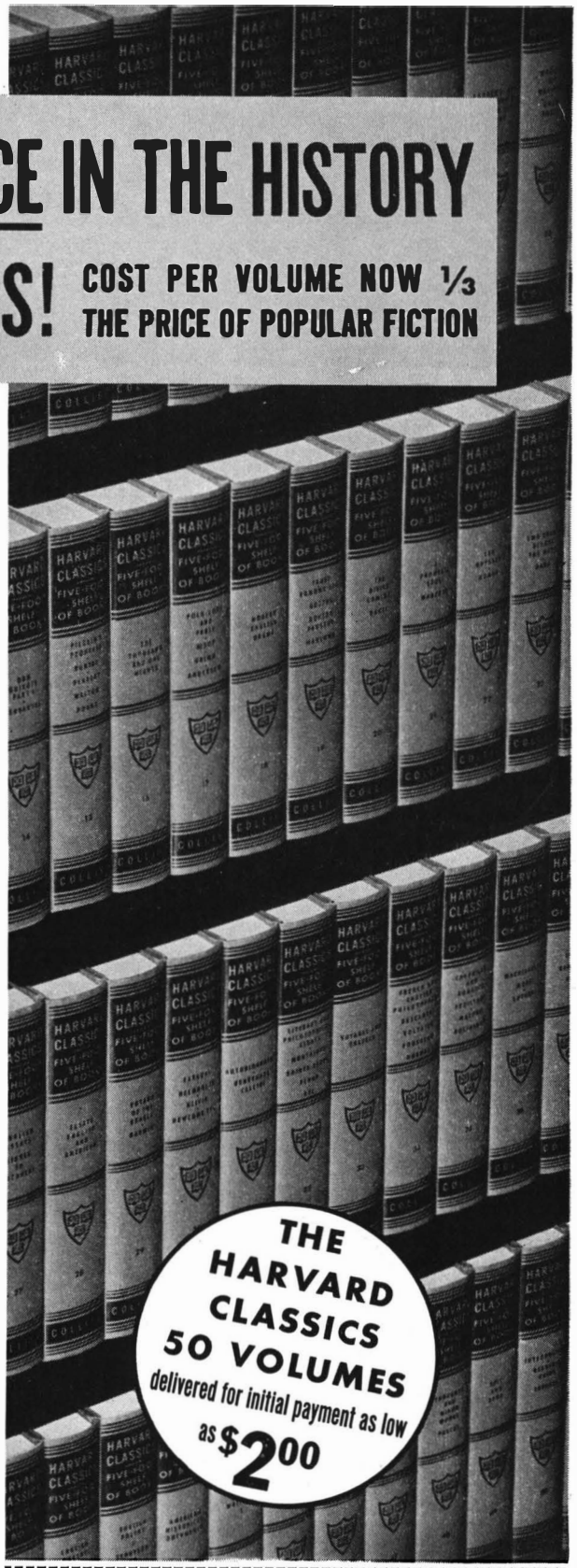

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The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

CONTENTS • APRIL • 1940

BUSINESS executives are taking more and more to the airways, in private planes, in order to keep in personal touch with activities within widely spread organizations. A well-designed example of planes that are being so used is the Spartan Executive type illustrated on our front cover. This particular ship is used by the Halliburton Oil Well Cementing Company to fly executives to oil-field jobs all over the country.

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Personalities in Industry

THOMAS H. CHILTON

WHEN Thomas H. Chilton, director of the du Pont Company's Technical Division, Engineering Department, was awarded the Charles Frederick Chandler Medal several months ago by Columbia University, he was cited "for his outstanding achievements in the discovery and formulation of principles underlying the unit operations of chemical engineering, and in the application of these principles to process development, to equipment design, and to chemical plant construction and operation."

Honors came to "Tom" Chilton early in life. As an engineering student in Columbia he received the Illig Medal for "commendable proficiency in the regular studies." He is a member of Tau Beta Pi, Sigma Xi, and Phi Lambda Upsilon. His portrait in the Engineering Alumni room at Columbia bears the designation "Leader in Fundamental Research."

Mr. Chilton was born in Greensboro, Alabama, August 14, 1899. He attended Starke's University School in Montgomery, and graduated from the Lanier High School in 1915. His college career began in the University of Alabama, which he attended one year as a student of chemical engineering. Then came his transfer to Columbia University, which he attended five years. He graduated in 1922 with the degree of Chemical Engineer. In 1918 Mr. Chilton was enrolled in the Columbia University unit of the Student Naval Training Corps.

While a student in Columbia, Mr. Chilton served two years as assistant in the Department of Chemistry and one year in the Department of Mechanics. He still serves Columbia as Lecturer in Chemical Engineering Extension and as a member of the advisory committee for the Chemical Engineering Department. He also serves Johns Hopkins University in a similar advisory capacity.

Following several years' association with F. J. Carman, on chemical research in New York City, Mr. Chilton joined the du Pont Company in 1925. Here Mr. Chilton was first assigned to the development of the pressure process for the oxidation of ammonia for the production of nitric acid, and he carried on this work during the period from 1925 to 28. He was also engaged in the installation of ammonia oxidation units for the supply of nitre for chamber sulfuric acid plants. In 1928-29, he was engaged upon studies on the improvement of the contact sulfuric acid process.

In 1929, Dr. C. M. A. Stine, then Director of the Chemical Department, authorized, as part of the fundamental research program of the du Pont Company, studies in chemical engineering, and a group of engineers was assembled for the purpose. Initially under the supervision of Dr. John H. Perry, the direction of the group was assigned to Mr. Chilton before the end of that year. The group was gradually enlarged, and in 1935 it was consolidated with a partly parallel group organized in the Engineering Department in 1932, under Henry B. du Pont, as Head of the Technical Division. Mr. Chilton was named as assistant division head, and in 1938 succeeded Mr. du Pont as division head.

The objectives of the group are the development of widely applicable design data for chemical process equipment. Studies have been made on fluid flow, heat transfer, crystallization, absorption, distillation, adsorption, drying, extraction, filtration, agitation, and other unit operations.

Mr. Chilton served as a director of the American Institute of Chemical Engineers for three years and is Chairman of their Committee on Papers. He is active in the American Chemical Society as a member of the editorial board of the Technologic Monographs.

Despite his many interests in industry, education, and in scientific and fraternal societies, Mr. Chilton always has time for his associates and friends. He confides, reluctantly, that he has one hobby, that of collecting automobile registration plates of the various states. However, those who know Tom best believe his real hobby is chemical engineering.

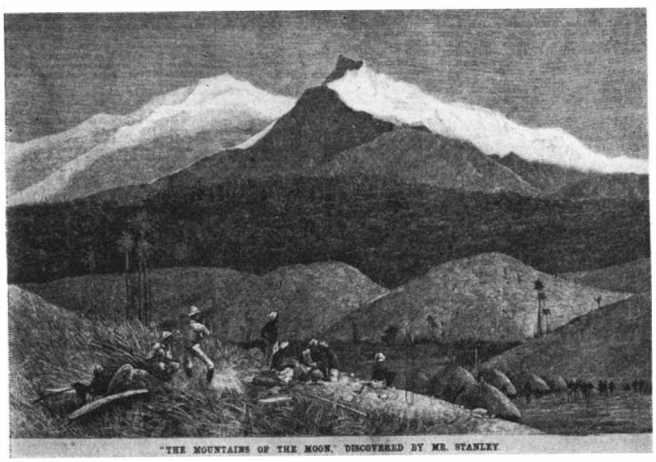
50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of April, 1890)

ROADS—"Prof. Ely, of John Hopkins University, estimates that poor roads cost the farmer, on an average, $15 per horse, and Prof. Jenks, of Knox College, Illinois, argues that with good permanent roads freight could often be hauled ten miles on wagons cheaper than it could be taken one mile on a dirt road to a railroad station, unloaded, put on the cars, and carried to its destination."

"MOUNTAINS OF THE MOON"—"The geographical discoveries made by Mr. H. M. Stanley's expedition in its route, accompanied by Emin Pasha, to the south of Lake Albert Nyanza (*sic*) and west of Victoria Nyanza, through a region previously unexplored, are the latest additions to our knowledge of the wonderful interior of what has been called the 'Dark Continent.' . . . He . . . describes the Ruwenzori range of mountains, rising above the Semliki valley and he considers them identical with what the ancients called



"THE MOUNTAINS OF THE MOON," DISCOVERED BY MR. STANLEY.

'The Mountains of the Moon.' . . . The scenery afforded by these mountains, as one passes by their feet, is most splendid. Deep valleys of an intense darkness run up from the forest beneath. A distinguishing feature of the range is the clear and well defined character of the hill tops. Almost invariably on the southern side these are of a conical shape, with extremely steep slopes, some of them being quite 45 deg. in steepness. . . In some places the ravines down which . . . streams flow are quite 6000 or 7000 feet deep. The height of the highest point of the range is about 17,000 feet, with about 2000 feet above the snow line."

RABBITS—"A good deal of interest is being centered in the colossal efforts made by the Victorian government for the suppression of the rabbit pest in that colony. In upward of 100 shires in the northern and western districts of the colony simultaneous action is to be taken for the destruction of the rabbits, in accordance with the Rabbit Suppression Act, recently adopted by the Legislature. Poisoned grain is to be largely used, and it is estimated that fully 75 per cent of the rabbits will be killed."

AT NIGHT—"At a recent test of search lights for the purpose of discovering an approaching enemy dressed in uniforms of various colors, it was found that the red uniforms were very distinct, blue being the least conspicuous."

BLIND—"Rev. W. H. Murray, a missionary at Peking, has devised a system for teaching the blind, and has reduced the Chinese language to 408 syllables. By this system the blind have been enabled to learn to read with marvelous facility. The blind themselves are employed in the stereotyping and printing of books, which are produced at an amazingly low rate, compared with books embossed for the blind in this country. Among the Chinese the blind are regarded with great consideration, and they are watched with intense interest when they read with their fingers from the books which they carry in their hands."

FLOOD CONTROL—"Recent tourists in China announce that . . Chinese statesmen . . . have entirely risen above superstition, and that the Chinese merchants speak contemptuously of the efforts of the priests to prevent the calamity of floods, saying, 'Chinaman, he all time chin, chin' (meaning that they resort to prayers and other priestly methods in time of calamity), 'while Melican man he build more stout walls to keep water back.'"

LIGHT—"The light of the firefly is not a vital, but a chemical process. . . It seems that chemistry should find means to imitate this process, giving us a form of combustion wherein the energy of fuel is all converted into light instead of being mostly wasted in heat."

RAILROAD SIGNALS—"The block system of running railroad trains . . . has recently been introduced upon the Central Railroad of New Jersey, between Jersey City and Bergen Point. It is a four-track road, and is traversed by a very large number of trains daily. It has been found advisable to protect all classes of traffic, and accordingly the system has been put in operation on the four tracks. . . The signals are semaphores, and are arranged one above the other for a single line of track. The upper semaphore has a square end: the lower semaphore is fish-tailed in shape. When the upper one projects at right angles from the post, it indicates that a train is on the next block. Whenever it projects in this way, the lower one is also set at danger or caution. As the train leaves the block thus protected the upper signal falls, but the fish-tail signal remains at caution until the next block is passed and the train is two blocks distant."

BILLS—"All of the bank note currency of the Italian government is engraved and printed in the United States."

TWENTY MULES?—"There are five teams engaged in hauling borax from the works in Saline Valley to the railroad. In this newly discovered borax field lies the greatest natural deposit of borax now known to exist in any part of the world. It is only necessary to dig up the mineral and shovel it into wagons."

AND NOW FOR THE FUTURE

¶ What is the place of blimps in modern warfare? By Brockholst Livingston.

¶ Archeological discoveries in an Anglo-Saxon treasure ship. By J. Reid Moir, F.R.S.

¶ New radio relay holds possibilities for networking television programs.

¶ The secret of immortality for living tissue. By Barclay Moon Newman.

¶ Industry makes good business out of the bad business of illness. By John F. McMahon.

AIR CONTROL SOLVES TUBE PROBLEM

CATHODE - RAY tubes, widely used in research laboratories and industrial applications, are sometimes temperamental. The reduced air pressure within them must be exactly right or they will not operate satisfactorily. This factor has been overcome by mechanical methods in the past, but only with partial satisfaction. When Westinghouse engineers were working on a new cathode-ray oscillograph (shown at left) for use in the new high-voltage laboratory of the Bureau of Standards, they incorporated in it a small bellows by means of which the number of air molecules within the tube could be accurately controlled, thus doing away with the formerly used mechanical devices. The new oscillograph will be used to measure high voltages in research on the effectiveness of electrical insulation and lightning arresters.

Every bunch of bananas is dunked at the shipping point to destroy all clinging pests such as insects

GREEN DRAGON OF THE TROPICS

Banana Fungus, Picturesquely Named by Natives, Threatened Extinction of Industry . . . Menace Averted . . . Enormous Cost, Ingenuity Involved

By CHARLES MORROW WILSON

THANKS to Hollywood, most of us think of bananas as the easy manna of the drowsy tropics. A recent movie depicted the hero lounging around the tropics and reaching up to pluck mellow, ripe fruit from the trees. In real life and in real tropics, bananas don't ripen edibly on the plant. They have to be cut green and left to ripen in the shade. If they ripen on the plant the pods split and the pulp sours.

Indeed the banana is one of the most delicate and scrupulously cultivated crops on earth. Every stage requires hard work and tender care. The banana also requires perpetual haste, an average initial investment of about $400 per banana acre, and more man-hours of labor than any other principal harvest of the modern world.

In bananas, every dime must be earned with hard work, salty sweat, and fast motion. That is why the banana-growing republics of Guatemala, Honduras, Costa Rica, and Panama are becoming elysiums of employment, why banana-growing centers frequently have more jobs than men to fill them. Machines are said to rob men of jobs. The banana industry flatly denies this. During the past ten years the tonnage of banana machinery has been almost doubled. So has the number of banana jobs. Every two acres of the crop now means a year-around job, and approximately every five tons of new banana machinery seems to create a new banana job.

AND to the normal hazards of flood, drought, and hurricane there has been added of late a further and more terrifying threat to this 300,000,000-dollar-per-year industry: the sinister disease known as Sigatoka. A leaf-killing fungus spread by a wind-blown spore, this disease has played havoc in vast sections of the republics to the south, threatening to obliterate the entire banana crop there as it has already done in the South Seas.

It is no longer enough that banana men work for a living. Now they have to fight for it—not with firearms or revolutions, but with spray guns, dust-throwing airplanes, and spray-squirting tractors. Banana-land's new war is a fight to the death against this mysterious leaf-killing fungus, scientifically known as *Cercospora musae zimm.*

Sigatoka takes its common name from the region where it first appeared—the banana-growing center of the Fiji Islands. Until the disease struck there, that region was one of the great banana-growing areas of the world. The tiny

Using the pipe-line type of spray against the fungus Sigatoka in Honduras. The pipe-line "grid", with hose connections, runs all over a plantation

round spores of Sigatoka settle upon the broad, lush banana leaves, and within two or three weeks multiply to form gray-brown "death-spots." These spread and grow until the leaf-structure of the plant is twisted and parched as though burned by fire. The fungus doesn't impair the food value of the fruit, but by killing the leaf surfaces it causes the fruit to ripen prematurely. Hence banana traders would buy green-cut fruit which looked all right. They would load it aboard ships and entire banana cargoes would ripen prematurely in mid-ocean and rot before they reached port.

The method by which the disease spread was as insidious as its effects. Borne by the wind, it swept on at altitudes from sea level to 14,000 feet, in the wettest jungles and driest deserts. One crew of alarmed pathologists took to the air. At 5000 feet they held out glucose-coated slides and caught live Sigatoka spores on the glass.

NO wonder the disease has circled the globe. By 1922, it had crippled banana production in Australia and New Zealand, swept into South China, Siam, Malaysia, and various South Sea islands and cut westward to India, the Canary Islands, and the Guinea coast of Africa. In 1935, Sigatoka blew into the western tropics. In 1936, the mysterious fungus began to invade tropical mainlands, striking first in the renowned Ulua basin of Honduras. Within a year, about 80 percent, or some 32,000 acres, of the champion Honduran crop was reported infested, and the "Green Dragon," as the natives call the disease, was charging forward into Cuba, Jamaica, and other West Indian islands.

Obviously something had to be done. Sigatoka was threatening the life of the American banana industry with its more than a half billion dollars of United States capital. We can't raise bananas commercially in the United States. But we eat about 10 billion bananas a year. Their caloric value is high; we absorb from them 460 calories per pound (peeled) and more vitamins than from any domestic fruit, berry, or melon. The banana has, therefore, been called the poor man's food-fruit. Current medical literature stresses bananas as infant food, a counter-actant for constipation, and as a hospital standby for the aged and infirm. A widespread shortage of bananas would seriously affect our national diet.

As the Sigatoka menace grew, it began to threaten international trade as well. For the banana is the one great American crop whose export volume is steadily growing. War-infested England and Europe still import nearly 40 million bunches a year. Western bananas have "taken over" English markets, made rapid inroads into continental Europe and Scandinavia and reached the markets of Spitzbergen, 300 miles north of the Arctic Circle. Hitler lists American-grown bananas as "indispensable food" and, until the outbreak of the present war, had bartered for import of more than 15 million stems per year. Last year watched the first shipload of Colombian bananas leave for Soviet Russia. Three weeks later, I read dispatches stating that a "novel delicacy called bananas" were being sold in Moscow at 35 cents apiece—thus yielding the U. S. S. R. a net profit of about 1500 percent! United States dealers have no such lofty ideals of profits for they gladly take a net profit on bananas of 1 to 5 percent.

But it is in South America that the banana is most needed. The lives of five republics down there depend upon bananas, which are their surest tax source, the basis of a 50-million-dollar-a-year cash payroll, the sustainer of at least 125 ocean ships and about 2500 miles of necessary railroads. In Central America, bananas build roads, bridges, and drainage systems. From Guatemala through Colombia, more than 400 common schools are maintained by banana planters and companies. United Fruit, alone, maintains 11 base hospitals from Cuba to Colombia, which give medical services and hospitalization to more than 200,000 patients each year. Malaria, scourge of the tropics, has been pretty well beaten back from the American banana front.

Tractor-drawn spray tank. Many nozzles shoot the liquid fungicide in all directions

Without bananas, it would probably come back and this largest battlefront against tropical disease would tumble.

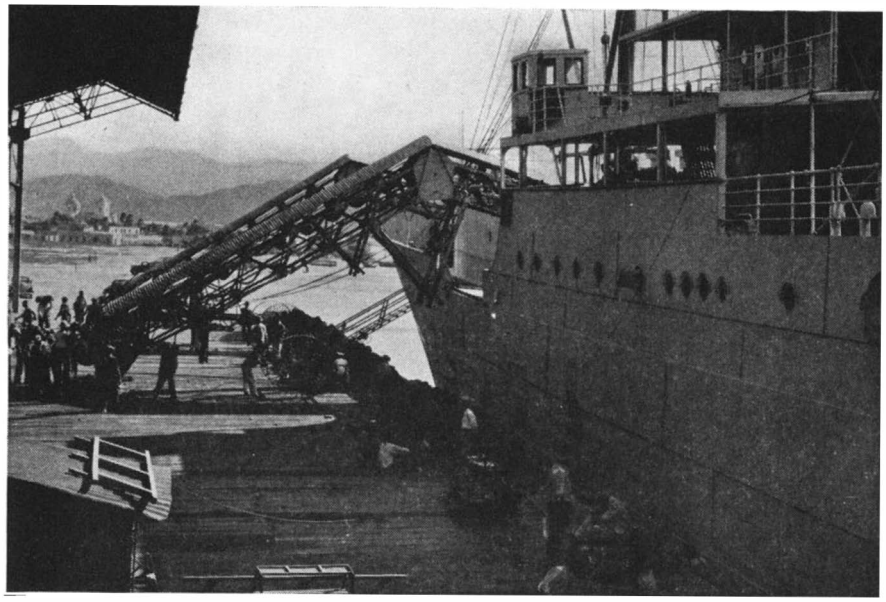
Green bananas are a basic food in the tropics. Fed to livestock, they are grass and grain together, since the starch and minerals of unripe bananas are like those of grain. Plantains, or cooking bananas, are a staple fare for people. Green bananas they mash into dough for pan bread, or they bake or fry them.

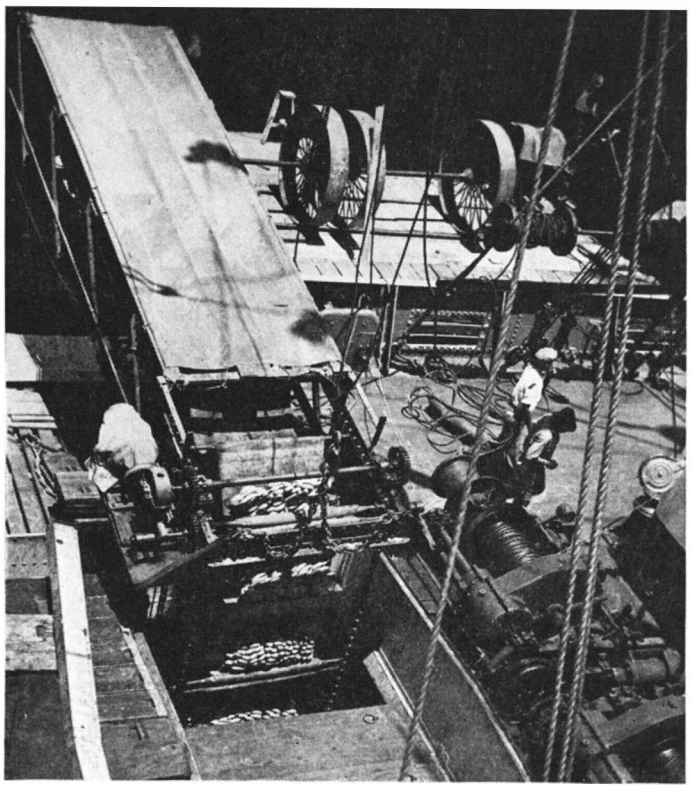
Moreover, the banana industry has hoisted tropical wage levels and banished peonage as it changed thousands of native workers, schooled only in use of the machete, to skilled workers who now qualify for more than 200 trades.

These newly skilled workers, many of whom earn as much in a day as their fathers earned in a week, couldn't be expected to return willingly to dried beans and jungle joblessness. If neglected, the spore of Sigatoka could very easily become the spore of Pan-American chaos.

But Sigatoka is not being neglected. Four years ago when the roundspore fungus made its dumbfounding appearance, native witch doctors arose vaporously to peddle alleged cures, including mysterious liquids to be injected with a hypodermic needle into banana stems. Some planters chopped down their banana fields in the vain hope that the ruining spores would not come again. Others pooh-poohed the menace and struggled to keep on with old routines. United Fruit, which owns and operates about 110,000 acres of banana lands, armored itself with a huge catalog of fungicides and set out as corporate knight to slay the ruinous Green Monster.

After four years of dramatic but bloodless jousting, Sigatoka is by way of being licked, but not without colossal work, headaches, and expense.





Conveyors carry bananas aboard ship and into the hold, *above* and *at left*. Since bananas must be handled with tender care, each bunch rests in a flexible canvas pocket

EARLY experiments proved that copper derivatives check the spread of the fungus. The chief task was to devise a practical means for getting a spray to stick to the leafy plant in heavy rainfall climates. United Fruit staged a ten-nation brain storm in which engineers, scientists, accountants, and fruit cutters turned inventors overnight. The new principle of the griddle-type pipeline spray came into being. Banana fields are grouped into spray units of 600 to 1200 acres. For each unit must be built a central pumping and mixing plant, equipped with a reservoir and a block of Diesel-driven pumps, which mix the spray and force it into the pipelines at high pressures. The pipelines are equipped with hose cocks at convenient intervals of from 120 to 200 feet. Actual spraying is done with garden-type hoses topped with high-pressure "nozzle guns" which break the liquid spray into fine mist and hurl it over the entire leaf surface of the giant plants. Permanent spray equipment requires a thousand or more pounds of metal pipe per acre.

In addition to this permanent installation, two-man spray crews make the rounds of banana fields at intervals of 10, 15, or 30 days, depending upon the virulence of Sigatoka, spraying every plant with Bordeaux mixture which consists of five pounds each of copper sulfate and hydrated lime to each 50 gallons of water. The men cover about five acres per day between dawn and noon, the preferred tropical working hours. A commanding majority of all banana growers throughout the American tropics are becoming "spray conscious." Tractor sprays are taking to dryland banana fields of Jamaica and Colombia. Small growers on banana outskirts are fighting the Green Dragon with squirt guns and back-pack sprayers.

At present, about 90,000 acres of United Fruit Company lands are under spray, and the acreage is rapidly being extended. Before the ground-spray networks were completed, the company opened Sigatoka warfare in the air, using a squadron of especially built dusting planes which set a world record by dusting 208,000 acres with 8200 tons of lime-sulfur powder in 2152 flying hours without a fatality or major crackup.

However, plane dusting is less effective than liquid spray and is gradually being discontinued. Meanwhile Sigatoka mysteries remain. It appears, for example, that the roundspore does not seriously molest banana plants which grow in shade. Nobody can explain this. But coffee-banana farmers, particularly of highland Guatemala, are taking advantage of it to grow bananas under shade trees used to shelter the delicate coffee bush. Unfortunately, shade impairs banana yields.

But Sigatoka defenses are holding. In sprayed fields, banana leaves no longer writhe and twist with coalescing death spots. New style banana plantings are being "put under spray" at overhead costs too great to allow the former practice of carefree abandonment to the omnipotent jungle. Nowadays profitable bananas must stay in bearing from 10 to 25 years, instead of five years which was once the average bearing period.

Banana planters continue to clear jungles, moving plantings farther and farther inland to tap new, rich, frontier

Part of the extensive mechanization of a banana plantation in the war against Sigatoka: a modern type of pumping station for banana spraying. *Below:* Like gigantic lawn sprayers, water-rotated nozzles throw firemen's streams over the banana plants. Each nozzle covers more than three acres and supplies two inches of "rainfall" every 24 hours for irrigation

All photographs by the author

soils. In Guatemala, Costa Rica, and Panama, new banana operations are crossing the high backbone of mountains. New banana railways crowd through primeval wilderness.

From Mexico to the Guianas, Sigatoka further speeds the banana tempo and motivates more and more investment and invention. One of the newest of these is banana irrigation, the most elaborate known to any big-scale agriculture. The newest style banana irrigation, introduced in Honduras and Guatemala, consists of linked series of 25-foot metal towers fed by giant Diesel-powered pumps. Each tower is topped by a water-rotated nozzle which throws a fire-hydrant spray over three and a third acres of planting for the equivalent of two inches of rainfall every 24 hours.

Cultivation and harvest methods are correspondingly improved, another important reason why the tropical Americas have become the commercial banana sources of the world, even though the real homeland of the fruit is India, 14,000 miles away, and even though the name "banana" is a dialectic from the Guinea coast of Africa.

To prevent dropping bunches during harvesting, plant trunk is cut

IT'S an ill wind that blows no good. Ill winds carrying Sigatoka spores continue to blow damage and ruin to outlying and unprotected banana lands. But the principal crop is being saved—and the fight against the disease has brought its benefits. Banana employment has increased between 25 and 40 percent, and the increase continues. Better cultivation, irrigation, and fertilizing necessitated by high costs of Sigatoka fighting have raised commercial yields from former averages of 150 market bunches yearly per acre to a new average of 300 and current highs of 400: more and better fruit from fewer acres.

Almost half of all market bananas are still grown by "independents," native farmers with limited acreage. These have been particularly hard hit. To help these small farmers, United Fruit installs the new-type pipeline spray equipment upon the land and provides necessary services—without taking the property in hock. The owner contracts to sell market-grade bananas to the company for a period of ten years at producer's prices common to the area. The company agrees to pay cash for all fruit purchased and assures the grower a market for his entire production the year around, regardless of market conditions. Spray systems are being installed in units averaging about 800 acres, with spray lines crossing boundaries of private farms.

Science, too, has had its wits tested in this battle. At present the conquest of Sigatoka appears to be man's most spectacular victory over a crop-destroying fungus. To make the victory stick will require unceasing vigilance, but in that vigilance as well as in the conquest, science will learn new strategies. These strategies will stand us in good stead later, for fungi, not insects, may yet prove the chief enemy of man.

OUR POINT OF VIEW

Co-Operation

SO vast is the sea and so great are the numbers of food fish in it that any attempt to conserve the supply for the future may seem, at first glance, like carrying coals to Newcastle. But the facts point the other way. One particular species of salt-water fish — the striped bass — is rapidly approaching extinction, and what can happen to one species can conceivably happen to another. And if the "striper" of our eastern coastal waters can be preserved by co-operative application of the science of conservation, the same can be done for other species when the need arises.

The striper is a fish that is of tremendous interest to both commercial and sport fishermen. Even when caught by the commercial fishermen in small quantities, the high price that the striper commands makes it rather worthwhile prey. To the sport fisherman, whose numbers are increasing by leaps and bounds, the striper is considered to be the king of surf and bay fish. The commercial fisherman contends that he has an inalienable right to net and trap these fish wherever found. The sport fisherman claims an equal right to the fish and to the beach along which the fish travel.

Here is where the need for more knowledge and co-operation comes into the picture. Little is known of the life and habits of the striper, although several groups are now engaged in studying them and data are slowly piling up. When more is known about these things, everyone concerned will be in a better position to determine future policy and procedure. In the meantime, sport fishermen of several eastern states are pressing legislation to protect the striper from the commercial fisherman, and the latter is just as active on the defense.

To this writer, it seems that the greatest need at the moment is two-fold co-operation; co-operation between the legislative bodies of the various states in whose waters the striper is found, and between the sport and commercial fishermen. Greed on the part of either or both of these groups should not be permitted to cause the striper to go the way of the buffalo, the heath hen, and the passenger pigeon. The science of conservation has progressed sufficiently to enable us to show what steps should be taken. Protection of the species is a positive necessity if it is to be preserved. Let us hope that this prize fish, so eagerly sought after by those who go down to the sea for sport, will not become extinct while the battle rages. Rather put severe restrictions on *all* fishermen first and then iron out the difficulties later, making readjustments as found necessary. At least this would preserve one of our natural heritages from extinction until tempers cool and the way is opened for satisfactory co-operation.—*A. P. P.*

Arms Against War

MANY attempts have been made to explain the present stalemate in the war between the Allies and Nazi Germany. No longer do people call it a phoney war; some, indeed, see in it a ray of hope for the future, a hope that the terrible bloodshed of 1914-1918 may never be repeated.

All wars are waged to wear down the enemy. To do this in the present war, each side thinks to starve the other out. Both know the futility of attacking along the French-German line, for both understand that the attacker would suffer enormously higher losses than the defender. There remain the sea and air. War on and under the sea has been put under control. The air, however, still has its menace. Aircraft are feared, not because they kill many civilians but for the deadly gas they can carry and because of their potentialities for the destruction of property. Small squadrons of planes have been active, but so far there have been no waves of hundreds of planes over enemy cities as was threatened. Why? Fear of reprisals? Britain evidently leans toward this theory if we can judge by an editorial in *The Engineer* (London).

In discussing safety measures taken in the British Isles to assure low casualty rates in case of air raids, *The Engineer* states: "It is impossible to estimate how many millions of pounds have been spent in this country on these air-raid precautions, and up to the moment of writing, it can only be said of them that by their mere existence they may have averted attack. Dread of reprisals is the most effective A. R. P. of all." We have confirmation of this dread of reprisals in Hitler's own words, the substance of which was that Germany had a weapon which could not be used against Germany. In making such a statement, he knew what all belligerents know; that, despite a certain difference in quantity of arms, the theme of this war is *quid pro quo.*

One further thought from *The Engineer*: "It would seem that man finds himself in possession of a weapon so terrible that he dare not use it save against the defenseless." In speaking thus of the deadliness of aircraft, *The Engineer* approaches closely to a thought we have held for months. It has been our feeling that the very deadliness and enormity of modern armaments have done more than all the cries of horror by the pacifists during the past decades, if not to stop war, at least to limit rigidly the bloodshed of a modern war between powerful nations. While the burden of armaments is a heavy load for populations to bear in peace times, it seems to us that this war may yet prove that it is the armaments themselves which have more effect than common disarmament which renders a country defenseless. It may follow from this that all peoples may see the utter futility of armed warfare, between equals, in the future and devote their energies solely toward the sort of economic warfare which is being waged today. — *F. D. M.*

Printing's Semi-Millenium

FIVE hundred years ago, if we can agree on the date, 1440, that has long been accepted, Johannes Gutenberg invented movable type. In the last five words of that sentence, there is basis for volumes of philosophizing.

Prior to Gutenberg's achievement, some thousands (or tens of thousands) of scribes laboriously made copies of books by hand. Consequently, books were costly and could be owned by few; the learning of the ages was passed on largely by lectures; and culture was a plant of extremely slow growth.

Following Gutenberg, civilization's processes were speeded up and the world passed through its most amazing 500 years of progress. Today a book which only a king could buy before Gutenberg, can be bought by any child out of his pocket money; and millions of people, from writers to compositors and pressmen to lumberjacks and paper makers to news dealers and truck drivers, have employment because of movable type. (Somewhere, too, the over-worked, much maligned, necessary evil called "editor" fits into that list.)

Technically Gutenberg's accomplishment was "re-invention," for the Chinese invented and used movable type many centuries earlier. Yet we have no desire to subtract one iota of the honor due this "scion of a patrician family of Mainz," as a recent bulletin from Germany proudly described him. His contribution to the broadening of culture, and therefore to the more rapid progress of civilization, is incalculable. It is unfortunate that war prevents the world from joining with Germany in her several celebrations this year to pay homage to this great and beneficent inventor. — *O. D. M.*

More Miles Per Gallon

Fuel of the Future . . . Car of Future Designed For It . . . Both Will Come Through Co-Operative Research . . . Future Presaged by Past Progress

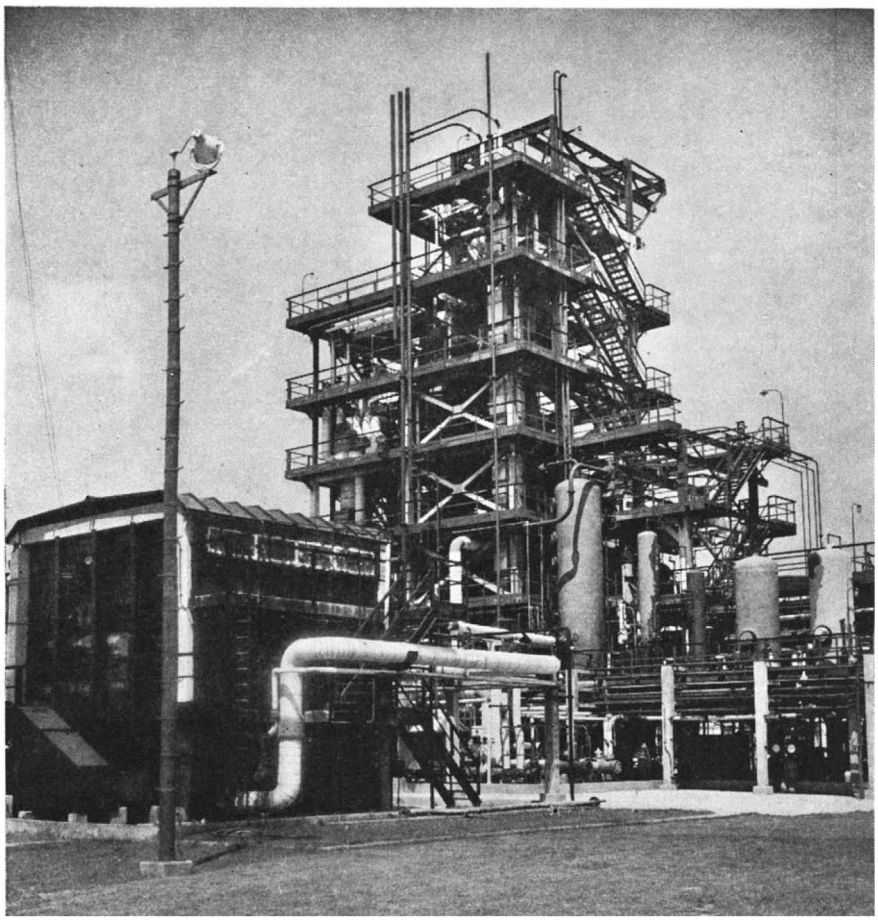
By Dr. GRAHAM EDGAR
Vice President and Director of Research, Ethyl Gasoline Corporation

IT is a virtual certainty that the automobile of the future will travel farther on a gallon of gasoline than the car of today. In all likelihood this gain, possibly as much as 50 percent, will come, not through any sensational discovery, but by following a path already well beaten — the continued correlated development of fuels and engines.

In the past, automotive engineers have taken advantage of constantly improving fuel quality by increasing the compression ratio with resultant increases in power per cubic inch of displacement and power per gallon of fuel. The improvement of the anti-knock quality of gasoline is a necessary part of this correlated development because the tendency of fuel to knock limits the ability of the spark-ignition engine to convert the energy of fuel into power. As this limiting factor has been removed, permitting higher and higher compression ratios. power and performance have improved. The recent rise in the anti-knock quality of gasolines available to motorists indicates that this trend is continuing.

The possibilities of increased gasoline economy through developing this principle still further have been amply demonstrated by exhaustive experiments. Research engineers, using an automobile equipped with a valve-in-head engine as a test vehicle, conducted a series of tests in the laboratory and on the road at a number of compression ratios and gear ratios. Fuels in each case were just capable of avoiding knock — approximately 69 octane for 5.25 compression ratio; 95 octane for 8.0 compression ratio; and something over 100 octane for 10.3 compression ratio. At 40 miles per hour, the miles per gallon improved from 12.5 at 5.25 compression ratio to 18 at 8.0 and 21 at 10.3. The average increase in economy, between 10 and 60 miles per hour, is about 45 percent, going from 5.25 to 8.0 compression ratio under conditions of constant performance.

Distribution of leaded gasoline has expanded enormously since first sold here in 1923



Part—just a small part—of the vast chemical industry that has been built up since 1923 to make tetraethyl lead for gasoline. This unit produces ethylene

Super-charging, generally applied so far only to aircraft, opens another field of opportunity for improved gasoline economy. Investigations in our own laboratories indicate that under certain conditions super-charging will result in substantial fuel savings, or in substantial increases in horsepower-hours from the same fuel consumption and, in some cases, both. With 10- or 12-octane number-improvement in the fuel, it was possible almost to double the horsepower of an eight-cylinder engine by supercharging.

Unquestionably one of the important industrial advances of this generation has been this correlated development of fuels and engines — a development that has changed our whole system of passenger and freight transportation. Out of it has grown a system of motor transportation unrivaled anywhere in the world — bus and truck lines that stretch into every nook and corner of the nation, 25,000,000 private passenger cars, transcontinental, intercontinental. and trans-

Fairchild Aerial Surveys, Inc.

Bromine is extracted from the sea at this plant on Kure's Beach, North Carolina. Water from the Atlantic Ocean, not shown, is pumped into the settling basin in the foreground, from which 200 million gallons a day flow into the processing plant

oceanic air lines on regular schedules.

Behind this development lies the collective effort of dozens of research laboratories representing many industries. All have made important contributions to the general program of improvement. Not least among these contributions was that made by tetraethyl lead in breaking down the barrier of knock. Tetraethyl lead was but one of the tributaries of the stream of progress, but, judged by any scale of values, it played an important role. Many of the facts about it have become a matter of general knowledge; others are not so well known.

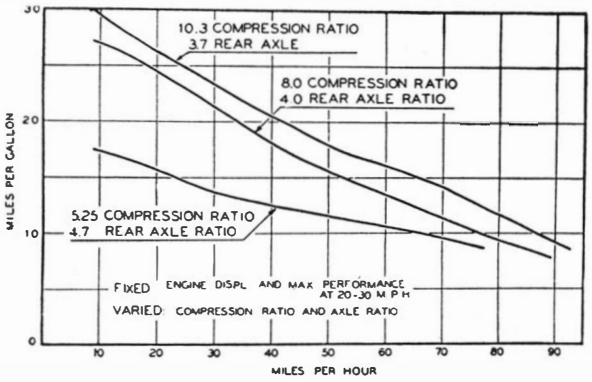
Almost every motorist is familiar with the small white sign on gasoline service station pumps which reads "Contains Lead." Some are familiar with the story of the recognition of the problem of knock by Charles F. Kettering of General Motors; with the long search by Thomas Midgley, Jr., and T. A. Boyd for a satisfactory anti-knock compound and the eventual discovery of tetraethyl lead. But few know of the obstacles that had to be overcome before this anti-knock agent could be made available commercially; of the problem of raw materials, of manufacture, or the years of continuous research that were necessary to the utilization of the product after it was developed.

Gasoline containing tetraethyl lead was first put on public sale at a single service station in Dayton, Ohio, on February 1, 1923, under the now familiar name of "Ethyl" gasoline. Immediate acceptance of the new product indicated that the ordinary fuel of that day was not satisfactory for even the low-compression automotive engine of the time, and the sale of Ethyl gasoline began to spread rapidly. By 1931, 12 percent of the entire gasoline consumption of the United States was Ethyl gasoline, sold at premium price. In April, 1933, oil companies began using tetraethyl lead in their regular-grade gasolines. Today, 75 percent of all gasoline sold in the United States and Canada contains tetraethyl lead. In the field of aviation, almost all gasoline of 80 octane number, or better, contains tetraethyl lead; in fact. the performance of the modern military and transport plane is due, in large part, to the development of high-octane gasoline, a development in which this anti-knock compound played an important part.

Outside of the United States, tetraethyl lead is used in motor gasoline extensively in England, France, Australia, New Zealand, and Germany, and to a smaller extent in many other countries. In aircraft, for both military and transport purposes, it is used in nearly every country in the world.

But this success story could not be told had it not been for the years of study and research on problems concerning which the general public knows little or nothing. Developing a product in the laboratory is one thing; manufacturing it in commercial quantities is quite another. The manufacture of tetraethyl lead has represented serious problems from the start. There was no "prior art" in the large scale production of any organo-metallic compound, and knowledge had to be accumulated by gradual and sometimes painful experience. Three plants in succession were built, used for a time, and then abandoned before we learned to make tetraethyl lead in substantially the way it is manufactured today.

It was necessary, first of all, to solve the serious problem of adequate supplies of basic raw materials. Tetraethyl lead is manufactured by the reaction of ethyl chloride with an alloy of sodium and metallic lead, and the immediate raw materials are therefore ethyl chloride, sodium, and lead. With the exception of metallic lead, none of these are available commercially in the quantities required, and for this reason, as well as in the interest of manufacturing economy, it was necessary to produce them at our own plants. An accompanying diagram gives a flow sheet of the manufacturing operations. Salt is electrolyzed to produce sodium and chlorine.



Increase the compression ratio of the car engine and the result is more miles per gallon at a wide range of car speeds

The sodium is melted with lead to form the alloy which, after grinding, is ready for the final reaction. The chlorine formed in the electrolysis is burned with hydrogen to form gaseous hydrochloric acid.

Recently a plant has been completed for the manufacture of ethyl chloride, using the ethylene process — the first commercial development of its kind. The plant is a model of manufacturing efficiency and economy, but it took years of study and work to develop this particular art to its present state. In the ethylene process, refinery stabilizer gases, consisting largely of propane, are cracked, and the cracked gases are fractionated at low temperatures to separate the ethylene formed. This is allowed to react with hydrochloric acid gas at low temperature in presence of a catalyst to produce ethyl chloride.

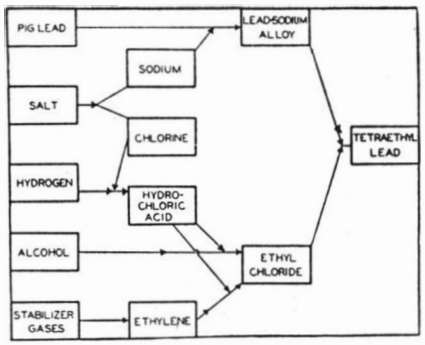
In addition to tetraethyl lead, the finished anti-knock fluid requires the addition of ethylene dibromide, ethylene dichloride, and dye. The latter two are purchased in the open market, but an adequate supply of ethylene dibromide at reasonable cost has represented a serious manufacturing problem for many years. In the early days of Ethyl, bromine was an expensive chemical and the supply limited. The young tetraethyl lead industry spent half a million dollars on a boat to "mine" that great reservoir of raw materials, the sea. The experiment itself was not an unqualified success, but it proved that bromine could be recovered in quantities with the proper kind of plant, equipment, and location. Subsequently, such a plant, the only one of its kind in the world, was built at Kure's Beach, near Wilmington, North Carolina, under the joint auspices of the Ethyl Gasoline Corporation and the Dow Chemical Company. Its present output exceeds three million pounds of bromine a month.

But the solution of these problems was only the beginning. Assured of an adequate supply of raw materials, the next step was exhaustive tests of engines on dynamometer blocks and millions of miles on the road to determine the exact proportions of certain constituents of Ethyl fluid for most satisfactory results. This is a study which must go on endlessly. Every new development in engines and fuels calls for renewed effort to determine whether or not changes in design or operating conditions may indicate the desirability of changes in the composition of anti-knock fluid.

These are problems specific to tetraethyl lead, but "lead" is also a part of the tremendous and intricate problem of the internal combustion engine and its fuel. When the full implications of the problem of knock were understood, the petroleum refiner set about to produce motor fuel of less and less tendency to detonate. The magic wrought by oil technologists in this connection is a matter of record. Cracking has been developed from what was originally merely a method of obtaining more gasoline from a barrel of crude oil to a method of changing the chemical structure of hydrocarbons. To the fundamental tools of temperature and pressure has been added the valuable instrument of catalysis.

The anti-knock quality of fuels is of vital importance to automotive and aircraft engineers. They must keep informed regarding the fuels that are available, and that soon may be available, and must design their engines to utilize these fuels as efficiently as may be practicable. They have other problems peculiar to their particular craft. With every increase in compression ratio, with every few pounds additional in brake-mean-effective-pressure, a host of problems present themselves. New materials and improved design may be needed. Difficult lubrication problems may arise.

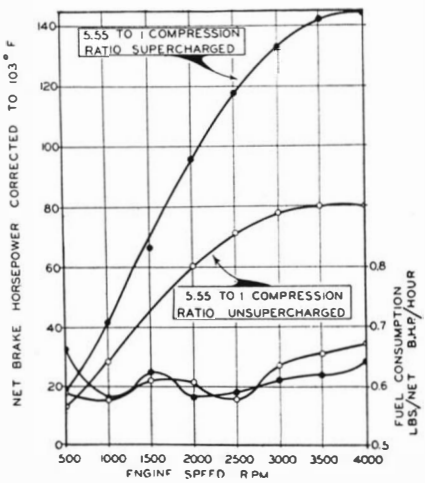
In addition to the problems peculiar to each of these great industries, there are others that require the joint efforts of both. Methods of measuring the knocking tendency of fuels, methods of expressing those measurements and the interpretation of the results, call for co-operative work by the technical staffs of the petroleum and automotive industries.



Flow chart of tetraethyl lead manufacture, showing chemicals needed

The Ethyl Gasoline Corporation is directly of neither the petroleum industry nor the automotive industry, but it is a child of both; and as such, it has been able to participate in many of the developments outlined above. Its research laboratories at Detroit and San Bernardino have not only studied problems specific to tetraethyl lead but have contributed substantially to the important progress which has led to the fuel and the engine of today.

It cannot be said that any of these developments have been due to a feeling of pure altruism on the part of any member of either industry. They are the natural result of the American competitive system, and their net result is that the public today has vastly better fuels and vastly better automobiles, trucks, busses, tractors, and airplanes than it had ten years ago.



Brake horsepower and fuel consumption with and without supercharging in engines under tests

But what of the future? Will anti-knock compounds continue to play the same important role in the correlated development of engines and fuels in the future as they have in the past? No one would be rash enough to predict the exact trends which may develop in the future, but enough data exist to show that a number of ways exist in which fuel of very high anti-knock value may be efficiently utilized.

What that fuel will be, no one can say. Constant progress in the refining art is increasing both the yield and quality of gasoline. But wherever it is more economical to obtain any given octane level by the use of anti-knock compounds, they will continue to be used and they will be added to the best available refinery product to produce the "fuel of the future" for which the automobile of the future will be developed.

What Does The Soil Need?

Scientific Fertilizing Produces Remarkable Results . . . Possible When Soil Minerals, Soil Needs Are Known . . . Proper Tests Give Answer To Grower

By H. T. RUTLEDGE

FIVE-INCH rosebuds, daffodils the size of salad plates, snapdragons six feet tall — such remarkable products of flower gardens are being reported by amateur and professional gardeners who are experimenting with the latest scientific methods of fertilizing. Similar results are being achieved by some vegetable and fruit growers.

Often applications of commercial fertilizers bring spectacular results, while in other cases use of the same fertilizer may bring little or no benefit. The reason for this anomaly is easy to find when fundamentals are considered. In the first case, improvement is visible and may be extraordinary if the material supplied by the fertilizer is lacking in the soil. In the second case, results will be negligible, or even non-existent, if the soil already has the materials which the fertilizer supplies, yet needs still others. The obvious conclusion is that the grower must first know the requirements of his soil; otherwise the fertilizer may be completely wasted.

WHEN the grower does know his soil, he may begin scientific fertilizing. In theory, the problem of perfect fertilizing is complicated by the fact that plant requirements are many, varied, and still partially unknown. In practice, it is greatly simplified because all but three of the important plant food elements are ordinarily bestowed without the aid of man. These three are easy to test for and easy to supply.

There remain some difficulties for the average gardener. Individual plants have different needs. The plant food content of the soil may vary widely within an area of a few square yards, and at different times of the growing season. But a little study and systematic effort will show the way to a fertilizing program of maximum effectiveness.

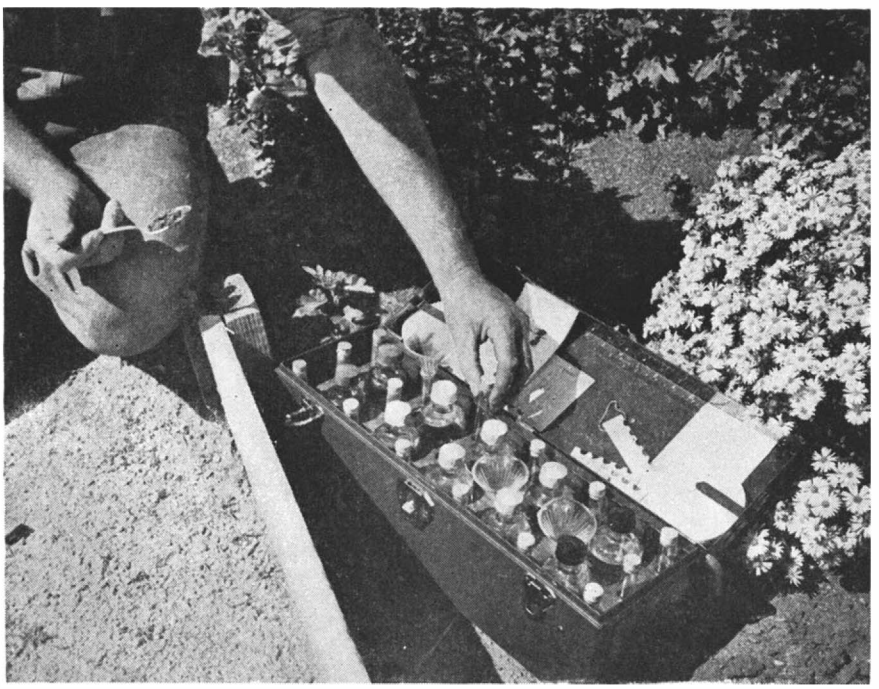
The three plant food elements which the gardener must usually add to his soil are nitrogen, phosphorus, and potash. Until recently, most people were content to use some general fertilizer which, it is true, did contain certain amounts of each of these essentials. But it would be partly luck if the gardener supplied the right food elements in the right amounts. He either wasted money by adding elements of which his plants already had enough, or he added too little of certain elements, and his garden suffered.

Hit-or-miss fertilizing usually means failure because there are so many important factors which it does not take into account. Drought and rainfall, sun and shade, affect the amounts of plant foods available in the soil. Plants themselves are continually depleting the soil of its nutrients, and their needs vary.

The amount and kind of fertilizer required depend on the condition of the soil at a certain time, in a certain place, and in relation to the needs of the plants that are being grown. By the use of simple but effective soil test kits, the gardener can determine for himself the degree to which his soil is deficient in nitrogen, phosphorus, and potash. The kits are easy to use, demanding only the ability to follow simple instructions and to compare colors accurately. With this information, the gardener can fertilize correctly — giving his plants the optimum quantities of foods which they would otherwise lack. In view of the constant changes in soil conditions, best results are usually obtained by making periodic tests and feeding frequently in rather small quantities. Larger applications at long intervals do not assure a regular diet of the foods that plants are using every day.

The fertilizing is comparatively simple once the soil has been tested. If there are no unusual deficiencies, the gardener can often use a complete fertilizer, selecting a formula in accordance with his determined needs. When certain elements are very low, special concentrated fertilizers may be used — either directly on the soil, or mixed with a "complete" fertilizer material. Nitrogen may be furnished by nitrate of soda, ammonium sulfate, or calcium nitrate; phosphorus by superphosphate, treble superphosphate, or steamed bonemeal; and potash by sulfate or muriate of potash.

The special needs of individual plants should also be considered in laying out a fertilizing program. It is important, in this connection, to remember that nitrogen contributes especially to the development of leaf and foliage; phosphorus to fruit and flowers; and potash to strong root growth. With identical soil conditions, a lawn requires more nitrogen in its fertilizer; the flower garden, more phosphorus; and beets, carrots, radishes, and other root vegetables, more potash.



With any soil testing kit, the tester uses but a spoonful of soil. Then, following simple instructions, he soon learns just what minerals his soil lacks—and needs

STARS THAT HAVE CHEMISTRIES

Certain Classes of Stars Have Atmospheres Like the Familiar Oxidizing and Reducing Atmospheres of the Chemical Laboratory . . . Low Temperatures

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

THE stars as a whole are very varied. Some of them are a million times as bright as others, a thousand times as big, a hundred times as massive, and ten times as hot on the surface. Before we can study them satisfactorily, we must separate them into groups which are less excessively different from one another.

The easiest way of doing this is to photograph their spectra. With a prism in front of a wide-angle lens, we can get many hundreds of legible records on one plate. Most of them, as everyone knows, show line patterns of a few standard intergrading types. Once in a while one used to come upon a queer one, unlike the general run; but as observation advanced, it became clear that these, too, belonged to classes of stars, similar among themselves, but less numerous than the main types. At the present time, when hundreds of thousands of spectra have been examined, it would be hard to pick out a single one which is not at least fairly similar to a few others. Nature evidently has standard ways in which the stars may shine, very few in number compared with the multitude of the stars themselves.

Among these less numerous groups are two closely related ones, denoted in catalogues by the letters N and R, and less technically, but more intelligibly referred to as the "carbon stars."

There is good reason for this name. Their spectra are cut to pieces by an enormous number of lines, grouped in many places into dense bands, which have long been known to be produced by carbon compounds. These have now been identified, not as the ordinary molecules familiar in our laboratories, but as molecules partly, but not completely, decomposed into their elements at the high stellar temperature. So we have now CH — with but one hydrogen atom remaining attached to the carbon — instead of the familiar CH_4 (methane); CN — not the cyanogen gas (C_2N_2) of the text-books, but a chemical "radical" so eager to combine with something that under ordinary conditions it combines with itself; and C_2 — carbon vapor, ready to condense into a solid except at very high temperature or low pressure.

In the red end of the spectrum, the lines are so crowded that they almost overlap. Here and there, a narrow clear space between them allows the normal "continuous" spectrum to show through. With moderate, or even fairly high, dispersive power these bright places look just like emission lines. For years they were supposed to be due to some unidentified luminous gas, until at last the detailed comparison of spectrograms taken with high dispersion with laboratory spectra revealed the truth.

The presence of compounds — molecules — in obvious abundance would be proof by itself that these stars are cooler, on the surface, than most others. This was realized first, however, because they are very red. The N stars, indeed, are much the reddest of all the important groups, beginning about where the others leave off, with a color index of two magnitudes (that is, with about six times as much red light in comparison with violet as a star of standard color, like Vega) and running on to some which are 50 times as bright in the red as in the violet. The R stars are in all respects less extreme. They are not so red, the bands in their spectra are weaker, and those with the weakest bands grade naturally into familiar spectra of about Class K (Arcturus). They evidently represent cases in which all but a relatively small part of the compounds are dissociated by higher temperatures.

THERE are other red stars in the heavens (called Class M) and a few of them are as red as even the N stars, and these too have compounds in their atmospheres. But these compounds are *oxides*. Titanium oxide gives the strongest bands — and, in a few stars, zirconium oxide — but oxides of vanadium, scandium and yttrium have recently been identified.

It would be wrong to conclude that these unfamiliar metals are the most abundant in the stars. Their oxides happen to have strong bands in the smallish part of the spectrum which we can observe. Other metals, which do not, will be missed.

But the fact that we find compounds of carbon in one sort of stars, and of oxygen in the other, is of great significance. Here, indeed, we come to the point where we can speak of a real chemistry of the stars.

The high-school laboratory student knows perfectly well the difference between an oxidizing and a reducing flame. In the first, there are enough oxygen atoms to provide more oxygen than is necessary to combine with the hydrocarbons of the gas supply, and the excess oxygen, at the high temperature, will act on any oxidizable substance on which the flame plays. In the second, there is not enough oxygen to use up all the hydrocarbons, and the excess will take oxygen away from many metallic oxides, and leave the free metal.

It was the late R. H. Curtiss, a dozen years or so ago, who first pointed out that in these two classes of stars, we have the familiar difference between an oxidizing and a reducing atmosphere. With oxygen in excess, the carbon compounds are used up (being transformed into the more firmly bound carbon monoxide, which absorbs only in the far ultra-violet) and the metallic oxides are left. With excess of carbon, the opposite happens.

The oxygen stars of Class M are something like 100 times more numerous than the carbon stars of Classes N and R. That is, we find about this proportion in our lists of stars down to the 7th or 8th magnitude. Among the 6000 or so stars visible to the naked eye the fraction is even smaller. There are only about 20 of Class N, and but one of Class R — and most of these are variable stars which rise above the 6th magnitude only at intervals.

But it would not be safe to conclude that oxygen stars were actually far more abundant than carbon stars, in space, until we knew at least the average real brightness of stars of the different classes. Those of great luminosity can be seen at greater distances, and will get into our lists in disproportionate number.

It is therefore of special interest to determine, if we can, the average distance and real brightness of the carbon stars.

These objects are much too remote for direct measures of parallax by the trig-

onometric method, and to get a good average we must depend upon the comparison of proper motions and radial velocities. The principle is simple. By the spectroscope we can find the rate of approach or recession of any star, in kilometers per second. By comparing observations of right-ascension and declination (if we have good enough ones covering a long enough time) we can find how fast, in seconds of arc per year, the star appears to move across the heavens. This last amount — the proper motion — depends both on the real velocity of the star, at right angles to our line of sight, and its distance. More precisely, it is proportional to the product of the cross-velocity by the parallax.

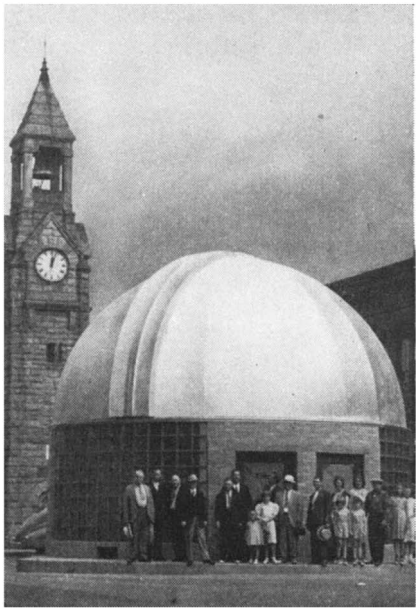
For an individual star, this leaves us none the wiser, for the ratio of the components of velocity along and across the line of sight depends on the angle between the direction of motion and the line of sight — which may be anything. But when we can take the average for a considerable number of stars, we can trust the laws of chance to give us pretty reliable values.

AN apparent complication — but a real advantage — is introduced by the Sun's motion in space. If the stars themselves were at rest, this would cause them to appear to drift in the heavens toward the point away from which we were moving, and, knowing the speed of the Sun's motion and the angle at which its effects were foreshortened for a given star, we could calculate good parallaxes for each one. When the random motions of the stars are added to this, we must take, not the motion of an individual star in the drift-direction, but the average for a large number, and trust the individual motions (which are about as likely to be in one direction as opposite to it) to "average out." This will never happen exactly; but, for the average of 100 cases, it is an even chance that the outstanding effect will be not more than one tenth of the motion of an individual star.

We can get a quite independent determination of the mean parallax by taking the proper motions of the stars at right angles to the direction of the drift. These depend on the motions of the stars themselves, in a specified direction at right angles to the line of sight. Now we can find the "peculiar" velocities of the stars themselves, along the line of sight, by subtracting from the observed velocity the effect of the Sun's motion, which can be very easily calculated.

We now take averages for the available stars — simply of the numerical values, disregarding the positive and negative signs — and trust that the mean will "average up" in the same way in one case as in the other. If there is no tendency for the real velocity of a star to be greater along the line of sight than across it (which should be substantially the case for stars scattered all over the sky) we should get good average values — indeed it is found that the average result for 100 stars should be right within 7 percent half the time.

This method was first applied to the N stars by Kapteyn, in 1910. The material then available was sufficient only to show that they were very distant, and among the brightest of all classes of stars.



Propped up diagonally in this little museum on a public square in Corning, New York, the first of the two 200-inch glass mirror disks (the slightly imperfect one) is now available at all times, without a particle of previous formality or even an entrance fee, for all who wish to come there to inspect it. This is the mate to the largest piece of glass on earth, the one cast later and sent to California. On a pinch it could even have been ground and polished and used in the telescope, and still could be so used in a tighter pinch. However, because one of the 114 cores embodied in the mold for the purpose of leaving the disk ribbed or skeletonized at the back melted loose during the pouring of the molten glass and left solid glass in its place, it was decided to cast a new disk. This was done in 1934 and that disk is now being prepared in Pasadena, California

Thirty years of observations now provide enough material for a much more accurate value, and a thorough discussion has recently been published by Dr. R. E. Wilson. There are now 106 stars of class N for which fairly good proper motions can be determined. Combining these with the radial velocities (which have been observed for 145 stars) and using both the methods just discussed, he finds that an average N star of magnitude 7.3 has a parallax of 0″.00166, which corresponds to a distance of 2000 light-years. The corresponding absolute magnitude is −1.6, which indicates a luminosity 300 times the Sun's. Certain refinements of calculation raise this to nearly 400 times the Sun's light.

These are therefore very luminous bodies. If we could measure the total energy radiated, including the invisible infra-red, we would obtain much higher values — probably at least ten times as great. The N stars are therefore giants of a pronounced type. There does not appear to be much difference in the visual luminosity between those in which the carbon bands are strongest and least heavy; but, as the former are probably cooler, the total energy radiated is probably greatest for the "latest" types, as it appears to be among the M stars.

They are much brighter, by any standard, than the average M star, so that our lists represent a hunt for them in a large volume of space, and they are still rarer than the first counts indicated.

The R stars are fewer and fainter, and only 37 of them are available for discussion. For these, by similar methods, Dr. Wilson finds an absolute magnitude of −0.5, or about 120 times the Sun's visual luminosity.

ONE third of the R stars, and four fifths of the N stars, are variable in brightness. Most of them vary irregularly, and over a moderate range (not exceeding two magnitudes), though some are periodic, and a few have the large ranges characteristic of variables of class M.

The physical conditions in these remarkable stars are still imperfectly understood. Unfortunately, we have no way of getting at their masses, and finding to what degree they obey the general rule that bright stars are massive. Their surface temperatures must be among the lowest known, but are difficult to estimate, on account of the way in which the bands cut up the spectrum. Their diameters must therefore be very large, and gravity at their surfaces low. What keeps them shining is still a puzzle — as for all the other giant stars; and how they came to differ in composition from the oxygen stars is a question which physics — even nuclear physics — is not in a position to inquire.

One curious fact should still be mentioned. Not a single carbon star has been found among the hundred and more of red dwarfs which have so far been observed. Since there are probably at least 200 or 300 oxygen stars to one carbon star among the giants in a given region of space, it may well be that we have not yet a sample of dwarf stars big enough to include one, and it is premature to theorize about it.—*Mt. Wilson Observatory, January 29, 1940.*

MAN'S EARTHLY FUTURE

How Long Will Our Earth Survive, and How Long Will the Species Called Man Endure on It? . . . Man's Fate: Either Oblivion or Improvement

By KIRTLEY F. MATHER
Professor of Geology at Harvard University

(In Two Parts — Part One)

DURING the first decade or two of the current century, geologists, astronomers, and physicists engaged in many discussions concerning the future of the Earth as an abode for life. Some believed that "the end of the world" was relatively close at hand; others that the prospect for the future was to be measured in terms of hundreds of thousands if not of millions of years. As usual in scientific circles there has emerged from the conflict of ideas during the years of discussion a general unanimity of opinion, and today the geologic outlook for the future of the Earth is quite clear.

Since the turn of the century new methods of measuring the length of geologic time have been discovered and applied. New concepts of the nature and sources of energy have been proposed and tested. New data concerning astronomic space and the distribution of the stars have been secured. Innumerable details of Earth history have been deciphered to give a trustworthy record of the changes which the Earth and its inhabitants have undergone in the past. The key to unlock the secrets of the future is now available in this knowledge of the past, and with our present understanding of the processes of nature that key may be intelligently used. All the evidence combines to lead us unmistakably to the conclusion that for many scores if not for hundreds of millions of years to come the Earth will continue to be a comfortably habitable abode for creatures like ourselves.

Surface temperatures of the Earth, the most important item in any consideration of its long-range habitability, are determined by the receipt of solar energy distributed through atmospheric agencies. For any given area of land the annual contribution of heat from the Earth's interior, hot though it may be, is just about equal to the warmth received from the Sun in 20 minutes by an equal area in equatorial latitudes under a clear sky at mid-day. The 19th Century picture of an Earth, initially fiery hot but progressively cooling so that yesterday it displayed a glacial climate and tomorrow it will be too frigid to support life, may now be thrown into the discard. The Earth will "grow old and die" only as a result of failure to receive adequate supplies of radiant energy from the Sun. The prospect that the Sun will "burn itself out" in a decrepit old age is so remote as to baffle all attempts to date that untoward event even by those who are expert in the juggling of astronomic figures. Nor is there any likelihood that the space-relations between Earth and Sun will change appreciably within scores of millions of years to put the Earth either too close to the Sun or too distant from it for comfort.

The lurid pictures of a sudden catastrophic debacle resulting from collision with some other heavenly body — comet, planet, star, or what you will — are products of a vivid imagination wholly without foundation in astronomic fact or theory.

THE only plausible alternative to the conclusion that Earth and Sun will continue the even tenor of their ways for an inconceivably long period of time is that the Sun will some day imitate the super-novae occasionally detected among the stars and terminate the existence of the entire solar system by a gigantic explosion. Precisely one such super-nova has been observed within the galaxy of the Milky Way and several such in all the other galaxies of stars during the last few decades. The astronomers could therefore calculate for us the chances on a statistical basis that any individual star — the Sun, for example — would suffer such a fate within any given period of time. The result would be a figure so infinitesimal as to set at rest the mind of even the most jittery of questioners. Pending the discovery of the kind of premonitory symptoms displayed by stars about to blow themselves to atoms, the best that can be done is to rest content in history. Since the earliest records of living creatures were left as fossils, if not indeed since the earliest sedimentary rocks were formed, the Sun has faithfully maintained its energy output within a fairly narrow range and has given no evidence of any fluctuations that might suggest any significant change in its behavior.

The geologist may therefore turn with confidence from the long perspective of geologic past with its one-and-a-half to two billion years of recorded Earth history to a similarly long prospect for the future. Time is one of the most overwhelming resources of our universe.

It should not be inferred, however, that the Earth will continue in the future to display the same environmental conditions as those which we enjoy today. The history of mankind thus far has been enacted against a background that in the full perspective of Earth history is truly extraordinary. The geologic period in which we live is a time of unusually rugged and extensive lands with notably varied climate ranging from the glacial cold of Greenland and Antarctica to the oppressive warmth and humidity of certain equatorial regions. Such conditions have apparently recurred many times at long-spaced intervals since the oldest known rocks were formed, but added together the time thus represented cannot be as much as a fourth of geologic time. Much more characteristic of Earth history as a whole have been the conditions illustrated by those periods when corals thrived in shallow seas occupying the site of Baffin Land and North Greenland, and coal-forming plants flourished on Antarctica. The probability is strong that eventually, say in five or ten million years, the Earth will display again the physical conditions of many past geologic periods that were characterized by broad low lands, wide shallow seas, and uniform genial climate.

But most of us have a greater interest in the next few centuries than in the subsequent millions of years. Minor changes in climate will doubtless occur just as they have in the last few thousand years. Unfortunately, or perhaps fortunately, there is no basis for prediction concerning their nature, whether for better or for worse. There is really no good reason for referring to the present as "a post-glacial epoch"; it may prove to be an interglacial epoch. But our ancestors weathered ice ages in the past and presumably we are better equipped for such contingencies than they were. Should the average annual temperature of the Earth as a whole be reduced something like 10 degrees, Fahrenheit, and

From the Eighteenth Sigma Xi Lecture, delivered at the recent Columbus, Ohio, convention of the American Association for the Advancement of Science.

remain at that lower level for a few millenia, it is likely that once more the greater part of Canada, the northern United States, and the Scandinavian countries would be buried beneath great ice sheets. But in consequence of the removal of water from the sea as vapor to form the snow to produce the glacial ice, considerable areas now shallowly submerged along the coastlines in middle and equatorial latitudes would emerge as dry land. Indeed, it is likely that the area of land suitable for human abode would be nearly or quite as great at the climax of a glacial period as it is today.

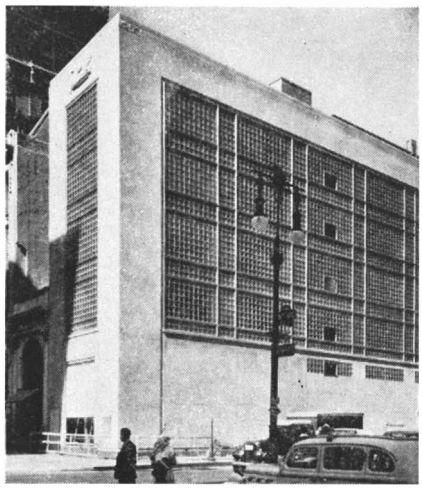
By the same token, the disappearance of existing bodies of glacial ice as a result of rapid amelioration of climate in the not-distant future would, if it occurred, be a decidedly mixed blessing. Return to the sea the water now imprisoned in the ice on the Arctic islands, Greenland and Antarctica, without any compensating changes in crustal elevation, and sea level would be raised 50 or 60 feet the world around. Considering the number of people who now work or sleep in buildings in metropolitan communities not over 50 feet above sea level, the importance of such a change is readily apparent.

But from the geologist's point of view these are relatively trivial matters. With due deference to the nature of the climatic variations and geologic changes which are certain to occur in the next few thousand years, there is nothing to be expected from such sources that would seriously deter the human species from maintaining a comfortable existence on the surface of the Earth for an indefinitely long period of time — a period to be measured in millions rather than in mere thousands of years.

AT last, it is generally understood that man is a part of nature. He may be something more than an animal (that depends largely upon definition), but he is none the less truly a part of the animal world. Like the other inhabitants of the Earth, man is a product of evolutionary processes operating on this particular planet.

We may be the last products of the creative forces displaying themselves in the organic development taking place in this particular portion of the cosmos, but we have no reason to assume that we are the last achievement of those forces. Nor does the fact that man has arisen from a lowly origin through processes of evolution validate the optimistic inference that he will necessarily continue his progress to ever higher levels of activity. Evolution does not guarantee progress; it merely guarantees change. The change may be for the better or the worse, depending upon the conditions of time and place and the vitality of the individuals concerned.

The pages of Mother Earth's diary reveal an amazing and thought-provoking record of the progress of living creatures throughout the long eras of Earth history. Again and again, in the procession of the living, dynasties of animals or plants have arisen from a humble origin to a position of world supremacy, maintained for a comparatively brief period and then lost forever.



Drawing the teeth of environment. In modern structures such as this (Fifth Avenue, New York, building of the Corning Glass Works), man, more now than ever before, is in near control of his environment. Here little pieces of an always comfortable world that does not often exist outside are created artificially. Man is the only animal which has been able to do this

Some have disappeared entirely as their paths have led them off into blind alleys. Others have sunk to a low level and have continued a degenerate existence to the present day. A few have given rise to other and more efficient forms of life which superseded their predecessors as leaders in the procession. Gradually we are discovering some of the reasons for success and failure along the path of life. Beyond question, man may profit from these experiences of the past, if he uses the intellectual and moral resources which are available for him.

From the point of view attained through knowledge of geologic life development, man has today a unique opportunity to gain continuing security for himself and his progeny on the face of the Earth, but whether or not he takes advantage of that opportunity is to be determined largely by himself. So far as we can tell, man is the first animal possessing the power to determine his own evolutionary destiny, but there is nothing in the record which guarantees that he will use that power wisely.

The animal species that in the past have been able to maintain their existence for more than two or three million years are relatively few in number. Most of them were comparatively simple types belonging to the less highly organized branches or phyla of the animal kingdom. Many were inhabitants of the sea where environmental conditions were remarkably stable throughout long periods of time. Among placental mammals, the major subdivision of the vertebrates to which man belongs, there is no similar record of longevity. Except under extraordinary conditions of geographic isolation, no species of placental mammal has persisted more than two or three million years. No matter how successful it may have been temporarily in multiplying and spreading over the face of the Earth, each has become extinct in a geologically brief span of time. Perhaps a half million years might appropriately be taken as the average "life" of a species in this group of highly organized and notably complex creatures.

BUT extinction does not necessarily mean failure; it has frequently indicated the acme of achievement. For example, some of the now extinct three-toed horses and four-toed camels passed on "the torch of progress" to their descendants, the one-toed horses and two-toed camels, and thus gained long-continuing security for their kind.

What then does the future hold for mankind? *Genus Homo* has already existed for three or four hundred thousand years; the species *Homo sapiens* has about 50,000 years to its credit. If the average applies, we may expect nearly or quite a half million years more of existence for our kind and then either oblivion as we reach the end of a blind alley or progressive development into some type of descendant better adjusted than we to the total environmental factors of the time.

But does the average apply? Must man exit from the scene through either of the doors, that which closed behind the dinosaurs and titanotheres or that which opened before the three-toed horses and notharctines?

Most creatures have gained security by specializing in adjustment of structure and habit to particular environmental conditions, whereas man is a specialist in adjustability of structures and habits to a variety of environments. No other vertebrate can live as can he on Antarctic ice cap, in Amazonian jungle, beneath the surface of the sea, or high in the air.

Furthermore, man is the world's foremost specialist in transforming environments to bring them within the range of his powers. Far more efficient than the beaver or the mound-building ant, he drains the swamp, irrigates the desert, tunnels the mountain, bridges the river, digs the canal, conditions the air in home, factory and office.

As a matter of fact, adjustability to environment is accomplished more by

controlling surroundings than by modifying internal organs or essential functions of the body. When we ascend with Major Stevens into the stratosphere, or dive with Doctor Beebe 500 fathoms deep off Bermuda, or live with Admiral Byrd through the long night of Little America, we take along with us a sample of sea-level atmosphere and temperate climate which is our real environment in a situation otherwise unbearable. Fur-lined parkas and tropical linen suits are but a medium for ensuring an immediate environment as nearly as possible like that of middle latitudes when living in polar or equatorial surroundings.

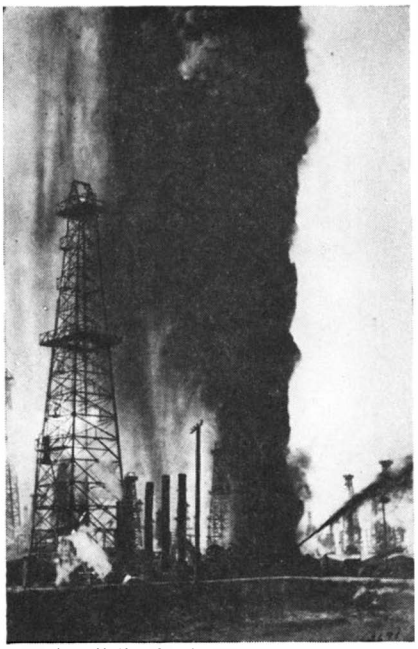
But, regardless of interpretation of procedure, the result is clear. Man has placed himself in control of external conditions to an extent immeasurably greater than has any other creature. He has practically "drawn the teeth" of environment.

ALTHOUGH we know little of the details, it is certain that most of the creatures of the past who "have had their day and ceased to be" were forced into extinction by changes of one sort or another in their environment, changes which came with such relative speed that they were unable to make adjustment to them in time. Man need have no fear on that score.

It is, however, immediately apparent that man's conquest of his surroundings has resulted from his clever use of things. Unless there is ceaseless flow of cotton, flax and wool, of coal, iron and petroleum, of copper, lead and tin, from ground to processing plant to consumer, he becomes a puny weakling. It is because he uses certain resources provided by his environment that he is freed from slavery to his environment. Are these resources adequate to keep him supplied with what he needs to maintain indefinitely the sort of existence to which he has accustomed himself?

There are two fundamental sources of the goods and the energy which man uses in the grim business of securing the sort of living which he apparently desires. On the one hand there is the farm and the waterfall, on the other there is the mine and the quarry. Things which grow in the field or forest, and power produced by falling water are in the category of annual income. Now that scientific research has made available the limitless quantity of nitrogen in the air for use as fertilizer, the resources of the plant and animal kingdoms are renewable; we use them, but we need never use them up. In startling contrast the resources of the mineral kingdom are non-renewable; they are in the category of accumulated capital. Petroleum and coal, copper and iron, lead and vanadium, these and many other prerequisites of modern civilization have been accumulated by nature through hundreds of millions of years of geologic activity. Thanks to scientific research, man is exhausting that store of mineral wealth in a few hundred, or at most a few thousand years. That inescapable fact is at rock bottom one of the most fundamental causes of economic distress, of war between nations, and of strife between classes.

Fairly accurate estimates of the world



Courtesy *National Petroleum News*

Photographs like this, showing oil wells afire and wasting thousands of barrels of oil, will be dug out, three generations hence, from the musty files of the magazines of 1940 and reproduced again, so that posterity, to whom we shall transmit but a meager supply of petroleum, may curse our prodigality in recklessly wasting a resource which we know to be non-renewable. Opinions differ widely. Some simply remark, "Why worry?" and quote that shopworn wisecrack: "What did posterity ever do for us?" True, we may learn to get heat direct from the Sun, lubricants from other sources than petroleum, energy from the atom, but are we sure?

stores of many non-renewable resources are now available. Take petroleum as an illustration. The known available reserves of petroleum beneath the surface of the United States total at present approximately 17 billion barrels.[1] Experts differ in their guesses as to the quantity of petroleum that may be discovered in the future in areas that have not yet been adequately explored with the drill or in known fields by discovery of deeper reservoirs not yet reached by the deepest wells in those fields. There are also many varying shades of optimism and pessimism concerning the possibility of increasing materially the percentage of recovery of the oil present in a reservoir rock when penetrated by drilling operations. Estimates of the quantity to be added to our petroleum reserves from these two sources range from seven or eight billion barrels to 15 or 20 billion. I would incline toward the larger figures, considering them as maxima which are extremely unlikely to be exceeded. On that basis, the present store of available petroleum beneath the surface of the United States is 25 to 35 billion barrels. That is only about 30 times the annual domestic consumption of petroleum in recent years. The average annual production of petroleum in the United States during the five years from 1934 through 1938 was almost 1,100,000,000 barrels,[2] and the 1939 production exceeds 1,250,000,000 barrels. At the present rate of withdrawal, the domestic stores of this essential raw material would, therefore, be exhausted in less than a third of a century.

DATA are not nearly so precise for the majority of foreign countries as for the United States. It is, however, fairly safe to conclude that the world stores of petroleum will last only something like 75 years at the present rate of withdrawal. With the possible exception of Mexico, no other country has been as successful as the United States in the attempt to exhaust its petroleum resources in the shortest possible period of time, but rapid progress toward that result is now being made in many regions.

Lest we become too pessimistic in response to such unwelcome figures, we should promptly note that substitutes for petroleum are already known. Gasoline, fuel oil and lubricating oil can now be manufactured from coal and other rocks rich in carbon, by processes of hydrogenation and polymerization. These are expensive processes and their products cannot now compete with the products from petroleum even in countries far removed, both geographically and psychologically, from the more productive oil fields.[3] They will, however, come into use more and more in the next few decades.

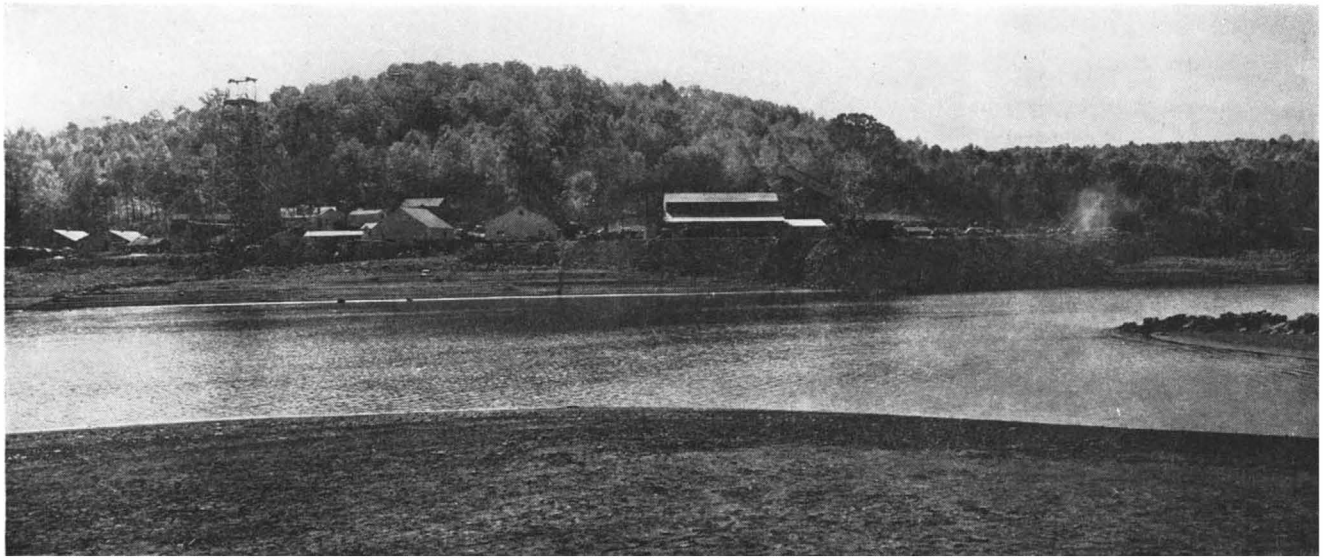
Enough bituminous and sub-bituminous coal is known to be available within the United States to meet the present annual demand for coal, plus enough to manufacture gasoline and fuel oil in sufficient quantity to meet current demands for at least 2000 years. In addition there is enough oil shale — a rock rich in carbon but containing little or no oil — to meet present needs for petroleum products for at least three or four thousand years.

(To be Concluded)

[1] "Petroleum Reserves Are Estimated by Institute Committee at New Record Total," *American Petroleum Institute Quarterly*, Vol. 9, No. 2, p. 7, 1939.

[2] Statistics from "Minerals Yearbook," published annually by the United States Bureau of Mines.

[3] K. C. Heald, "Technology and the Mineral Industries, WPA National Research Project, Report E-1," pp. 27-31, 1937.



Half-empty condition of one of the Croton reservoirs during the 1939-40 water shortage

When Water Shortage Threatens

Lessons Learned by New York City . . . Prolonged Wet Spells Give False Sense of Security . . . How Wastage May be Decreased to Conserve Supply

By EDWARD NUEBLING
Division Engineer, Department of Water Supply, Gas and Electricity, City of New York

NEW YORKERS have been so accustomed to obtaining, at a mere twist of the wrist, an unfailing supply of clear, wholesome water, that the probability of a water famine seems well nigh incomprehensible. However, the shortage of the winter of 1939-40, intensified by a dry spell that began May, 1939, is not the first of its kind; the city's history is punctuated with water crises of varying degrees, with even the early settlers of Manhattan having their troubles. In fact, the story of New York's water system is a chronicle of the city's constant growth and the efforts of the system to keep pace.

The Dutch inhabitants in the 17th Century were the first to encounter difficulty. The increasing density of the growing population was making private wells unfeasible, as well as insanitary, and the year 1658 marked the construction of the first public well and the decline of the individual type.

By 1832, the population had grown to nearly 200,000. Water conditions were intolerable. An epidemic of cholera was the impetus that led to the development of the Croton Watershed, 35 miles north of the city. A small dam was built across the Croton River at a point where it drained an area of 352 square miles. By the summer of 1842, work on the aqueduct had progressed sufficiently to permit water to flow from the Croton River to a distributing reservoir in the city. The aqueduct had a capacity of 90 million gallons a day, and some engineers confidentially predicted that the water supply problem had been solved for all time. But the city continued to grow and it became apparent that the yield of the watershed had been overestimated.

Courtesy of *Water Works Engineering*.

At least the impounding reservoirs were too small to maintain the required supply through the long dry spell that started in 1880 and caused the city to experience its most harrowing water crisis the following year. In September, 1881, rigid emergency measures had to be taken to reduce the consumption: outlet gates of the reservoir in the city were partially closed; public fountains were shut off; street sprinkling was stopped; appeals were made to the public to economize on water consumption. The heavens finally relented and a long rain saved the situation. It is a matter of record that another ten days of dry weather would have left the reservoirs as dry as the Sahara and the city's 1.200,000 inhabitants would have been without water.

By 1885, the Croton Aqueduct had become inadequate to furnish the supply of water needed in the city, thus creating a shortage that was not due to weather conditions. Work was begun on a new aqueduct having a capacity of 285 million gallons a day. Water was delivered through it to the city, for the first time in 1890. This was none too soon, for the Old Croton Aqueduct was being forced to deliver water beyond its safe carrying capacity and was being subjected to pressures for which it was not designed.

In 1895, a new supply of 20 million gallons a day from the Bronx and Byram Rivers, near the city, was made available. Three years later, Greater New York came into being through the absorption of the various communities lying in and about New York Harbor; the consolidated city includes the boroughs of Manhattan and the Bronx (the former city of New York), Brooklyn, Queens, and Richmond. The population of the Greater City in 1898 was 3,272,420, of which 1,976,570 resided in Manhattan and the Bronx.

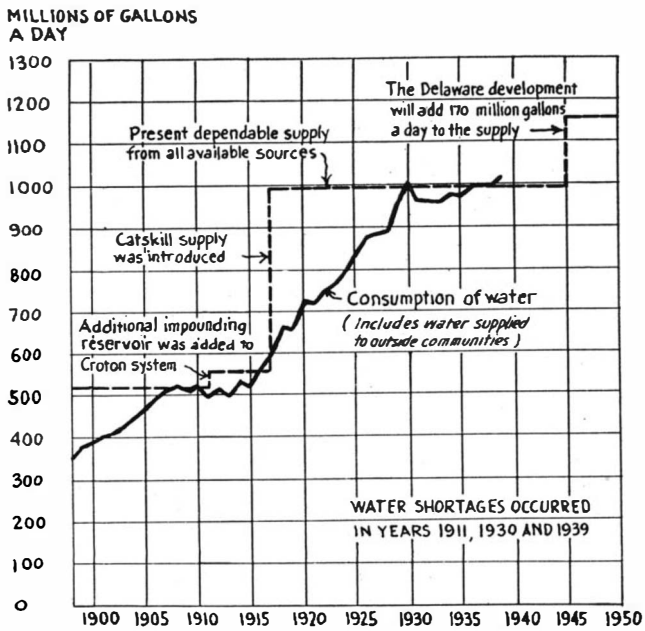
Upon consolidation, all of the publicly owned plants within the greater city were placed by statute under the jurisdiction of the Department of Water Supply. Some 16 privately owned plants continued to be operated by the owners. Three large plants, one in Brooklyn and two in Queens, are still in operation.

Shortly after consolidation, the necessity was foreseen of providing a large additional supply of water for the greater city as a whole. So in 1907, construction

was started on the development of the Esopus and Schoharie Watersheds in the Catskill Mountains, 100 miles north of the city. However, construction work was started too late to avert another shortage of supply in 1911. The Croton Reservoirs were far below normal, and the supplies available to the other boroughs, which were obtained mostly from underground sources, were inadequate to meet the demand.

The emergency measures of 1881, as well as new ones, were taken to relieve the condition. For the first time, systematic underground waste work and house-to-house inspection for the detection and suppression of leaks was tried. This waste work was instrumental in holding down consumption until the present Catskill source was added to the system in 1917.

The last water shortage incident occurred a decade ago. It was the peak of the boom period. In a city of New York's size, there is a definite correlation between business conditions and water consumption; good business means increased production, and many industries use large quantities of water. A prolonged dry spell at this time (1930-1931) found the reservoirs emptying at an alarming rate. The Department of Water Supply's first action was to employ emergency measures similar to those used so successfully in 1911. But it was not long before the repercussions of the stock market debacle began to be felt in industry. At this juncture, and with a more immediate salutary effect on the water supply, capricious Nature dipped into one of those unpredictable wet cycles which was destined to last nearly a decade. In the frenetic period of unemployment and national upheaval that prevailed, people soon forgot that there had been a threatened water famine.



New York City water consumption and supply

BUT the engineers and experts of the Department of Water Supply and the Board of Water Supply, a separate organization empowered to develop large additional sources of supply, did not forget. In fact, they had anticipated the shortage, had been seeking an additional water source for a number of years. The upper Delaware Watershed, adjacent to the Esopus and Schoharie Watersheds, was finally decided upon as the best new source of supply.

The concomitant wet cycle tended to imbue many people with a false sense of security. Among these people was a group of citizens who minimized the necessity of the costly Delaware project. They admitted the need for a new water supply in the near future, but believed that universal metering was the logical solution.

Water was then, and is now, sold to domestic consumers in New York on a flat, yearly basis. Under universal metering, each consumer would pay for the exact amount of water used. This system, it was contended, would eliminate waste and extravagant use and would result in an estimated saving of 200 million gallons a day. It was further pointed out that the cost of metering would be one tenth the cost of the Delaware development and would take one fifth the time. In other words, it was held that the Delaware development would add another heavy burden upon the taxpayers, whereas metering would not.

The proponents of the Delaware project counter-argued that when completed it would bring 540 million gallons a day to the city. The constantly increasing population and the inevitable necessity of the project was emphasized.

It was finally decided to proceed with the $273,000,000 Delaware project. Looking back now, it is agreed that both projects should have been started simultaneously. But then, there was the question of money, which was, as usual, the main bone of contention.

The Delaware project is to be built in two stages. Actual construction on the first stage was begun in 1936 and will be completed about 1945. It will bring 170 million gallons a day to the city. The commencement of the second stage, which will bring an additional 370 million gallons a day, will be held in abeyance until the necessity for a larger supply becomes apparent.

Normally, 90 percent of the city's supply of water comes from impounding reservoirs in the Catskill and Croton Watersheds. The last reservoir added to the system was the 20,000 million gallon Schoharie Reservoir, which was placed in service in 1926. This brought the total available storage capacity of the Catskill and Croton systems up to 285,000 million gallons. While this enormous quantity of stored water would at the present time be used up in less than a year, it would have sufficed liberally for all of the wants of the old city from the time of settlement up to 1842 when Croton water was first supplied, a period of 230 years. The slow growth of the city in its early period lends truth to the saying that "water supply establishes a dead-line beyond which no city can grow with safety and health." Shortly after Croton water was introduced, the per capita consumption increased from 35 gallons a day to 80 gallons, and, in the following 15 years, the population was doubled.

IN April, 1939, all of the reservoirs were full nearly to overflowing. At the close of the year, owing to low rainfall and run-off in the watersheds, there remained in storage only 129,000 million gallons. During the nine months from May through December, the reservoirs were depleted at the rate of 620 million gallons a day. This rate of depletion, if continued, would leave the reservoirs empty by the summer of 1940.

In 1939, the consumption of water from municipal sources of supply averaged 963 million gallons a day. Of this amount, 22 million gallons a day were supplied to communities outside the city. Private water companies operating within the city furnished 60 million gallons a day, bringing the total city's supply up to 1023 million gallons a day. The population served, including outside communities, is estimated at 8,000,000. In addition, some 500,000 commuters enter and leave the city daily.

The dependable source of supply—that is to say, the supply of water that can be made continuously available through prolonged drought periods such as the city might now be passing through—amounts to only 990 million gallons a day. The demand for water last year exceeded the dependable supply. The only reason that the city is not now confronted with empty reservoirs and a water famine is that drought conditions did not prevail throughout the year and that private water companies are still pumping from ground water beds that are nearing exhaustion.

To remedy conditions, the Commissioner of the Department of Water Supply, Gas and Electricity, Joseph Goodman, outlined the following courses:

1. APPEALS TO THE PUBLIC TO STOP WASTE: The low stage of the impounding reservoirs was first called to the at-

tention of the public through the press last October. Heads of city departments have since been requested to repair all defective water fixtures in buildings under their jurisdiction. The use of water for street cleaning has been reduced to a minimum. Posters were displayed in all cars of the subway lines giving notice of the low stage of the reservoirs to the several million passengers who travel on the lines daily. One and a half million folders, calling attention to the water shortage and the necessity for stopping waste from leaking faucets and toilets, were printed for distribution in schools and through other public and private agencies. In addition, the municipal and other radio stations helped with spot announcements, reminding the citizens of the water shortage and requesting co-operation in reducing waste.

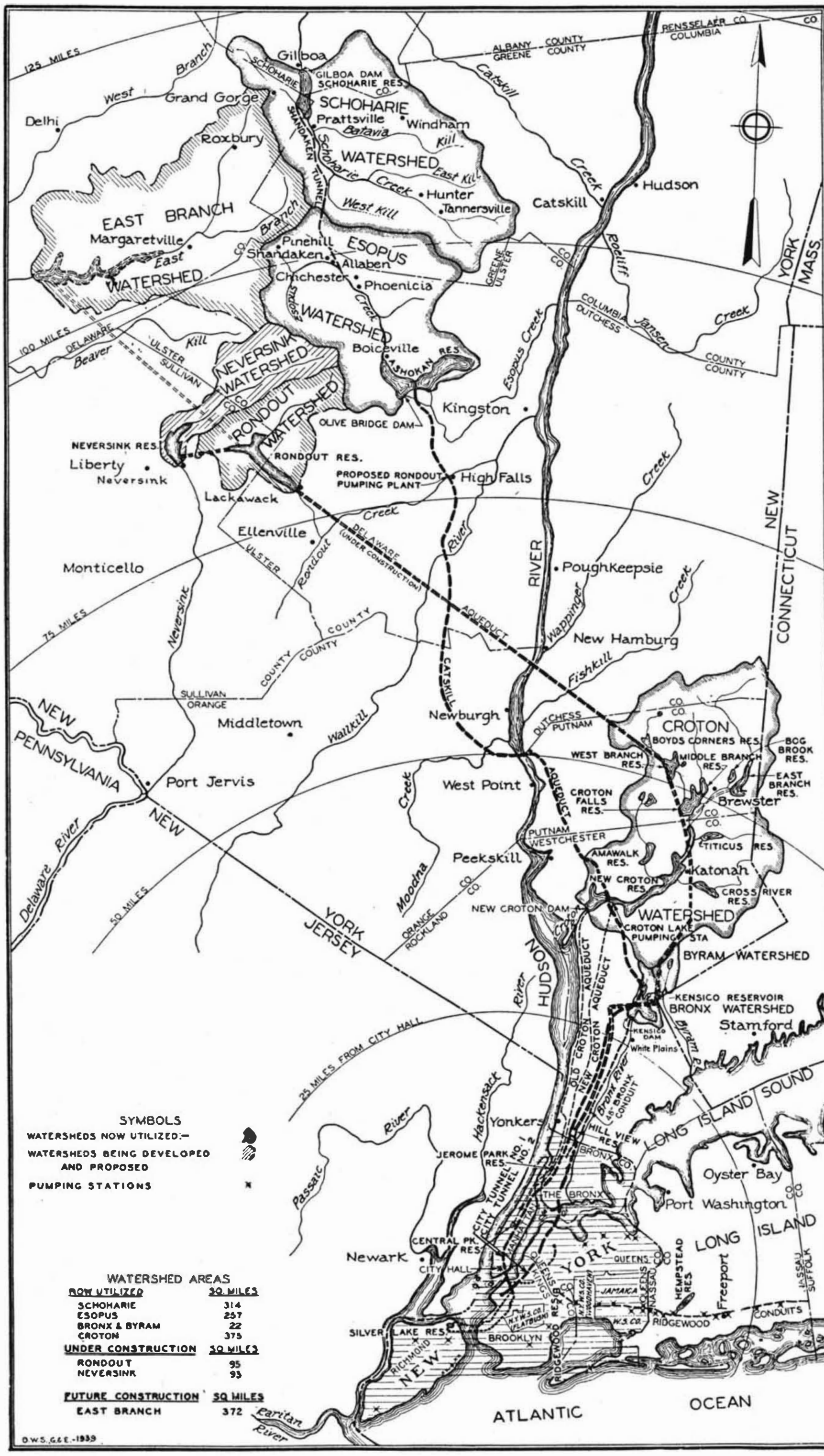
2. Development of Additional Wells In Long Island. When the Catskill supply was introduced in 1917, Long Island well sources were for a brief period discontinued. However, as the city grew, the well supply was again drawn upon to supplement other sources. Measures will now be taken to rehabilitate old wells so that the entire available supply may be utilized, and also to provide additional wells. The additional wells will add 50 million gallons a day to the system. However, the approval of the State Water Power and Control Commission must be obtained before this development can be undertaken.

3. Detection and Suppression of Leaky Fixtures In Buildings: The last house-to-house inspection was made with WPA labor from 1934 to 1937. The survey took in 473,000 buildings, revealing 400,000 leaks. In one section of the city, one toilet out of every five examined was found leaking. Over 50 million gallons a day were being saved at the time of the project's discontinuance. Since new leaks are continuously developing, house-to-house inspection must be repeated periodically to be of lasting benefit. At the present time, it is estimated that virtually all of the saving made on the last survey has disappeared and that by instituting another campaign, the consumption can again be reduced some 50 million gallons a day.

4. Detection and Suppression of Underground Leakage: Water is conveyed from source to consumer through a vast and intricate underground network of 5000 miles of water mains and 640,000 service pipes. Leaks in this subterranean system develop at the rate of 20,000 a year. Most leaks appear at the surface and are promptly repaired. However, an appreciable number flow through underground channels. During the past ten years, a special force of men has been ferreting out these leaks in Manhattan and the Bronx, covering the two boroughs about once in three years. It has maintained a saving of about 30 million gallons a day that otherwise would have seeped irretrievably into the soil. Underground waste work is also being done by a WPA force in Brooklyn and Queens. Enlargement of the present force and extension of this work to all five boroughs should raise the savings to a total of 50 million gallons a day.

5. Reduction of Pressures: It is estimated that well over 200 million gallons a day is now being lost from leaks in water fixtures and underground pipes. Obviously, by reducing the pressure in the pipes, the amount of leakage will be decreased. This method of reducing consumption, however, will be employed on a large scale only if it should become necessary to avoid emptying the reservoirs completely.

It is estimated that the conservation measures outlined above, when in full swing, will reduce the demand for water in the city by 80 million gallons a day. This saving, plus the additional well supply, may suffice for the needs of the city up to 1945.



Present and future water-supply areas for New York City

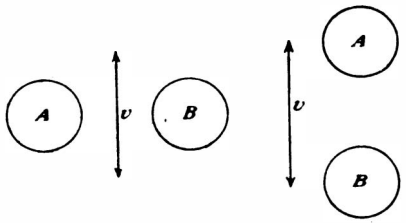
SOUNDLESS SOUND WAVES

Supersonic Waves in Science and Industry . . . For Smoke Precipitation, Emulsification of Liquids, in Fishing and in War . . . Sounds that Burn

By WALTER L. FINLAY, Ch.E.
Research Chemical Engineer, Remington Arms Company

(In Two Parts—Part Two)

EGOCENTRIC Man, unless he favors the Boston State House, usually considers himself the hub of the universe. From his point of view, a sound wave is that which he hears; from the universe's viewpoint, however, it is a longitudinal vibrational disturbance, usually of the air. Thus is resolved the apparent contradiction in the title of this article. If the disturbance vibrates faster than about 20,000 cycles per second it is inaudible to human ears



From Gottschalk and St. Clair, in *Mining and Metallurgy*

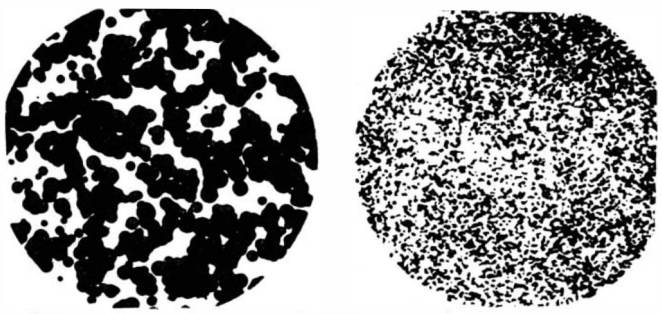
Figure 1: **An illustration of the "principle of Bernoulli," which is used in precipitating fumes**

and these soundless sound waves are called ultrasonics.

Apparent contradiction is not confined simply to the title but extends as well to the behavior of ultrasonics. For example, by dipping the bulb of a glass thermometer into an ultrasonically-vibrated oil bath one can enjoy the unique experience of having one's fingers burned despite the fact that the object held is, as evidenced by the thermometer reading, at all times at room temperature. Or, if ultrasonic vibrations are applied to an arm or a leg, the bone remains at the normal body temperature but the marrow is heated. The explanation lies in the fact that glass and bone conduct ultrasonic vibrations much more efficiently than do flesh or marrow. The latter absorb the vibrations and, as a consequence, become heated.

An interesting illustration of this heating effect is given by a simple experiment. A mixture of water and ice will maintain a constant temperature of 32 degrees, Fahrenheit, regardless of whether it is heated or cooled, until either all the ice has melted or all the water has frozen. Hence, if a newly formed block of ice made from distilled water is immersed in a bath of cracked ice and water and ultrasonics are applied, both the bath and the block will remain at 32 degrees, Fahrenheit. But if, after some exposure to the waves, the block is then squeezed, it will shatter like "rotten" ice, indicating that the vibrations had caused liquefaction at the grain boundaries. Natural ice—that is, pond ice—does not exhibit this effect, presumably because it is a single crystal.

The vibrational energy which burns the fingers holding the thermometer previously mentioned can be concentrated in a point with rather curious results. If the neck of a glass flask is heated and drawn out into a point, and the body of the flask is immersed in an ultrasonically-vibrated bath, the vibrational energy will be concentrated at the point. A pine chip held on the point will be penetrated in short order by a combination of drilling and burning. Even a plate of glass will have a hole drilled through it and, during the process, tiny globules of molten glass will be flung off in a miniature shower.



From Dr. B. Claus in *Zeit. techn. Physik*

Figure 2: **Showing how ultrasonic vibrations facilitate the emulsification of some highly immiscible liquids.** ***Left:*** **Result without vibration.** ***Right:*** **With vibration**

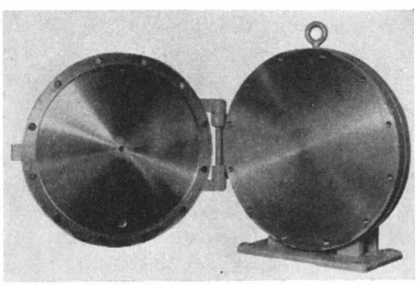
But ultrasonic vibrations provide more than just the mainspring of a magician's hat, for they have several rather important industrial applications. Ultrasonics of suitable intensity, for example, can precipitate tobacco smoke or the fumes of NH_4Cl, P_2O_5, SO_3 or HCl in one second. This precipitation effect has been explained by Gottschalk and St. Clair as an illustration of Bernoulli's principle. In effect, this principle states that the pressure in a fluid is least where the velocity is greatest. Thus, in Figure 1, at the left, the direction of vibration, that is, of motion of the air molecules, is perpendicular to the line of centers. Hence the pressure between the particles is lessened and the particles coalesce. In the same figure, at the right, the particles, oriented in a different direction, are urged apart but it is simply a matter of time until they are properly oriented to other particles for coalescence. Settling therefore is rapidly effected.

PRECIPITATION of smoke and fumes is an illustration of the ability of ultrasonics to destroy dispersions of solids or liquids in gases. But these paradoxical vibrations are also able to produce dispersions of solids or liquids in liquids. Such highly immiscible liquids as mercury and water can be transformed into rather stable emulsions by ultrasonic radiation alone. And, if mercury is electro-deposited from an aqueous solution of one of its salts and is simultaneously subjected to ultrasonic vibrations, a much finer dispersion is obtained. This can be observed by comparing the two halves of Figure 2, which were photographed at 2000 magnification.

Just how this emulsification by ultrasonics is effected is not clear but a large number of solids and liquids can be dispersed by this method. If an already existing dispersion of colloidal—that is, ultramicroscopically sized—particles is subjected to these vibrations the colloidal particles become still further divided. Milk, for example, is an emulsion of fat, casein, and so on, in water. The January, 1939, Scientific American (page 39) discussed how milk is now being commercially given a finer degree of emulsification by sonic radiation than Mother Nature was ever able to bring about, and Figure 3 shows the apparatus used. The advantage of this finer emulsification seems to be that smaller and

more easily digested curds are formed in the stomach. If the particles are already of molecular size, very slow further subdivision may still occur. For example, starch may be converted into dextrine, and cane sugar may be split into monosaccharides. Of more practical importance is the fact that the homogeneity of photographic emulsions is improved by ultrasonic radiation. As a result, it is possible to increase the silver halide concentration with a consequent increase in resolving power.

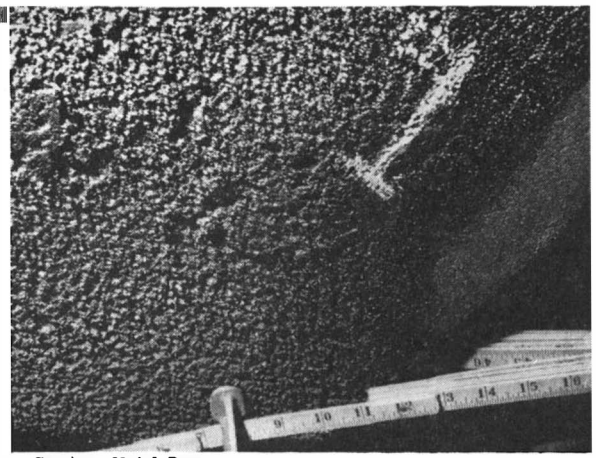
IT has persuasively been suggested that the phenomenon of cavitation is the basis of ultrasonic emulsification but the exact mechanism of just how it brings about this effect is not yet clear. Cavitation causes a tea kettle to "sing" just before boiling. The harmony comes from a ballet of bubble dancers but, in this case, there is nothing behind the bubbles. The singing arises from the condensation and collapse of steam globules as they rise into the colder water near the surface. When this colder region becomes sufficiently heated the bubbles cease their Swan Song and start to boil. The late Lord Rayleigh calculated that pressures of thousands of atmospheres might be developed at the moment of collapse and, of course, at highly localized spots. That such pressures are no mere mathematical abstraction is indicated by the cited fact that, during maneuvers, after a destroyer had rushed for several hours at maximum speed, the armor plates above the propeller were completely eroded through over an area of almost one square foot. Turbine and propeller design must, of necessity, take into account these cavitation effects in order to mitigate them. Figure 4 illustrates the destructive pitting action of cavitation on the cast steel blade of a hydraulic turbine after 18 months' service.



Courtesy Submarine Signal Company

Figure 3: **A two-foot, stainless steel diaphragm with hinged cover, as used for sonic treatment of milk**

In the ultrasonic radiation of a liquid, cavitation is brought about by the actual tearing apart of the liquid. A sound wave is propagated in the form of periodic compressions and rarefactions of the propagating medium. During the constantly recurring rarefaction phases of the vibration the liquid is literally stretched, and the resultant reduced hydrostatic pressure permits either dissolved gases or vapor of the liquid itself to form bubbles. Those bubbles which do not collapse are evolved from the liquid. Application of this principle to the industrially important problem of removing dissolved gases from molten metals has formed the subject matter of several patents. A corollary effect is the lowering by as much as two degrees of the boiling points of many liquids.



Courtesy *Metal Progress*

Figure 4: **What the phenomenon of cavitation in water did to the solid steel blade of a hydraulic turbine. Pitted deeply, the surface is no longer smooth and as efficient as before. Propellers similarly are pitted as a result of this odd phenomenon**

Ultrasonics are conducted much more efficiently in water than in air. In fact, communication and depth sounding are commercially carried out by its means. In the "echo" system of depth sounding a burst of ultrasonics is sent out from a piezo-crystal-vibrated diaphragm on the ship's bottom. After reflection from the floor of the sea these vibrations are picked up by another similar diaphragm. The piezo crystal of the latter converts the vibratory changes in pressure to easily recorded electrical impulses and the depth is automatically calculated from the elapsed time between transmission and reception. As many as 15 soundings per second can be made in this manner and an experienced observer can even distinguish between a mud, rock, clay, or sand bottom. The information obtained is of considerable value to commercial fishing trawlers. To polish off this facet of the many-sided ultrasonics as a real fish story, one need only relate that the exact location of close-swimming shoals of fish can be readily determined by the echo method. The fanciful might thus suppose that Mary Mackerel and Cathleen Cod can sense a premonitory chill as the searching beam of ultrasonics puts the finger on their svelte sides.

Much smaller organisms than mackerel or cod experience more than a merely premonitory chill. To very small fish and vegetable growths like protozoa, the initial chill is also the final one of death. This lethal effect is probably due to the destructive action of the phenomena — cavitation, degassing, and dispersion — which accompany ultrasonics.

Submerged submarines, by making use of the echo principle, can determine their position by determining the contour of the ocean floor and, also while submerged, can locate, and fire topedoes at, an enemy ship. Submarines can also communicate over distances as great as 10 to 15 miles and can concentrate the ultrasonic beam within one degree of the direction desired. Tapping such a private "wire" presents something of a problem to an eavesdropping enemy.

EFFICIENT as water is as a conductor of ultrasonics, metals are even more so. However, inclusions, cracks, blow-holes, in fact any discontinuities in the metal, are potent sources of reflection or absorption of the ultrasonic vibrations. Means for the non-destructive testing of metals is therefore provided by this phenomenon and a patent has been granted for this application.

It has also been claimed that ultrasonics accelerate the nitriding and carburizing of steel, both of which important processes impart a hard skin or case to steel, the former by compounding with nitrogen and the latter by compounding with carbon. Later investigations, however, did not substantiate these contentions. Nevertheless, other processes in solid metals may possibly be expedited by these vibrations. A super-heated liquid flashes into vapor and a supersaturated liquid immediately precipitates upon ultrasonic radiation. By analogy one might expect that such extremely important metallurgical processes in the solid state as the precipitation-hardening of age-hardening alloys such as duralumin and beryllium bronze and the austempering transformation in steel could be similarly accelerated.

These versatile vibrations are thus seen to be of interest to the scientist, to the industrialist and to the simply curious. It is a relatively new field for most of the pioneering work in it has been done within the last 15 years. And, although soundless, it seems quite probable that ultrasonic vibrations will be increasingly heard from in both industrial and scientific circles.

RAILROADS IN THE CELLAR

Capitalization of Model Railroads Now Runs Into Many Millions . . . Serious Avocation . . . Men Form Exclusive Clubs . . . Run Trains Like Railroaders

By R. T. GRIEBLING

WHEN a boy buys his father a toy train for Christmas, when a western Pennsylvania wife obtains a divorce because her husband spends too much time in the cellar "building railroads—little railroads," and when the president of a large eastern transportation system considers it perfectly proper to officiate at the opening of a model railroad, then it is high time to investigate a hobby that is breaking all records for sustained interest, and one which, because of its very nature, is going to stay with us for a long time.

Building and operating model railroads is not child's play, as one would ordinarily surmise, although it may have had its start from an urge to provide the youngster with more realistic equipment. But Junior isn't skilful enough to do the building himself. Dad has to help, and before you know it, Dad is over his ears in a new hobby.

Immediately, the boy can forget about his train entirely. It's Dad's now! And, incidentally, Junior isn't any too welcome when the trains are running. Model railroaders may love children, but they don't want them around expensive equipment, for children have an uncontrollable desire to handle the various pieces, and these must not be touched except with reverence.

Time made the mistake of talking flippantly about model railroading not so long ago, and almost immediately received the following rebuke from J. H. Bramble, of Farrell, Pennsylvania:

"Your phrase 'plays with toy trains' is a red flag to all serious followers of the hobby. . . Would you refer to a philatelist as one who plays with bits of colored paper, to an antiquarian as a collector of junk, to a fisherman as one who floats bugs on a string, or to a hunter as one who goes into the woods to kill things?"

They're touchy, these model railroaders, even worse than ping-pong players; and there are, according to best estimates, nearly 100,000 of them in the country. But model railroading is not confined to the United States alone. One manufacturer of model-railroad equipment is proud of the fact that he has customers in Canada, Mexico, Central America, Panama, Cuba, Puerto Rico, the Argentine, Hawaii, New Zealand, the Philippines, England, Belgium, Italy, Sweden, and France.

It takes blue chips to play the game right, too, depending, of course, on the scale used. There are cheap model railroad sets on the market — the hobby has already reached that stage — but the difference between one of these and a good set is as great as between a dollar watch and a fine Swiss movement. Both tell the time, but the latter does it just a little bit better all the way 'round.

Those of us who thought it was plumb crazy to pay up to $100 for a mah jong set, can get ready to be shocked all over again. Thirty-five-dollar locomotive assembly kits are as common as flies, and if you want a truly super-de-luxe engine, you'll pay as high as $295 for it. And don't forget that this sum pays for only one power unit and a tender; a good model railroader, proud of his set, has several of them. Cars, unassembled, will run from $3.50 to $10. Rail for tracks costs about 5 to 10 cents a foot (completely assembled track costs $1 a foot), and we haven't even begun to figure on ties, roadbed gravel, spikes, third-rail connections when necessary, frogs, switches, cross-overs, signal towers, waiting stations and other buildings, scenery, mannikins, transformers, and wiring.

WIRING is not always a costly item, but in some cases it might well be. Consider, for example, the largest and most complete model railroad ever built — exhibited at the New York World's Fair. The signalling system used 3,000,000 feet of wire. Other figures to make the eyes pop include 70,000 wood ties on 3500 feet of track, 125 switches, 10 double slips, 30 locomotives, and 400 pieces of rolling stock. Six thousand miniature trees make up the forests, and 7000 gallons of water were needed for the waterways.

If this model railroad is the ultimate dream of the enthusiasts, then it explains the entire hobby. The attention given to detail is nothing short of remarkable, and therein lies the fascination that is exercised over both builder and spectator.

The reason for model railroading's popularity is to be found in the ability to reproduce in miniature, with uncanny accuracy, the various pieces of equipment that go to make up a railroad. To build a coach with six-wheel trucks, when only four-wheel trucks are used on the prototype, is rank heresy, and model railroaders would be booed by their brethren for such inaccuracy.

Models built entirely by hand are museum pieces and take many months to execute. These are eminently not the ones that are found in model railroads. The tiny locomotives and cars that serve model railroads come either assembled or in kits unassembled. If they are of the latter variety, they can be put together in a reasonably short time. It takes much longer, however, to lay the track and install the wiring system. But anyone who has a knack for tools can join in the fun.

Fastidiousness is the principal joy of the model railroader. Everything must be "just like on the big trains," or else it has no real hobby value. All parts are built to scale, so that the complete outfit is actually a vest-pocket edition of the real thing.

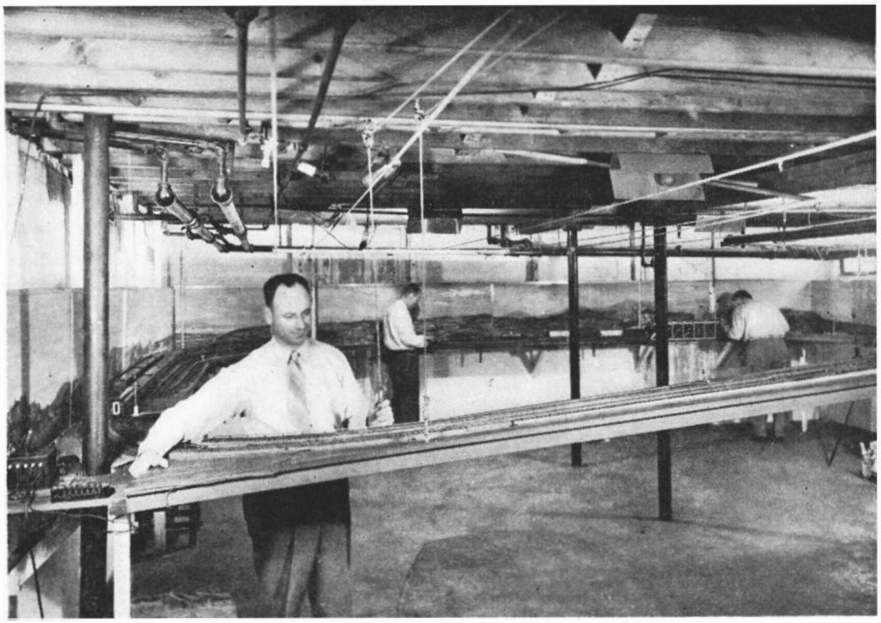
And that brings to mind another interesting fact about model railroading. Ever since the Union Pacific streamliners made their appearance in 1934, the amount of aluminum used in model railroad construction has increased, principally because the Union Pacific's new trains employ so much of this metal. And the sales arguments used by the manufacturers are quite similar to those used by aluminum salesmen in real life.

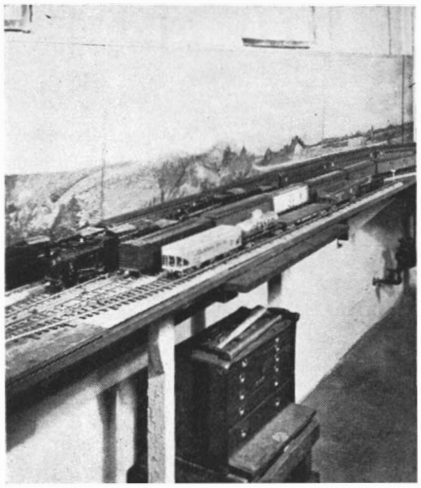
"Light weight and strength," says one maker, "are of vital importance in the manufacture of operating models, and this naturally brings us to the use of numerous aluminum castings."

"Duralumin rail," says another, "has everything in its favor. Color similar to steel, will not rust, gives good bite to drivers, is hard but cuts and bends easily, no excessive slipping, good conductor of electricity, produces good sound effects as wheels roll over it, and is inexpensive."

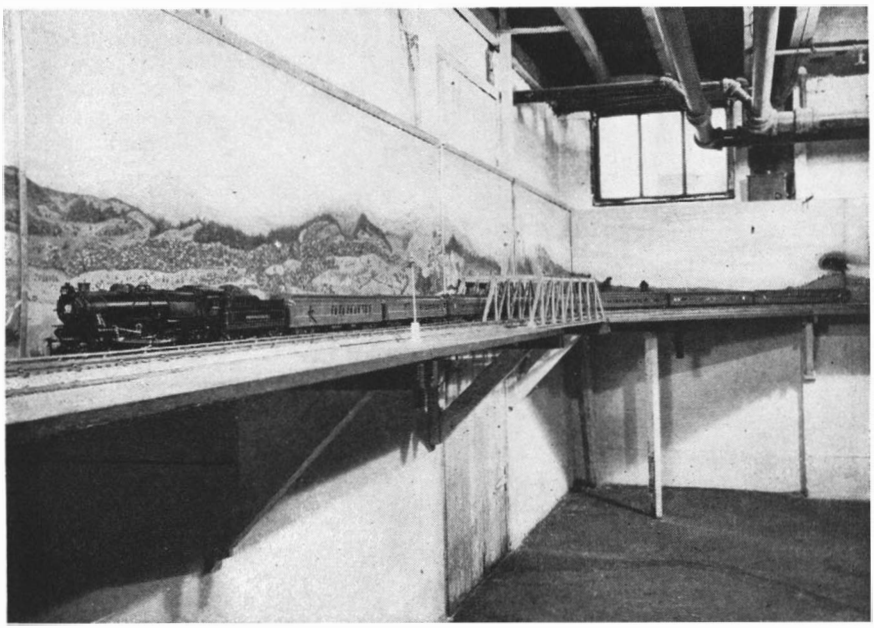
Fully assembled units may be purchased at higher cost than kits, but most model railroaders have sufficient skill to put the unassembled cars together. They also have enough skill to build the platform on which the model system runs.

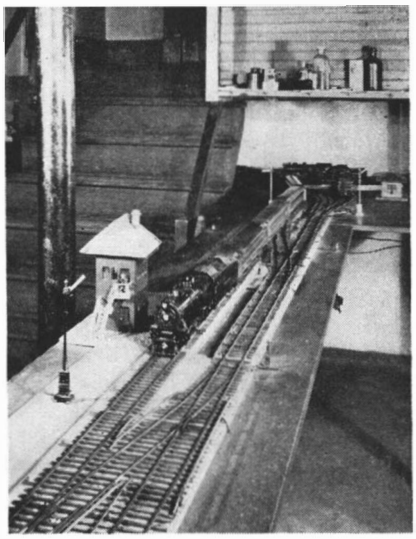
What a model railroader's cellar looks like. *Right:* The owner, S. T. Gustina, is shown in the foreground lowering a lift bridge. When the road is not in use, the bridge is lifted out of the way by counterweights. *Below:* Classification yards with three locomotives and several kinds of passenger and freight cars. A continuous landscape is painted all around the wall





Below: On the main line! An aluminum truss bridge carries the track over the space before the vegetable cellar door. Again, note background mountain scenery





Another view of the lift bridge which carries the track across the room, showing cross-over switches, signal tower, and semaphore. A turntable, operated by a crank, is in the rear near where the track turns under the cellar step

This requires some knowledge of carpentering, but is not difficult.

In model railroading there is even a place for the man who has no skill whatever but would like to indulge in the sport. Since elaborate systems are quite costly (even a real hobbyist can seldom afford them!), groups of enthusiasts band themselves together into clubs, collect monthly dues, hire some space, buy whatever equipment they need, add to this from month to month, and build the road in their spare time. The skilled members lay the tracks and assemble the signal system; the unskilled members keep the books, figure out operating schedules, and do the other chores that are commonly done in real-life railroads. "Club night" to these enthusiasts means a night in the selected space or in the cellar of one or another member, "working on the railroad." And once they are at it, no interference is tolerated. They are indeed serious, these model railroad men!

The model railroad has arrived. If each of the estimated 100,000 enthusiasts own 100 feet of track — and there are many who own more — then, by laying all sets together, it would be possible to run a single track line from New York to San Antonio, Texas, or double track from New York to Milwaukee.

And if there are 50,000 model trains in use (the figure, to the best of our knowledge, is conservative), then on the run from New York to San Antonio you would meet a train every 200 feet. If you figure that there is $200 invested for every 200 feet of track ($75 for the carefully detailed locomotive, $10 each for six cars, $20 to $40 for 200 feet of track, depending upon the type of construction, and $25 for transformers, wiring, and control systems), then more than $10,000,000 has already been spent on this hobby.

Some friend of yours may say to you, one of these days: "I sure beat 'er on the back on the high iron last night!" If he does, please don't stare at him. Remember, you have always thought of him as a respected, conservative citizen with a good job, a nice home, and all the other accessories of the more abundant life. He's just talking railroad lingo, referring to the fast time his train made on the main line of his model railroad. Bear with him. You might be the next one to get the bug.

Food By Vein

Hospitals are Beginning to Use the New Method of Supplying Food to Those Who Cannot Eat . . . The Expectations are Auspicious

By BARCLAY MOON NEWMAN

AN important new way to prolong life has just been discovered. Food is now being given by vein to patients who cannot eat — because of excessive weakness at the time of operation or because the surgeon must cut some portion of the alimentary tract, as in removing a tumor. The new method is already being used in hospitals and enables patients to survive digestive crises hitherto often fatal.

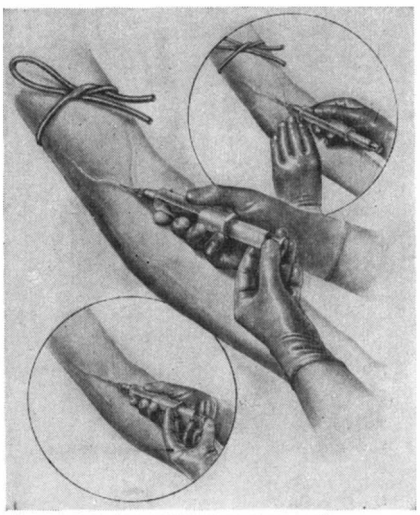
Of course, calories for heat energy have long been given by vein in the form of a solution of the simple sugar dextrose, and the body is thus supplied with a priceless source of immediate energy with which to run the human mechanism. The indispensable carbohydrate component of the diet is taken care of in this way.

Salt solutions also have long been provided by vein, and the mineral component of the diet is accounted for. Existence for weeks is possible without vitamins, although they have in many cases been found to mean the difference between death and continued life. Now a number of pure vitamins — including vitamin A, thiamin, ascorbic acid, riboflavin, nicotinic acid, B_6, D, E, and K — are commercially available and are injected as a common practice. Some are safely given by vein, others by administration under the skin so that they are only very slowly absorbed into the blood. Ultra-violet rays synthesize small quantities of vitamin D in the skin upon which such light is made to fall. So the vitamin problem has not been a major obstacle to successful surgery and convalescence.

The fat component of the diet can be dispensed with, for many days at least, if not weeks. But even fat has been provided by injection. In 1935, Dr. Emmett Holt, Jr., and his associates at Johns Hopkins Hospital made exceedingly fine emulsions of fat — olive oil — and injected the preparation into dying patients. Improvement followed. Inasmuch as fat is not only an essential nutrient and must eventually be taken if the patient is to remain alive but also a more efficient source of energy, weight for weight, than carbohydrate, future developments in fat administration will be important and should bring new successes that will permit the patient to recover more rapidly.

Water, sugar, mineral salt, vitamin, and fat are five of the six nutrients known to be indispensable in human nutrition. The sixth is protein, until recently the main obstacle in the way of perfecting the administration of food by vein, through an extended period.

Now, for the first time in medical history, there is a satisfactory substitute for protein-by-mouth. Bases for the complete solution of the problem of intravenous feeding—of food by vein—have been established. The digestive tract can be completely dispensed with for weeks. Meanwhile, it can in many cases be restored to approximately normal



Illustrations from "Dextrose Therapy," monograph by E. Martin, Sc.D.

One of the methods of injecting food by vein is by the syringe

activity. Thus the patient balks death.

Credit goes to Doctors Robert Elman and D. O. Weiner, of the Department of Surgery, Washington University School of Medicine, and of the St. Louis City, the St. Louis Children's, and the Barnes hospitals, St. Louis.

These doctors knew that it would be dangerous to try to inject into the veins even the most carefully purified protein, such as casein from milk. The blood and tissues of the body cannot cope with foods so intricate, for protein is the most complex chemical structure in the world. A first injection of casein would sensitize the body so that a second injection would result in a terrific shock, very likely to be fatal. This sensitization to protein is an unavoidable, normal body reaction; a condition like that of allergy is set up. It is the work, instead, of the digestive tract to break down proteins so that only fragments of the former huge molecules are made available for absorption.

The ferments of the digestive juices are the catalysts that bring about this cracking of the protein molecule into its main constituents or component units, known as amino acids. Following such decomposition, absorption of these simple chemical structures, the amino acids, occurs. These building blocks of the proteins thus arrive in the blood stream, which transports them to tissues that in turn absorb them. Once in the tissues throughout the body, the amino acids are, in utterly unknown chemical reactions, put together so that new protein, the chief basis of living tissue, is synthesized. Without a steady supply of amino acids, tissues degenerate and die, and the body dies. With a steady supply of amino acids, usually derived from food protein, tissue is constantly regenerated to replace that which is lost in those activities which we call life.

TISSUES starving for protein become pathologically swollen with excess water; but when protein-building units are supplied, the swelling subsides. Other less obvious changes take place, and the patient grows stronger with the trend back to normal.

To a limited extent, serum from a blood donor may be used to supply amino acids. But even a quart of serum a day will not yield enough building blocks to construct the large numbers of protein molecules required throughout the tissues.

Doctors Elman and Weiner had learned that, in 1913, two other scientists, Henrique and Andersen, had kept a goat alive and gaining weight by food via vein. The source of protein building blocks, the amino acids, was meat whose protein had been digested in the test tube. Also, Van Slyke and Myer had sent *digested* protein coursing through the blood vessels of dogs, and no harm had been done.

With these favorable discoveries in mind, Doctors Elman and Weiner di-

gested casein with acid, and so prepared a mixture of most of the indispensable building blocks of protein. The acid, however, decomposed one of the amino acid units known as tryptophane, and casein, to begin with, is low in another, called cystine, an invaluable source of sulfur for protein; therefore the mixture was fortified with a small percentage of tryptophane and a little cystine—amino acids which can be bought on the market.

The preparation was tried first on rats. They grew and thrived. Further experimenting showed that the preparation was free from dangerous, undigested protein. In this test, guinea pigs were used. Repeated injection did not bring about a sensitized condition, and no shock resulted.

Next came the dog, into which the amber solution of amino acids plus some sugar was injected. Careful measurements of the level of amino acids in the dog's blood were then made, and it was found that the injected nutrients rapidly and safely disappeared from the blood, certainly to go into the tissues, there to be caught up in the swirl of life's chemical laboratories and made into canine protein. Little of it seemed to be wasted by way of the kidneys. The method appeared to be efficient.

In one set of experiments, the dogs were allowed to fast, and a certain quantity of blood was drawn, to reduce the quantity of protein in the blood serum. Then amino acids were given by vein. Re-synthesis of lost protein occurred within six hours after the injection of these protein-building blocks.

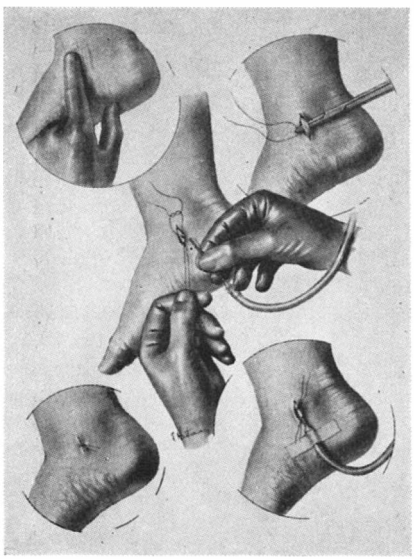
IN another series of experiments, dogs were fed a diet free of protein, for several weeks. Serum protein was observed to sink to lower and lower levels, and characteristic accumulation of water due to protein deficiency began to swell the tissues. But when amber-colored amino acid-dextrose solution was administered by vein, the amount of protein in the dogs' blood serum rose toward the normal level. The most careful examination, moreover, showed no damage to liver or kidney or other organ. Now for human beings.

"Our first concern," the two pioneers report, "in giving digested casein to patients was, of course, the possibility of untoward reactions, even though none had occurred in dogs. At first, small doses were injected; they produced no demonstrable effect, so that eventually we administered what was thought to be a full daily quota of amino acids, that is, from one half to two grams per kilogram of body weight."

A sense of warmth was noticed by one patient; a slight chill was felt by another, but the temperature remained normal. A child had a slight, transient rash after one of the injections.

In practically every instance, benefit came from amino acids by vein, and water-logging of tissues was diminished. No injurious after-effect whatsoever could be seen. All the tests gave proof of the body's use of amino acids to build up new molecules in tissues that had been starving for protein.

Still, the substitute for food by mouth is only a temporary measure. The present limit of food by vein is a few weeks at most. One vein cannot be used continuously, so vein after vein must be subjected to the inflow of fluid, and generally the first vein has not recovered sufficiently by the time all the veins have been used.



Food is also given by vein by a continuous method ("venoclysis")

We do, however, have a great beginning. Deeper blood vessels may turn out to be available for use, when better techniques have been devised. When more is learned about protein-building amino acids, probably some of the less important ones can be temporarily dispensed with, and the injected quantity kept at a minimum.

Practical possibilities are increasing as amino acids become cheaper through improved commercial syntheses. Drug manufacturers already have placed predigested casein preparations on the market, and with such solutions universally available for research, we can expect further notable developments.

Perhaps we can look forward to a considerable extension of the periods during which patients can be kept alive though their digestive tracts are not working. Approximately seven percent of all deaths after the age of 45 is caused by disease of the digestive system. This mortality should be reduced as the use of food by vein is increased through the development of refinements both from the nutritional side and from the mechanical side, where better methods of forcing fluids into veins are concerned. The fluid undoubtedly will be made nutritionally more valuable. The vein through which the fluid is forced will surely be more satisfactorily guarded against possible injury. The stomach, the intestines, the liver and the pancreas will be given longer periods of rest and a greater opportunity to return to health.

Fifty percent of cancer deaths is traceable to cancer originating in the digestive system. Already, through the contributions of Doctors Elman and Weiner, a practical step has been taken toward helping the cancer specialist in his vast labors; operation is safer, because there is less danger of starvation following surgery of the digestive tract.

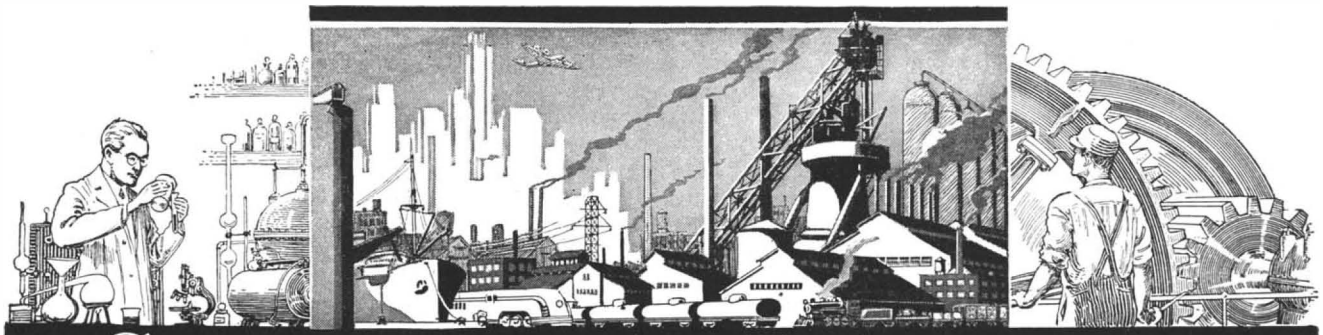
UNDOUBTEDLY, the main dietary components are known to nutritionists and, by one method or another, injection has been made practical, at least to a degree. But none would assert that the optimum proportions of the various food factors have been determined; for one thing, age will have to be considered more carefully. What percentages of what amino acids are best for the year-old, the decade-old, the semi-centenarian, or the aged? Here a vast research for the future looms. And, even if we now know enough about the main essential items of diet to keep a person alive with food by vein over a period of weeks, no scientist would state that other factors, yet undiscovered, do not after a while become indispensable for longer life.

Most experts believe that several additional vitamins are to be turned up, perhaps including vitamins M, P, and factors U and W, the evidence at present pointing to the existence of these and others.

Not long ago, copper was added to the list of indispensable metallic elements included in the group termed "mineral salts." Some think that cobalt and zinc, perhaps other metals, in ultravisible quantities will turn out to be necessary.

There are excellent indications also that dextrose does not altogether satisfy the body's demand for sugar. There are other sugars, including the most remarkable of all, galactose, which is one half of the molecule of milk sugar, dextrose being the other half. Galactose is abundant in brain and nerve tissue and present in considerable quantities in every tissue of the body. No tissue (except that of the lactating mammary gland) is known to be able to synthesize galactose.

None can ever say how far medical science will go. Research brings astonishing powers to delay death. Food by vein is a major advance in the science of prolonging life. The future of this system can certainly be awaited with high hopes.



SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

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

"Damp Cold" Better than Dry Cold

MODERN home air conditioning is gradually teaching us that one of our most widely cherished beliefs is a complete fallacy —the one that says "you feel 'damp cold' so much more than you do 'dry cold'." Actually, the National Warm Air Heating and Air Conditioning Association points out, the reverse is true. Relatively high humidity causes low temperature to be less uncomfortable; and when people have learned this, they can begin really to enjoy the increased comfort, and even more the improved health, which can be provided by the simple type of air conditioning which is becoming the rule in modern American homes.

It isn't the temperature that the thermometer shows that tells the whole story as to whether you feel comfortable, or cold, but the rate at which your body is losing its own heat. The colder the air around you, the faster you lose heat, other things being equal; but other things never are quite equal. Under most conditions you lose heat faster to dry air than to relatively moist air, faster to dense air than to thin air; and faster to air in motion than to still air. And if you are in bright sunlight, even on a cold day, you receive enough radiant heat to make up for a lot of your loss, and so don't feel the cold so much. The kind of cold people think of as "dry cold" is actually found in the thin air of high altitudes, on still days of bright sunlight; and what they call "damp cold" is that of a cloudy day with a raw wind, on which you lose heat faster, and there is less radiant heat from sunlight to make up for it.

New Kind of Blood Bank

MOTHERS, as they bring new life into the world, are also contributing blood that has life-saving properties in Massachusetts Memorial Hospitals, Boston. This novel sort of blood bank is stocked with blood from the placenta, secured during normal, healthy childbirths through the cord through which the baby got its nourishment before birth. After typing, to tell whether the blood will mix safely with the blood of a prospective patient, other tests and the addition of a special preservative, the mother's blood is stored for use, and remains good for three weeks and even longer. This special sort of blood has a stimulating effect and is successfully used on desperately ill patients suffering from malnutrition, secondary anemia, hemorrhage after childbirth, and from certain types of cancer, ulcers, and gall bladder, stomach and bladder disorders. — *Science Service.*

Mending Paste Plastic

NEWLY arrived on the market is a multi-use paste plastic in colors, which should be welcomed by the home handy-man and hobby-crafter. Packaged in small tubes and in cans under the name of Plastico Rok, this material is adaptable for use on those varied mending jobs that are always springing up in the home.

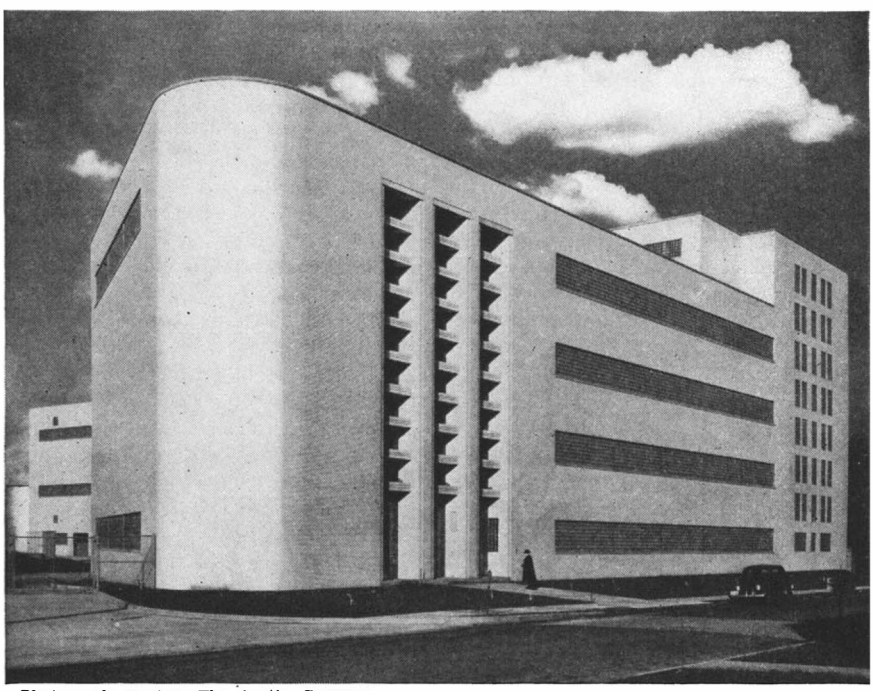
It is simple to use, clean, comes in ten beautiful colors and is an ideal mending material for cracks, dents, or holes, in wood, stucco, linoleum, and like materials. It acts as a powerful cement, besides the added advantage of allowing use of a binding material of the same color as the material or object being mended.

Advantages of Plastico Rok are that no special thinner is needed and excess may be wiped off with a wet finger or a damp cloth. Thus, it may be used on the finest furniture without fear of marring the finish. After application, Plastico Rok quickly dries literally "as hard as rock."

"Bicarb" from Cleanest Chemical Plant

THE manufacturers of Cow Brand and Arm & Hammer Brand baking soda will probably say that their product is not now any purer, that it was always as pure as it was humanly possible to make it, but these two brands are now being made in what is said to be the world's cleanest chemical works.

The modern plant of Church & Dwight Company, Inc., shown in our illustration,



Photograph courtesy The Austin Company

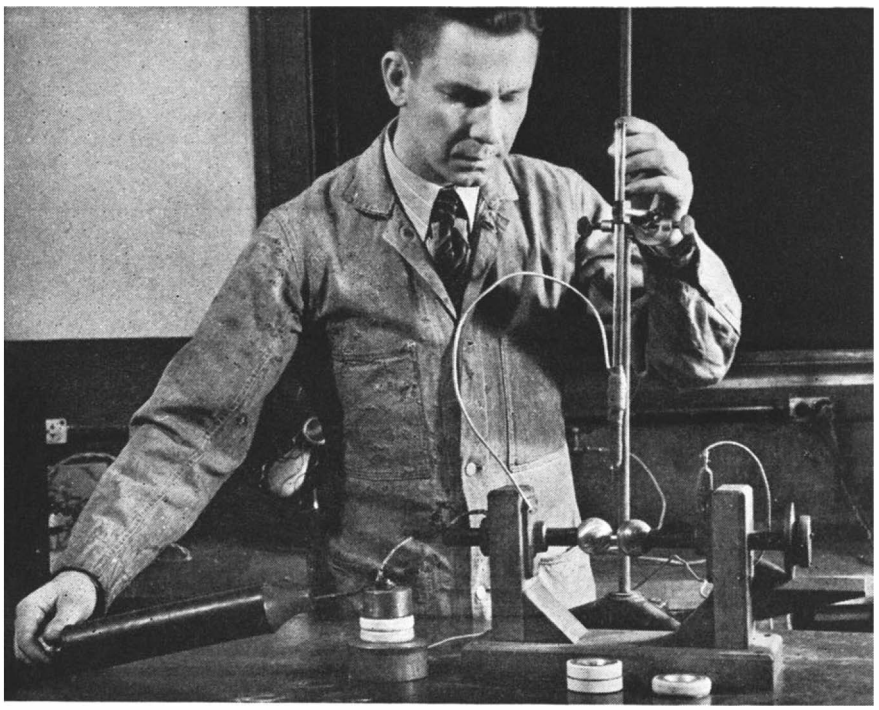
Functional design characterizes this modern chemical plant

is not only striking in appearance but is actually simply an air conditioned "package" to support and enclose conveyors, carbonating towers, and eight-story tanks lined with stainless steel. The plant has interior walls of glazed tile and functional panels of glass block instead of windows. Its entire framework was electrically welded, as was most of the equipment required for the new continuous process. Produced from start to finish in an enclosed maze of equipment, the bicarbonate of soda will not even come in contact with air inside the plant until it is ready for packaging.

Two things — motor trucks and the relatively new process of adhering rubber to metal — provide the modern means of transporting large quantities of chemicals shown here. This special trailer tank of 2500 gallon capacity is lined with rubber so that it will carry corrosive solutions. It is one of two such trucks put in service by the American Cyanamid and Chemical Corporation; the tanks were lined by the Goodyear Vulcalock process

Engineer Discovers "Lightning" Radiation

DISCOVERY that lightning generates an ultra short-wave radiation which it uses to open a path to ground through a lightning arrester after striking an electric



High-frequency radiation in the gap between the spheres makes the gap "fast"

power system, was reported recently by W. E. Berkey, research engineer of the Westinghouse Electric & Manufacturing Company. He made the discovery while experimenting with lightning arresters. He said the newly tagged radiation is emitted from the regions of an arrester's electrode-insulator contacts which are stressed by a lightning surge.

By generating ions, or charged particles, in the air space separating the electrodes of a spark gap inside a lightning arrester, the radiation lowers the gap's resistance to the flow of electricity. It acts as a trigger to start the lightning surge jumping across the gap toward the ground. In engineering slang, it makes the gap "fast," when speed is dealt with in terms of fractions of a millionth of a second.

"As a result of our discoveries," Mr. Berkey said, "we can control and increase the intensity of this radiation and can improve the spark gaps of our lightning arresters."

The investigator described the radiation as being near the soft X-ray region of the spectrum, with a wavelength of approximately only 1000 Angstroms as compared with 5000 Angstroms for visible light. (An Angstrom is a unit of measurement so small that there are some 254,000,000 of them to an inch.)

Short-wave radio power which travels through the air at several million cycles a second appears to be loafing when compared with the frequency of the new radiation, which oscillates one quadrillion times a second. Because this radiation is absorbed in a few centimeters of air, it has escaped earlier discovery.

Glycerine Saves Plant Roots

GLYCERINE is hygroscopic. That is, it attracts and holds moisture. Therefore, when Dr. R. N. Du Puis, of Chicago, studied the problem of preserving the roots of young tomato and cabbage plants during shipment, he turned to this sweetish liquid.

Every year, millions of young tomato and cabbage plants are shipped long distances. Ordinarily their roots are packed in moist sphagnum moss. Too often the moisture dried out and the plants were damaged, so Dr. Du Puis thought of using a solution of glycerine instead of plain water to moisten the moss. As a result, more than 75 million plants were shipped satisfactorily during the last season with this glycerine-solution protection. It was found, incidentally, that the treatment also discourages the fungus that causes stem canker.

Encouraging results have also been obtained in the use of this solution with other plants such as narcissus, onion, potato, asparagus, and horseradish.

ON THE HOOF

APPROXIMATELY seven million tons of live stock — enough to keep New York City supplied with meat for seven years — were transportated by American railroads in a single year.

Display Signs Save Light Bulbs

THE high light-transmission and edge-lighting qualities of Lucite, methyl methacrylate, a du Pont plastic, have been utilized by the Lauv-Lite Corporation to make a new type of display sign, claimed to have several times as great visibility at less power consumption, and to operate at lower maintenance cost than other types. Limitless color effects are possible in these signs which, furthermore, are said to have no glare or dead spots.

The signs are made by outlining the desired letters, figures, or other patterns with small button-lenses of the plastic. These lenses, ground from small diameter rods, are fitted into holes punched through the face of the signs. The back of the lenses pick up light from a concealed source and carry it to the head of the lens, giving a sharp, bright glow. One lamp provides illumination for several lenses, and in the event that a lamp fails, enough light is picked up from other lamps to maintain visibility.

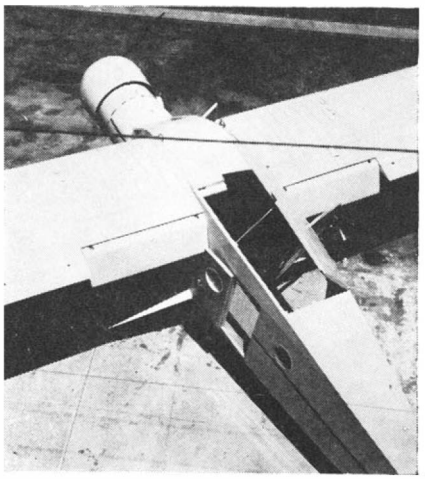
On-and-off and moving effects can be obtained in any color by using various color combinations of lenses and blinking bulbs.

The signs vary from small indoor counter displays to large and spectacular types for

outdoors. For the latter, Lucite's resistance to extremes of atmospheric conditions without discoloration or warpage, and its high tensile strength, are especially advantageous.

Tractors by Air

ONE of our photographs shows a Bellanca Aircruiser specially modified for use in gold mining in the Philippines. The



Cargo hatch in miner's airplane

Davao Gold Mine is productive of untold wealth, as a gold mine should be, but is inaccessible and located in very rough country. The Aircruiser brings to the mine such articles as a Diesel-electric power unit, electric hoists, a Diesel engine weighing 4095 pounds. It is apparently impossible to build a real road into this difficult country, but the airplane has not failed to meet all requirements. Owing to the peculiar formation of the surrounding ridges at the mine, all landings are made towards the east, along the single prevailing direction of the wind.—*A. K.*

PILOTS

IN mid-January, more than 35,000 hours had already been flown by the 9130 students in the Civilian Pilot Training Program, without serious accident of any kind. Furthermore, a total of more than 1200 of these students had already reached the solo stage of instruction.

Modern Training Planes

IN the World War I, the training planes were Curtiss Jennies and Standards with a top speed of 75 miles per hour, with all sorts of projecting struts and wires; logy and slow to respond to the controls.

Even today, we are apt to think of a training plane as something like an Aeronca or a Cub — small, slow, and safe; but a military pilot who is to maneuver a 400-mile-an-hour single-seater, cannot possibly pass from a Cub class directly to the fighting class. Our photograph shows the Curtiss Falcon 22 — a combat trainer which is the first of a large number just completed for a foreign government by the Curtiss-Wright Corporation.

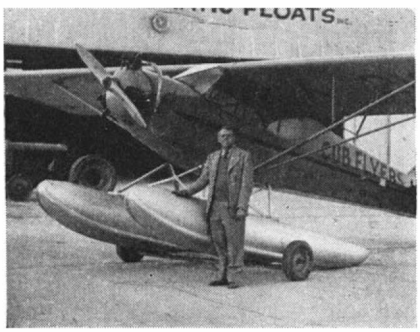
While designed for less spectacular service than the Curtiss Hawk Pursuit ships doing such remarkable things on the Western Front, the Falcon is a splendid example of modern military design. Although it is a trainer, it incorporates every aerodynamic structural device of the day with perfect streamlining, retractable landing gear, all-metal construction. The front cockpit is equipped for the pilot, while the rear cockpit is prepared for a gunner or observer or instructor or bomber.

Performance figures give a maximum speed of 215 miles per hour at critical altitude; climb of nearly 5000 feet in three minutes; service ceiling of 25,900 feet; cruising range of 515 miles.—*A. K.*

Pneumatic Seaplane Floats

AN interesting development is now reaching successful completion in the McKinley pneumatic floats for seaplanes. The first application of the float is to small airplanes. One of our photographs shows the pneumatic floats mounted on a Cub plane, a ship of no greater weight than 1000 pounds. The PF-2 model float is 12 feet 9 inches in length and 22⅝ inches in diameter at the point of maximum girth. The weight of each float is only 42½ pounds. The material used is of standard airship fabric type — long-fiber cotton treated with layers of rubber. Special cement is used at the joints.

The step, which is of importance in seaplane take-off, is tailored into the fabric.



Air-inflated pontoons

Spray tubes extend from the nose to the step. These tubes, held in place by cement, divert the water in taxiing to a take-off, diminish spray, and also conduct a stream of air on the under-side of the float, which aids in breaking the water seal.

Each float is divided into five compartments, but in place of a rigid bulk-head separating the compartments, a fabric diaphragm is utilized. The fifth compartment in the nose also serves as a pneumatic bumper. The only rigid member in the float is a V-beam for attachment of the struts and to provide a walk. This beam is of duralumin suitably protected against corrosion.

Advantages claimed for the float are its shock-absorption qualities, its lightness, and economy in maintenance.

In experiments extending over 300 hours of service, deliberate collisions have been made with driftwood, buoys and other objects at high taxiing and take-off speeds. Resiliency was proved in every instance and no damage was incurred. Drop tests have proved equally satisfactory.—*A. K.*

Annual Report

THE Annual Report of the Bureau of Aeronautics, submitted by Rear Admiral J. H. Towers, gives a splendid picture of the energetic efforts of the Bureau of Aeronautics in advancing naval aviation. Naturally, of course, it does not disclose the details of all that is being done.

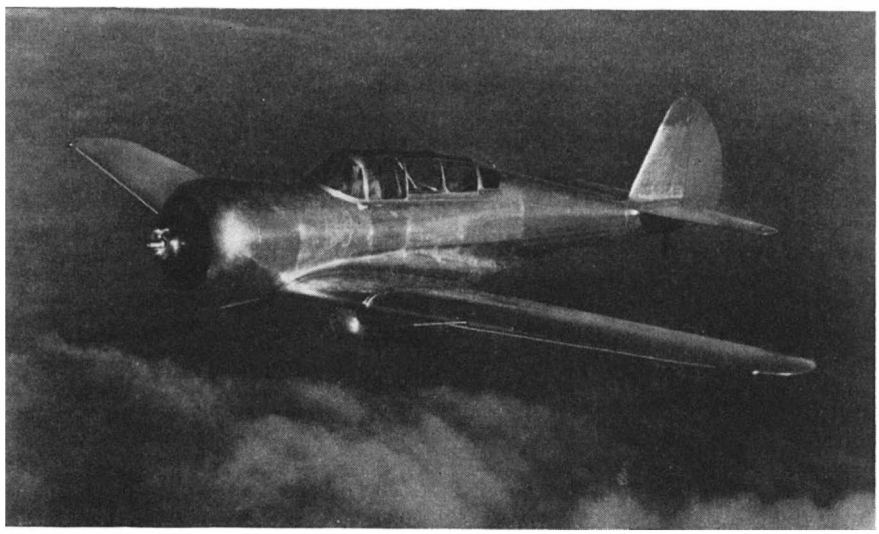
Glancing through the report we found some technical items of particular interest. Thus, in testing airplanes to destruction, stress distribution is now also measured. The constructor not only knows that his ship has failed under load, but where the dangerous points of stress concentration were. As ships increase in speed, vibration becomes more and more of a danger, so it is logical to include vibration surveys. On landing, the seaplane or flying boat takes a terrible beating, so pressures on hull bottoms are under continual investigation. It is good news to hear that a light, automatic pilot has been developed. Perhaps this will lead to the use of the automatic pilot in private flying.

The Bureau takes particular pride in the variable venturi non-icing type of carburetor. A meter to measure the quantity of fuel in aircraft now has the remarkable accuracy of 0.25 percent.—*A. K.*

White-Lead Paint in Colors

ANNOUNCEMENT has been made that several of the leading mixed-paint manufacturers are this spring offering ready-mixed pure white-lead paint in colors.

Both professional painting contractors and consumers will consider this departure



Modern military design in the Curtiss Falcon 22

SOIL TESTING

shows you how to Grow Plants to Perfection

SUDBURY SOIL TEST KIT

the Scientific Way to better gardens

Easy to Use

New Club Model, size 9¾" x 3¾" x 2". Makes 50 individual tests for nitrogen, phosphorus, potash and acidity.

Wouldn't you like to enjoy—*this year*—the rich, velvety lawn, the abundance of flowers, and the strong, healthy plants which are the *proof* of your skill as a gardener.

Such results are easy to obtain when you use scientific methods. Experts say that four out of five lawn and garden failures are due to soil deficiencies that could easily be corrected by soil testing.

Have you Met with any of these Failures?

Lack of Blooms
May be caused by insufficient phosphorus, or by *too much* nitrogen. Soil testing will tell you which.

Weak, Sickly Growth
Often caused by lack of phosphorus or potash, or incorrect acidity. Excess nitrogen causes soft, weak growth, and reduces disease resistance.

Retarded Development
Lack of nitrogen retards leaf growth. Insufficient phosphorus or potash means slow establishment of seedlings and poor root growth. Excess potassium delays maturity.

A "Spotty" Lawn
Improper acidity and lack of nitrogen are common causes of lawn failure. For good results, *both* conditions must be corrected.

What Your Plants Need—To possess the lovely lawn and garden of your dreams, you should simply *make sure* that your plants have:

1. The acid, neutral or alkaline soil conditions that they require, and
2. A *correctly rationed* diet of the three important plant food (fertilizer) elements—nitrogen, phosphorus and potash—balanced in accordance with your soil conditions and individual plant needs.

No More Guesswork—When you test your soil, you end the guesswork that so often results in failure. You *know* whether your soil is too acid or too alkaline—and *how much* lime or other material you should add to make it right. You apply the *kind* and *amount* of fertilizers which are essential to healthy plant growth.

Danger of Over-Fertilizing—As most gardeners know, a soil that is too acid or too alkaline acts as a poison to many plants. But did you realize that excess *fertilizer* can be almost as harmful? Too much nitrogen leads to general weakness and hinders flower formation. Excess potash slows up growth. You can prevent these disappointments—and save fertilizer, too—by testing your soil before you plant.

WHAT USERS SAY

Amazing Results—We have in our files dozens of letters from users who tell us of the amazing results they have obtained with Sudbury Soil Test Kits. Here is an unsolicited letter from Mr. George Thurkauf of Englewood, N. J.:

"I grow exhibition dahlias. This year I cleaned up with them, and my success was due to your product. It was not a case of hit and miss when I applied my fertilizer. I know what my soil needed and my results have proven that."

Saved His Lawn—Another user says: *"My lawn was in bad shape for three years, and I thought I'd have to dig it up. I decided to test my soil first and got one of your kits. I followed the instructions, and my lawn is perfect now. This kit certainly saved me a lot of trouble and expense."*

It's Fun—It's Easy—If you like to work with your hands—and get at the whys and wherefores of what you do—you'll find soil testing a fascinating subject. You get results in ten minutes time. No specialized training required.

CHAPERONE FREE

to pre-season buyers

Order your Sudbury Soil Test Kit early, and we'll send you **FREE** a full 4-ounce bottle of Liquid Chaperone—the wonderful new dog repellent that rain does not wash away. *This special offer must be withdrawn after the start of the active gardening season.*

The Club Model Kit

The Sudbury Soil Test Kit, new club model, is a beautiful piece of equipment—used by thousands of enthusiastic gardeners from coast to coast. Cased in handsome sturdy imitation leather. Makes 50 individual tests for nitrogen, phosphorus, potash and acidity. Complete instructions. Helpful chart shows need of lawn grasses, 74 flowers, 50 vegetables.

A Permanent Investment — Best of all, your Sudbury Kit is a permanent investment. With the inexpensive refills now available, you can use it year after year.

SEND NO MONEY

We want to help you make your first soil test. Take a Sudbury Kit out into the garden, and judge for yourself whether it is going to be every bit as useful as we say. If you think not—if for any reason you are not delighted with your kit—you can return it to us and we will gladly refund the full purchase price. It isn't even necessary to send any money now. You can pay the postman when the kit arrives. Only $4.75 plus few cents postage. Enjoy your garden as you never have before. Use this handy coupon now.

MAIL THIS COUPON NOW

Sudbury Soil Testing Laboratory
P. O. Box 711, South Sudbury, Mass.

Please send me one Sudbury Soil Test Kit, New Club Model. I will pay the postman $4.75 plus few cents postage. I understand that you will refund the full purchase price, if I am not delighted with the kit.

Check here if you buy early ☐ Please send me free 4-ounce bottle of Liquid Chaperone as offered.

Name .....

Address .....

City .....

Want us to pay postage? ☐ Check here, enclose $4.75 and we will ship prepaid. Same money back guarantee.

in manufacturing procedure as good news, for the ready-mixed, pure white-lead paint in colors retains all the beauty, durability, and high protective qualities of the home-mixed, pure white-lead and oil paint. This manufacturing development now can supplement the usual practice of purchasing white-lead paste, linseed oil, turpentine, drier and mixing them on the job with colors-in-oil when tint is desired. — *C. F. Greeves-Carpenter.*

COST OF TREE PLANTING

ONE and one quarter cents is the cost of each of the many millions of trees planted by the U. S. Forest Service during 1938. The average tree cost the Service about two fifths of a cent to produce and another four fifths of a cent to plant.

More Uses for Nylon

NYLON, which was discussed in detail in our February issue, has been adapted to other uses not mentioned in that article. A new patent, just issued posthumously to the Du Pont chemist, Dr. Wallace H. Carothers, covers the use of this coal, air, and water product to coat paper, leather, cloth, and wire mesh, for making a superior patent leather; long-wearing, flexible, waterproof clothing; and a sturdy, transparent window glass.

When the chemicals, known as polyamides, are pressed into goat's leather, a new type of patent leather is produced that is more highly resistant to cracking than ordinary patent leather. They strengthen and water-proof cotton cloth. On wire mesh they make a window "glass" that transmits ultra-violet light. Many similar applications for them have been suggested.

Automatic Rifle Procurement

THE question has often been raised as to how rapidly we might equip our Army with the new Garand automatic rifle discussed in February, 1939, issue of Scientific American. At recent hearings before the Senate Appropriations Committee, Brigadier-General L. D. Gasser, Assistant Chief of Staff, disclosed the fact that early in January the Army had about 25,000 of these rifles and was getting more at the rate of about 4000 a month. He stated further that it is expected that the Army will have 150,000 by June, 1942.

To these figures, we might add the comment that this is simply peace-time production, and that in case we should go to war, production would be stepped up considerably. The one snag would be the matter of tooling up more plants for large scale production, and that, of course, would repeat the delays which we experienced in 1917 practically all along the line.

Automatic Booster Engine for Trucks

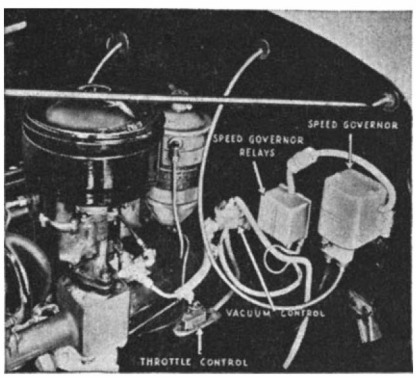
BENEFITS of vital importance to truckers, and particularly to those specializing in heavy-duty long-distance hauling — as well as highway safety advantages of a most important nature — are claimed for a new booster unit which the Clark Equipment Company has been developing over the past two years, and which has now reached the point where experimental jobs are said to be giving excellent account of themselves on the road. The Commercial Car Department of Chevrolet is co-operating in the development.

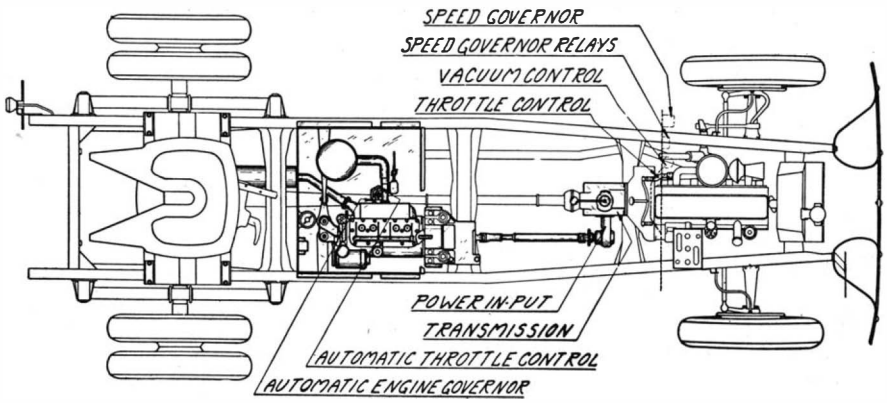
The heart of the unit consists of an auxiliary gasoline engine which automatically starts when greater power is needed for a grade, and which delivers its output to the rear axle of a 1½-ton truck or tractor through a simple and sturdy over-running clutch. Automatic starting, speed governing, and stopping are provided, the entire cycle of operation being independent of the driver.

The unit is said not only to give the medium-duty vehicle performance characteristics of units costing considerably more, but to do this without entailing the high initial outlay and high operating and maintenance cost involved with heavy-duty units. Forty-five horsepower, providing approximately 55 percent additional torque, is made available, automatically, for quicker starts and economical high-speed performance on hills.

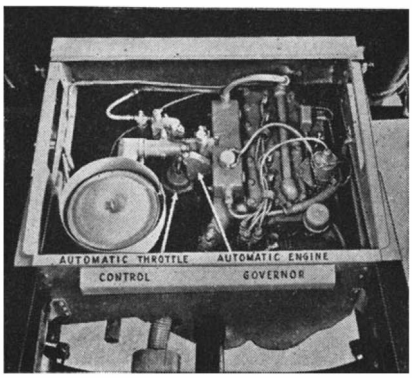
The engine of the Clark Automatic Booster comes into use only when the main engine is unequal to conditions of road and load, and throws out when the main engine can take care of the load alone. The booster has two principal uses; to get the tractor-trailer combination up to road speed quickly from a standing start, and to maintain cruising speed once the unit is under way. An ingenious, yet sturdy and dependable system of controls not only makes this possible, but dispenses with attention from the driver, the booster being subservient to the main engine at all times.

These controls comprise a speed governor, a vacuum governor, an accelerator governor, and an automatic throttle control. In practice, these interrelated units work together to start, control, and stop the booster engine, and assure a smooth, positive flow of power from it to the transmission, when, and only when, the need for extra power exists. Each phase of the booster's operation is automatic and instantaneous, the entire cycle being completed in a fraction of the time it takes to describe it.





Above: Booster engine controls under hood. *Below:* Placement of booster in chassis. *Lower right:* Photo of booster engine in place



MILK

OWLREST'S Alice, a Jersey cow at the New York State Experiment Station, now in her twelfth year, has not only mothered ten calves but has also produced over 90,200 pounds of milk testing 5.66 percent fat.

Printing Process Freezes Ink

THE limiting factor on printing speed today is the time required for liquid ink to dry. Heat, more heat at a higher temperature, has been applied until the paper has been tried to the limits of its endurance in many cases.

A new approach to the problem of high speed printing and better printing is now offered in the form of ink and apparatus combined in a printing process which sets or dries ink by cold, not by heat. It promises to relieve the paper manufacturer of many of the problems which he now faces as a consequence of too much penetration and too much heat.

Cold-set printing is the process of drying ink by freezing instead of by absorption, evaporation, oxidation, or polymerization. All inks when dry on the paper are solid mixtures of color and binder. In the processes of printing, however, the ink must be fluid in order to feed from the fountain to

the relief printing surfaces in controlled amounts. In customary printing, this fluidity is obtained by using fluids and a fluid mixture of color and binder is deposited on the paper. This creates the printer's major problem: drying.

In the cold-set process, the fluidity of the ink necessary to feed it properly from the fountain to the relief surfaces is realized simply by melting the solid which is finally wanted as a deposit on the paper. The fountain, the ink carriage steels, and the plate cylinder are all heated by hot water from within. This keeps the normally solid ink fluid and controllable. When the hot ink touches the cold paper (that is, cold as compared with the temperature of the ink) the ink freezes or solidifies without penetration and remains as a solid deposit in relief on the top of the fibers. Thus the paper fibers may be loose or tight. They may be uncoated or coated. The cold-set ink from a half-tone dot, for example, always sits on top of the fibers or coating in sharp relief right where it was deposited. There is no lateral spread or vertical penetration due to fiber suction as with liquid inks.

Iodine Most Potent Germicide

IODINE has come through a new series of tests in which it retained its title as most powerful germ-killer, at least against such germs as those which cause typhoid fever and the suppurating skin infections such as, for example, boils. The tests and results were described by Dr. A. J. Salle and W. A. McOmie, of the University of California, at a meeting of the Society of American Bacteriologists.

Of the other halogens (chemicals close to iodine, such as fluorine, bromine, and chlorine) the chlorine compounds, azochloramid and chloramine, also appeared to be highly potent germicides. After these, other germ-killing chemicals were effective against the two test organisms in the following order: the phenols (carbolic acid compounds), silver compounds, and mercury compounds. — *Science Service.*

Motor Torpedo Boats for the U. S. Navy

FOR several years, the British and the Italian navies, and perhaps others also, have constructed and experimented with large numbers of small, high speed boats which, for operation in relatively restricted waters, possess great potentialities as defensive weapons able to administer a disproportionately powerful sting. As described by Dr. Oscar Parkes in Scientific American some three years ago, they are inexpensive, carry a crew of about six men, have a range of up to 1000 miles, are exceptionally fast, are armed with machine guns, and carry a number of torpedoes. Lightly armored, their speed would enable them to escape quick destruction and it is possible that a number of them, zig-zagging toward a single target, might sink even a battleship at only a fraction of the usual cost in men and money for such a feat.

Among American naval men, it has been said that we could have no use for such boats because of our peculiarly strategic position. However, in 1936, it was felt that we should see for ourselves whether the

type had possibilities, and $15,000,000 were appropriated for experimental purposes. A design competition was held, and the Navy Department began a building program which included four 59-foot and four 81-foot motor torpedo boats plus several submarine chasers. All of these boats should be running by the end of summer.

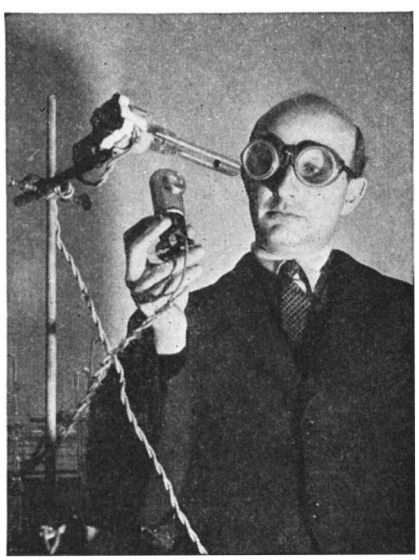
To check our own developments, the Navy ordered a motor torpedo boat of a design by Hubert Scott-Paine, from Elco, Scott-Paine's sole licensee in this country. It was delivered in the United States in September, 1939. At that point, it became evident that it would be months before the best American type could be selected for reproduction, and the Secretary of the Navy felt that the strained international situation was such that no unavoidable delay was acceptable in the matter of commencing tactical training and experimentation, and training of personnel. As he saw it, here was a British design that had been actually proved, was reasonably good, and could be reproduced in numbers. So he at once placed an order for 23 more of the Scott-Paine design from Elco.

Purchase of such a number in one lot assures an immediate and homogeneous fleet in being without waiting until the best American design could be selected and then duplicated. Mr. Edison felt that it was vital to start work with such a homogeneous fleet, and determined to speed up the development of the strategic and tactical use of the type.

While all those concerned with procurement of these boats, of a type new to the United States Navy, are interested primarily from a technical standpoint, they also look upon the present situation as a fine sporting event. Everyone is looking forward to the day when the American boats will test their worth, beam to beam, with the British design on the open sea and under the stiff trial conditions that the Navy is imposing on the new boats.

PHOTO-TUBE MEASURES ULTRA-VIOLET

A "BUBBLE" window, 0.002 of an inch thick, and a sodium cathode have been incorporated by scientists of the General Electric Research Laboratory at Schenectady in the new photo-tube shown in our



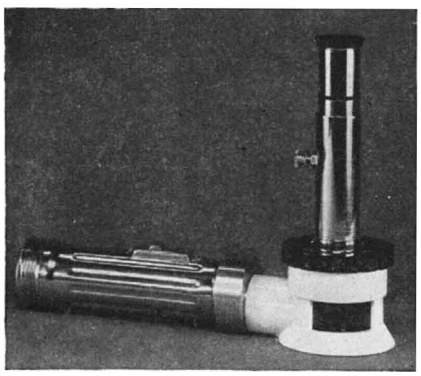
In hand: U-V measuring tube

illustration. It has a maximum response at a wavelength of about 2500 Angstrom units in the invisible ultra-violet spectrum and a very small response to visible radiation.

It is made of a special ultra-violet transmitting glass and replaces a more expensive tube in a quartz bulb. Mercury vapor detection and the measurement of ultra-violet output of low-pressure mercury germicidal lamps are among its applications.

Illuminated Shop Microscope

TO the Flash-O-Lens which was described in these pages some months ago as a useful magnifying glass with a self-contained light, there has been added a microscope to increase its magnifying power. The original device gave a magnification up to seven powers, whereas in the new Flash-O-Lens with the Bausch & Lomb shop micro-



scope, the power has been extended to 40 times. The shop microscope has an engraved scale mounted in the body tube which reads direct to thousandths of an inch, and estimations can easily be made to .00025 of an inch.

This new device, which is shown in an accompanying illustration, may find wide use in routine inspections of product and process equipment. With it may be examined cracks, flaws, surface blisters, halftones, color process plates, textiles, paper surfaces, and the like. It is made by E. W. Pike and Company.

Glass Chalkboard in Colors

A NEW chalkboard or blackboard for schoolroom and home use, manufactured from a specially treated plate glass, was announced recently by the Pittsburgh Plate Glass Company.

The new chalkboard, called Nucite, is being produced in three standard colors — ivory, green, and black — in order to give school decorators more leeway in working out color and lighting schemes. Dark chalk is used on the ivory colored "board" and light chalk on the green and black products.

The development of Nucite, according to W. O. Lytle, secretary of Central Research of the Pittsburgh Plate Glass Company, was the result of an effort to provide a very durable chalkboard that would lessen eye strain of children of school age.

Nucite has less glare and its lighter colors can be used to advantage in better illumination of school rooms. Tests show that Nucite is an important contribution toward the protection of the eyesight of school children.

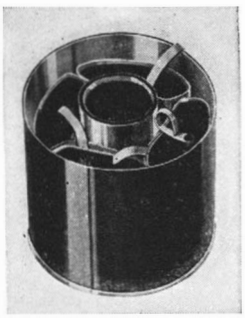
In addition to the reduction of eye strain, the variety of colors in which Nucite is available permits the adoption of more pleas-

ing and brighter color schemes in school rooms. Some school authorities claim lighter colors have a favorable psychological effect on the students.

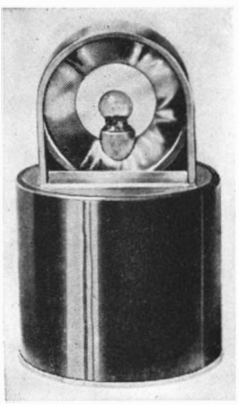
LIGHT BATTERIES THAT DO NOT DETERIORATE

INDEFINITE storage before actual usage is no longer detrimental to a new emergency electric light which has been perfected by Triumph Explosives, Inc. Designed strictly for emergencies, this patented light has all the qualities of the old dry cell with the important advantage that no deterioration can take place before the light is required for use.

The new battery is similar to the standard type of lantern battery both in appearance, method of contact, and voltage capacity. The main difference is that the cells are packed and sealed in a dry state and are activated only when the bottom of the battery is struck against any solid object.



Interior view of new battery that does not deteriorate. Inactive cells surround a glass vial which is shattered by striking bottom of can



Right: **An emergency truck flare using the battery shown above. Other forms of lamps using these batteries are designed for emergency lights at airports, in subways and mines, and so on**

Units are made up of four cells connected in series. Cells are made up of carbon and zinc similar to ordinary dry cells, except that the activating liquid or electrolyte has not been added, which is the factor that makes them non-deteriorating on shelf life. When the glass or vial is broken, this liquid is absorbed by the cells which immediately activates them and then they are in every respect identical to ordinary dry cells. The cells and vial of activating fluid or electrolyte are in an insulated can.

These lights are designed for emergency use in subways, mines, on aviation runways, trucks, and other motor vehicles, railroads, boats, in hospitals, and for military and marine use.

COLORS BRASS BLUE

A BLUE color can be obtained on brass by using a solution of sodium thiosulfate and lead acetate, according to *Copper Alloy Bulletin.* Suggested quantities are 124 grams of thiosulfate and 38 grams of acetate

for each liter of solution. The thiosulfate and the acetate are dissolved separately, each in a half-liter of water, and the two solutions are mixed just before use. Temperature of the bath should be about 60 degrees, Centigrade. A yellow-gold color is produced first and is followed by the blue in about one half minute.

INSULATION

IN placing wall insulation, it might be well to consider the statement of P. D. Close, of the Insulation Board Institute, the gist of which was that the first inch of insulation equals in effectiveness the next 20 inches.

FLUORESCENT PAINTS IN COLORS

A NEW series of 12 light-emitting paints have just been announced by Continental Lithograph Corp. By ordinary light these colors have the appearance of ordinary colored lacquers, with perhaps an apparent fluorescent quality, but under the invisible glow of so-called "black light" (ultra-violet) the colors all come alive and glow in a fiery sort of beauty. The "black light," which is harmless, is generated in simple black bulbs which may now be purchased for as low as $2 each.

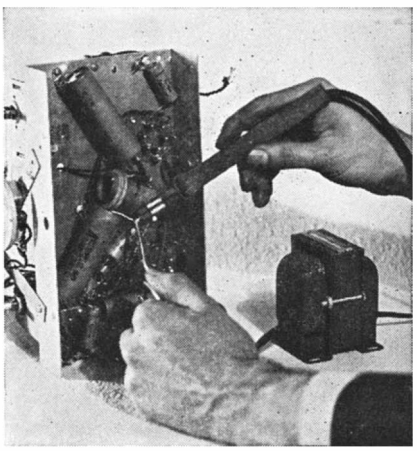
The Conti-Glo lacquer-enamels have numerous decorative uses. They are being applied in theaters for striking effects, in murals in restaurants and other public buildings, and may indeed find use in carrying out design schemes in homes.

"INSTANT HEAT" SOLDERER

A NEW electric solderer recommended for all kinds of light soldering is announced by the Ideal Commutator Dresser Company. Called the "Instant Heat" because it heats instantly upon touching the wire or terminal to be soldered, this tool is hardly larger than a lead pencil and easily solders in hard-to-get-at places.

Heating stops instantly upon taking the carbons away from the wire or terminal so that as soon as the soldering is finished the tool can be put away in the kit ready for the next job. It can also be laid down without fear of scorching any article it touches.

It is safe to use because the line current is reduced by a transformer to harmless low



Just touch the point to be soldered

See our other advertisements on pages 239 and 253.

voltage so that there is no danger from electrical shock or burns. When soldering, heat is concentrated on exact part being soldered, which eliminates danger of damaging adjacent delicate parts.

BROTHER-SISTER MARRIAGE

DISCUSSION of the case in Indianapolis where a girl is reported to have married her own brother without knowledge of their kinship revives an old question. If a scientist in the field of human heredity were asked to decide the question, "Should brother and sister marry," he would probably answer, "Well, that depends."

Ignoring for the moment all questions of law, custom, and religious taboo, and considering only the biological interest of possible children to the marriage, the geneticist would want to examine the history of the family.

If weaknesses, either physical or mental, have "run in the family," then the child of a brother-sister marriage runs a very much more than double risk of inheriting such weaknesses. If, on the other hand, the family is "good stock" with many desirable traits, the child of such close intermarriage has a strong chance of receiving a valuable inheritance.

The facts hold true, although in lesser degree, of the marriage of cousins.

Among the animals lower than man, mating of sister to brother is common practice and is not frowned upon by biologists. On the contrary, it is the method selected for building up traits most desired in future generations. Man, although surrounded by complex social restrictions, is still an animal in matters of heredity.

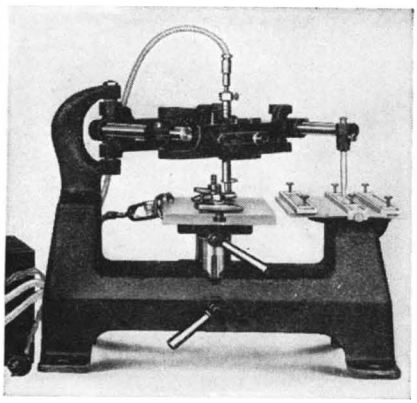
But the taboo against brother-sister marriage is pretty general in all human societies as it is in our western civilization today. Brother-sister marriages were encouraged in ancient times among royalty in Egypt, Peru, and Hawaii, but even there the common people were bound by the same taboos as elsewhere. In different times and different places, the taboo is stronger or weaker, but it seems to have been universal. It even extends to some sub-human animals.

Yet brother-sister unions have always occurred regardless of taboos, among civilized as well as among primitive peoples. This has led Dr. John M. Cooper, anthropologist of the Catholic University of America, who has made a special study of incest among primitive peoples, to conclude that there is nothing instinctive about the reluctance of brother to marry sister. It is, he believes, purely a socially-imposed restriction. — *Science Service.*

COMBINED ENGRAVER AND ELECTRIC ETCHER

A NEW bench-type pantographic machine for general industrial engraving work on all materials, and electric etching on soft or hardened steel, has been introduced by H. P. Preis Engraving Machine Company. Separate heads, quickly interchangeable, are used for the two classes of work.

On engraving work, depth of cut is controlled, independent of the depth of master characters, by a micrometer adjustment mechanism on the engraving head. Movement of the engraving cutter, to and away from the work, is controlled by a cam-action



For engraving or etching

drop lever, thus eliminating the necessity of raising and lowering the pantograph. Either raised or sunk engraving can be produced. For engraving on uneven surfaces, on slightly concave or convex surfaces, or on objects varying in thickness, an automatic depth-of-cut regulator is furnished.

On electric marking, contact of the etching point with the work is controlled by a sensitive spring pressure. The etching point may be removed from its fixture and used as a hand-etching pencil for rough or free-hand marking. An electrical transformer provides three or more voltage stages for various depths of marking.

The compactness of this unit, and the fact that it can be plugged into any light socket for instant use, are features that should recommend it for a wide range of industrial and commercial work.

AT THEIR POSTS

BELIEVED to be the first time so many employees have been reached at one time without leaving their jobs, Pontiac workmen recently were addressed by William S. Knudsen, president of General Motors. The talk was made over a public address system and loud-speakers throughout the plant, the first installation of its kind.

VESSELS OF MANY SKINS

THE continual increase in the pressures used in industry for gas storage, gas separation, hydraulic presses, high-temperature hydrogenation, and many chemical syntheses has required an equivalent increase in strength of the vessels which are used for the processing, says the *Industrial Bulletin* of Arthur D. Little, Inc. Equipment manufacturers have found that the problem could best be solved by a change in construction principle, rather than by a simple increase in the thickness of the walls of the vessel.

One promising development is the multi-layer vessel constructed essentially by wrapping several thin-walled vessels around each other until the required wall thickness is attained. These vessels are now rather common and one has been successfully operated at high pressures since 1931. On service testing these vessels to destruction, the designers found that when a break finally occurred it was by stretching and deforming, rather than by explosive shattering. One explanation of the success of the multi-layer

construction is that hidden flaws in the metal or the welding are confined to one layer so that a break in one layer is not followed by an immediate break in the entire vessel.

As pointed out in a recent article in *Chemical and Metallurgical Engineering*, multi-layer construction is advantageous not only in strength but also in economy and flexibility of production. As always with advances in equipment design, chemical engineers are already anticipating the process improvements these vessels will permit.

Eye Muscle Exerciser

WEAK, lazy, and inefficient eyes may be exercised with a new and versatile small-size metronoscope developed by the American Optical Company. This device does two important things: it aids in training one to read more efficiently and at the same time exercises weak and lazy eye muscles which do not function together.

". . . trains and reconditions eyes"

The metronoscope has three shutters in front which open and close in sequence, exposing a third of a line of words printed on a reading roll. The patient sitting before the instrument and looking through special lenses (prisms) is forced to read correctly, for the operation of the instrument does not permit long pauses or any retracings of matter that has gone before. In addition, the reading roll can be speeded up, thereby training the subject by degrees to increase his reading speed. Such enforced reading trains and reconditions the eyes.

Man-Made Sunlight for Miners

AN improvement on nature has been accomplished by engineers of the famous Boliden gold mine in Swedish Lapland. By means of a solarium, equipped with ultra-violet and infra-red lamps, the miners are assured of a necessary supply of life-giving — although artificial — sunrays during the six-month Arctic winter. It has successfully solved a very difficult problem, since a Boliden worker who toils under ground does not, in fact, see daylight from the middle of September to the middle of March, except during mealtimes and on his days off.

The solarium, which is free to all employees who wish to use it, is housed in a pleasant, modern building with direct connection to shower rooms and lavatories. It is provided with four powerful sunlamps and four heat lamps. In order to increase

the intensity of the rays, the walls and ceiling are lined with sheets of aluminum-bronze. Through the length of the room runs a gangway between guard rails, along which the sun-bathers slowly walk. The workers use the solarium about every second day in the winter, each treatment lasting only two to three minutes, a period regarded as sufficient to provide the body with the needed amount of "sunshine."

The beneficial effects of this innovation have been clearly demonstrated in a questionnaire, which the company recently circulated among its workers. Eighty-four percent of the employees reported that they were less troubled with colds than before, while some even testified that they had conquered this ailment completely. In other cases muscular aches and fatigue have been eliminated, and the number of fractures reduced. In general, the sun-bathers claim that they enjoy a much sounder sleep since they began the lamp treatments. In addition, statistics for the winter 1937-1938 show that 175 workers had 78 fewer days off for sickness than during the dark season of the preceding years. The working capacity of each individual who uses the solarium regularly also has increased.

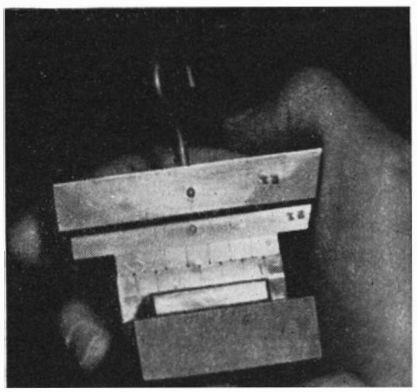
Boliden has long been a pioneer in means and measures for improving the health and working conditions of its employees. It is now reported that many other Swedish industrial concerns, especially those located close to the Arctic Circle, will install similar solariums in their factories.—*Holger Lundbergh.*

Powerful Magnet Assembly

A NEW permanent magnet assembly, roughly three times as strong as any previously known, was disclosed recently by the General Electric Research Laboratory. It permits a tiny piece of sintered alnico to lift and hold 4450 times its own weight.

The previous record assembly, developed in the laboratory last year, allowed a piece of the same material to lift 1500 times its own weight. Sintered alnico is an alloy of aluminum, nickel, and iron as the basic or essential ingredients, and is made by pressing together the powdered metals and heat-

Magnet holds 4450 times own weight



The multi-gap magnet assembly

ing almost to the melting point. By itself, without the special assembly, an alnico magnet has a normal lifting power of 500 times its own weight.

A new mounting of brass and iron in which the magnetic flux passes through many air gaps, instead of the usual two, in bridging from pole to pole, is responsible for the greatly increased power. The new assembly is not a commercial development and the largest turned out in the laboratory to date contains but three cubic centimeters of alnico.

Though smaller than a thimble and weighing three fourths of an ounce, this magnet in its mounting has supported as much as 200 pounds in tests.

Sulfite

SULFITE liquor remaining after the cellulose is removed from wood pulp is not only an uninviting material but is also troublesome because it kills plant life and fish. Yet from this unpleasant material is made sweet-smelling vanillin, the basic constituent of vanilla extract, while the remaining liquor is used to make lignin plastics.

NEW BIRD

DISTINCTLY surprising is the fact that despite our vaunted complete knowledge of every aspect of our country, an entirely new bird species has just been discovered. It is the first new species of bird to be discovered in the continental United States in 21 years and was found in the "panhandle" district of West Virginia by Karl W. Haller, ornithologist of Bethany College.

Eyes that Shine in the Dark

THE strange light that "shines" from the eyes of cats and other animals at night has been investigated for the first time by Ernest P. Walker, assistant director of the National Zoological Park of the Smithsonian Institution.

It must be a reflection from some surface of the eye of the light that shines upon it, Mr. Walker reports in the annual Smithsonian yearbook.

Mr. Walker carried out his investigation in the zoo with flashlights, aided by zoo policemen making regular rounds. While the shining of eyes is a well-known phenomenon, Mr. Walker points out in his report, most of the observations have been

made in the wild. The owner of the eyes is frequently unknown, and it is usually impossible to observe the same individual again under similar circumstances.

His best results, Mr. Walker reports, were obtained with light of moderate intensity. If the light is too bright the shining is less conspicuous, or does not appear at all.

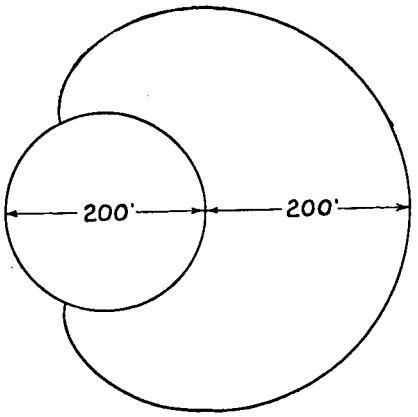
The "shines" range in color from pale silvery through silver, blue green, pale gold, gold, reddish gold, brown, amber, to pink, with a wide range in intensity from dull to very brilliant.

Mr. Walker experimented with the effects of red and blue light on the "eye shine" color of 40 species of mammals and reptiles, but he found little variation in colors of the reflected light, other than the expected red and blue tinges.

Second Circular Pasture Problem

READERS who have been addicted to Lieutenant-Commander Leonard Kaplan's mathematical problems will recall that, in his first, published last September, a cow was tethered inside a circular pasture 200 feet in diameter. This time our bovine mathematician is tied outside the same enclosure, and thus has a new problem on her mind.

A circular fence encloses a field 200 feet in diameter. A cow is tied by a rope 200



feet long to a point on the fence, and outside the enclosure. Over what area will the cow be able to graze?

Commander Kaplan suggests that the answer be published in advance, and it is 89,498.52 square feet. The solution, which is, of course, what chiefly interests the mathematician, will be published in the next number. In the meantime, send your own solutions, also any communications regarding the problem, to Lieutenant-Commander Leonard Kaplan, in care of Scientific American, 24 West 40th St., New York, N. Y., and these will be forwarded to him.

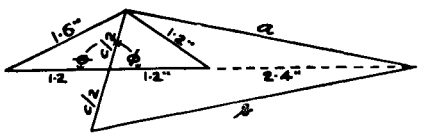
Readers who have been working on this series of problems may be interested to learn that Commander Kaplan is the Ship Superintendent in charge of the actual construction of the *North Carolina*, first of the new 35,000-ton battleships of the Navy's new building program, which will be launched in June or July. The mathematical problems represent one of his outside hobbies.

Solution to the Problem of the Medians

Last month's problem was as follows:

Construct by graphical means the triangle whose medians are 1.8", 2.4", and 3.6". Compute the lengths of the three sides of the triangle so constructed.

The solution: First, construct a triangle whose three sides are respectively equal to two thirds of the lengths of the medians. For the problem given, this will be a triangle whose sides are 1.2", 1.6", and 2.4". Draw any one of the medians of this triangle — the one to the 2.4" side, say — and produce it its own length $c/2$, as shown. Extend the side of the construction triangle to which the median was drawn its own length (2.4") in either direction. Connect the point so laid off with the extremities of the median produced, and the resultant triangle (de-



noted as having sides a, b, and c) will be the one whose medians are 1.8", 2.4", and 3.6".

Proof of the construction follows from the theorem that the medians of a triangle intersect at a common point, which trisects each median.

Since 1.6" completes the triangle, whose other two sides and the included angle are 1.2", $c/2$, and θ respectively, we may write the following relation,

$$(1.6)^2 = (1.2)^2 + \left(\frac{c}{2}\right)^2 - (2)\ (1.2)\frac{c}{2}\cos\theta \qquad (1)$$

and similarly, for the triangle where 1.2" is the side opposite the angle φ included between $c/2$ and 1.2",

$$(1.2)^2 = (1.2)^2 + \left(\frac{c}{2}\right)^2 - (2)\ (1.2)\left(\frac{c}{2}\right)\cos\varphi \qquad (2)$$

Adding (1) and (2) gives

$$(1.6)^2 + (1.2)^2 = 2\ (1.2)^2 + 2\left(\frac{c}{2}\right)^2 \qquad (3)$$

from which,

$$c^2 = 2.24$$

and

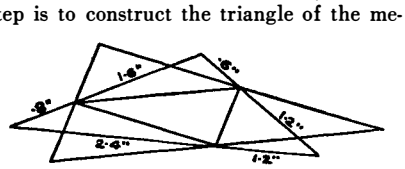
$$c = 1.49666''$$

We may solve for the other two sides in the same way. They evaluate to

$$a = \sqrt{11.84} = 3.44093''$$

$$b = \sqrt{15.20} = 3.89872''$$

A second method of graphical solution is shown in the second sketch. Here, the first step is to construct the triangle of the me-



dians — the triangle, that is, whose sides are 1.8", 2.4", and 3.6". Next, lay off progressively — from left to right, say — two thirds the length of each of the sides of this triangle. The triangle connecting these points will be similar to and will have sides one half those of the triangle desired. The latter can be produced graphically by drawing through each vertex of the half scale triangle parallel to the side opposite.

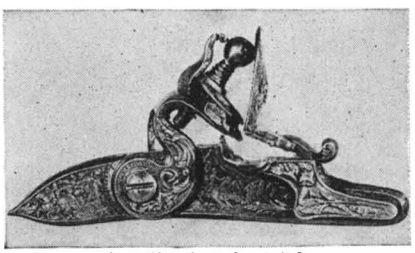
YOUR FIREARMS

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; science has so developed them that millions yearly find sport and recreation in their use. Hence this monthly department presenting a wide variety of discussion regarding firearms, their handling, and their accessories. Suggestions from readers will be heartily welcomed.*—The Editor.

"Caviar" Guns, and Others

THE fine art of engraving on guns is almost as old as firearms themselves, but modern engravers are said to surpass the 16th Century artisans in skill, imagination, and execution. Since the days of Simon and Pedro Marcarte and Albrecht Dürer, tools of the trade have improved a thousand-fold, which no doubt accounts in large measure for present-day excellence in artistry. Despite endorsement of the Marcarte brothers' art by Holy Roman Emperor, Charles V, the appointment of Pedro Marcarte as Royal Arquebusier to Charles II of Spain, and notwithstanding Dürer's unimpeachable reputation as painter and engraver, the picture of the late 17th Century

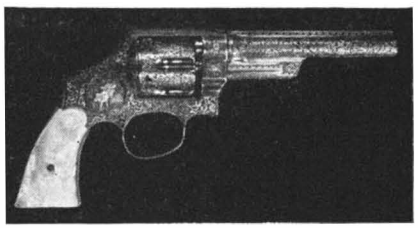


Courtesy International Studio Art Corp.
From the 17th Century

Italian-made flintlock, reproduced here, indicates that although European gunsmiths had by then plied their trade more than 200 years, the decorative art and its delineation was crude, unimaginative, and lacking in perspective and depth, as compared with the modern work of Joseph Fugger, for example.

The infancy period of firearms history might be termed the "Age of Caviar and Kippered Herring," for the ornate and inlay work, which often covered the entire weapon, meant as much to the medieval huntsman as the utility of the piece and so increased its costs as to prohibit ownership by any save kings and noblemen. If the medieval vassal owned a gun at all, it was a plain, simple affair with shooting proclivities probably on a par with that of his feudal lord and master, but it was conspicuous for the absence of designs and decorative effects. Today, while the taste for "caviar" guns has improved and increased, rather than diminished, the "kippered herring" class of firearms is being served up with a bit of toast, so to speak, and, to carry the fancy further, frequently with butter and a garnish of parsley.

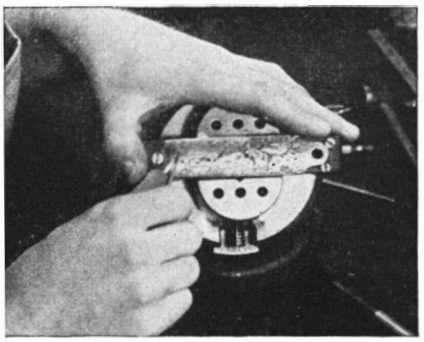
But this doesn't mean that the cost of beautiful engraving has decreased, as indicated by the price for a truly amazing and intricate pattern of relief work in gold and silver on a Smith & Wesson revolver, recently completed by the firm of Griffin & Howe, New York. The job required almost a year of working hours on the part of Joseph Fugger, Griffin & Howe's ace engraver. While this piece is considered by S. R. Griffin to be one of the finest ever turned out in the 17 years his firm has been in business, the constant flow of orders for firearms decoration from all parts of the country frequently brings commissions which keep Joe Fugger on the same weapon for 100 to 150 hours.



In gold and silver

The name of Rudolph John Kornbrath will be familiar to many owners of beautifully engraved guns, for during his hey-day he was acknowledged as America's No. 1 firearms engraver, and it was Kornbrath who enticed Fugger to this country after the latter had completed a four-year course in engraving in his native Austria. Kornbrath, an earlier graduate of the same Austrian school, took the younger man into his shop in Hartford 16 years ago as apprentice. From there he went to Griffin & Howe, for whom Kornbrath had frequently done special work. Today, Fugger, whose father before him was a noted Austrian gunsmith, is the acknowledged suc-

Of the 20th Century



Hands that do the work

cessor to the master, Kornbrath, who has been forced into retirement by ill health.

Fugger, according to S. R. Griffin, is typical of the skilled artisans who are products of English, Austrian, Belgian, Swedish, and German training in gunsmithing. Contrary to American mass production methods of firearms—necessary to supply our 8 million licensed hunters—the Europeans still adhere to the "custom-made" theory of sporting gun manufacturing to a greater extent

Machine manipulated

than do we. Because of the high quality of workmanship demanded by his clients, Griffin, therefore, has found it advisable to staff his shop entirely with European trained workmen, all of whom, incidentally, are naturalized American citizens.

However, this is no diatribe against our own firearms manufacturers, whose inventive genius, perspicacity, and business acumen are responsible for more improvements in firearms since America's cradle days than all the rest of the world put together. As stated above, mass production in the U. S. A. is necessary to supply the demand, and the fact that our manufacturers have not only accomplished that, but also have incorporated in their products many refinements and niceties found in European "tailor-made" guns, speaks volumes. It took American ingenuity to find methods of serving up the "kippered-herring" gun with "toast, butter, and parsley." And just so we won't be misunderstood, our personal gun rack contains an $8.95 single barrel, 16-gage shotgun which has accompanied us through numerous vicissitudes, and if you don't think it's valued highly, try to get it out of our den.

Typical of American efforts to enhance medium priced shotguns is the newly perfected electric etching process of the J. Stevens Arms Company. Machine manipulated, and directed in accordance with the lines of a pre-determined master pattern, this process produces in exact detail on gun receivers any scene depicted in the original specimen. Although full description of this etching process remains a secret, it can be told that the method provides a means of making changes in the pattern at very reasonable cost so that the same scene or decoration need not appear on all products. A further variation exists in the reversal of the process to bring out the image in relief.

Of course, kippered herring may never hope to attain to the status of caviar, and it hasn't been our intention in this column to intimate that we think all shotguns or rifles are the same under their etchings. There are just as many differences between the well made, straight-shooting, $9 single barrel (like our's) and the magnificently constructed $1000 piece (which we don't own!), as there are between any other manufactured products with a wide price variance. The point is that, under the American system, those of us who have "kippered herring" incomes can shoot just as well and have just as much fun shooting as anyone else.

Pot-Shots

AT THINGS NEW

THE DAIRY SPECIALTIES, INC., announce the "Ferret" shotgun cleaner, made to fit any standard cleaning rod and all gun gages. Composed of a bronze alloy wire, soft enough to prevent gun-barrel injury, yet hard enough to remove rust, lead, other deposits, the "Ferret" is tapered at both ends to permit passing through choke in both directions, on rod or stout cord, and is self-sharpening, working even better after being used a few times. It sells for 65 cents.

BOOKS OF THE MOMENT include "A Handbook of Salt Water Fishing," by O. H. P. ("Ollie") Rodman, Editor of "Hunting and Fishing," and "Mastering the Rifle," by Morris Fisher, National, International and Olympic Champion.

THE POLY-CHOKE COMPANY offers for 1940, in addition to their well-accepted device for producing nine different degrees of choke on automatic or repeater shotguns, the "Aero-Dyne" Super Poly-Choke, especially adapted to the new, crimp-top shells. The new product produces a more open pattern than the regulation wide-open bore and is available for 12, 16, and 20 gage shotguns. All Poly-Choke products are described in new, free booklet, "How to Become a Better Wing Shot."

FRANCIS BANNERMAN SONS are celebrating their 75th Anniversary with a new and larger catalog of 287 pages, plus index and appendix. This comprehensive volume, devoted to war relics, ordnance, antique firearms, military goods of all kinds and description, is as authoritative a book as is published on these items. Catalog sells for 50 cents; is worth many times the price.

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

Lighting Goes Miniature

THE ability to create special lighting effects with equipment that can be handled with ease in the average home and has, in addition, the advantage of portability, is something that most serious photographic workers desire. The selective lighting so characteristic of spotlights is particularly in demand. Recently, some succesful ventures in this connection have been undertaken by enterprising manufacturers to bring to amateur as well as professional workers, so-called "miniature spotlights" that, in our opinion, provide all the lighting facilities necessary for many types of pictures, whether "straight" or otherwise.

Those at present available are usually equipped with a Fresnel lens, which gives a soft outline to the spot; a small projection bulb corrected to 3200 degrees, Kelvin, the temperature required for color work; a control lever for varying the size of the projected beam; adjustability of the lighting angle; and a base that can either be set on a table, floor, or similar support, screwed into a tripod head or, by the use of an accessory adapter, attached to a regular light stand.

Among the miniature spotlights now available, or soon to come on the market, are the Dinky-Inkie, now being used extensively in Hollywood studios for special portrait effects; the F-R Hi-Spot, and the Lafayette Hi-Lite. Another type of miniature spotlight is the Willo Spotlight which uses a Photoflood bulb and a condensing lens to provide a small, bright spot.

Among the uses for which this type of equipment seems particularly adapted, there at once come to mind still lifes, tabletops, and portraits. By controlling the beam, either through close approach to the subject, the use of a "snoot" as on the Dinky-Inkie, or varying the distance between the spotlight lens and the bulb, one may illuminate small areas and thus place light emphasis where it belongs.

Figure 1

Figure 2

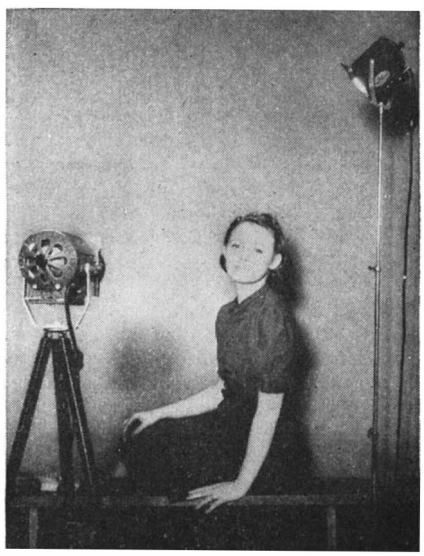


Figure 3

The versatility possible with these miniature spotlights, when equipped with diffuser and snoot, is demonstrated in the result shown in Figure 1, which was lighted with two Dinky-Inkies. One unit was placed in front, near the camera, with diffusing screen before the lens, while the other, equipped

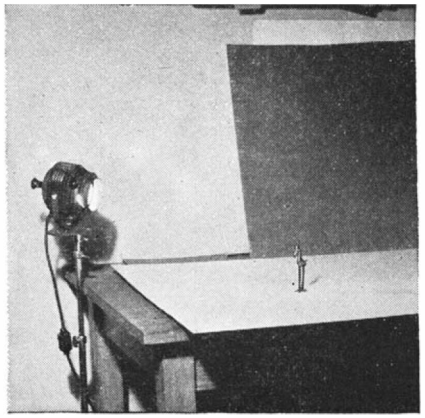


Figure 4

with a small diameter snoot, was set at an angle to the subject. The result shows a definite spotlight effect on the selected area (the face), with shadows filled in by the front diffused light. These snoots are available in various diameters. In addition, one may obtain a set of "barn doors" or blinkers to keep light away from unwanted areas of the subject-matter. Figure 2 illustrates a more or less "straight" portrait lighted as shown in Figure 3.

These spotlights are a particular joy to the tabletopper and those workers who take a delight in still-life photography. Figure 4 shows an F-R Hi-Spot in use on a table-top subject. The ease with which these lights can be handled is obvious to anyone who has had experience with larger equipment. Because of their small size, they may be placed in out-of-the-way corners, even behind the subject, and at all sorts of angles.

To provide a general light, the lens may either be fronted with a diffusing screen or, where a stronger light is wanted, the lens may be removed entirely and the bulb moved forward as far as it will go. A surprisingly large area can be covered in this way. This all-round usefulness of the miniature spotlights brings the suggestion that one might assemble a complete lighting outfit by using three miniature spotlights, provided with three light-weight stands. For these, a fiber case might be made to house the entire equipment. Such a combination, with its extreme portability, would not only allow the worker quickly to assemble or dismantle his lighting equipment for storing in a closet, but would also permit taking the whole affair to distant scenes of picture-making.

A New Profession

COMMENTING on the scarcity of photographers who at the same time have a background of scientific training in a special field, Fairfield Osborn, Secretary of the New York Zoological Society, proposed a new profession at a recent Conference on Photography, held in New York City under the auspices of the Institute of Women's Professional Relations, Connecticut College. He suggested that there should be a fruitful field for young people in a thorough training in a specific field of science, going hand in hand with a thorough training in motion pictures or still photography, towards the end of achieving the ability to interpret science for the layman.

The man who "knows his stuff" is always in demand and the photographer who has a good knowledge of the subject he is photographing, and therefore interpreting, is hard to find. As an example, Mr. Osborn pointed to the fact that for some time his organization has been looking for a good motion-picture photographer who had also had a good training in zoology, and that so far the search had been in vain.

Colonel Edward Steichen, the photographic ace of our time, addressing the same group, referred to photography as "the universal medium of expression." Differentiating between the amateur and the professional, Colonel Steichen said that the amateur, even though he may sell a photograph now and then, may still keep his amateur status because he works only as the mood moves him, whereas the commercial photographer must turn out pictures as and when ordered. The news photographer, he added, has a still harder job because, although the commercial photographer, even though working against a deadline, may have opportunity to shoot 50 or 100 negatives, the news photographer must bring it all in on one plate.

Speaking of the financial reward in photography, Colonel Steichen said that if a man or woman goes into the field with the idea of making a lot of money, he or she had better forget about it right away. All the aces in photography, he said, started off with the idea of turning out a good picture, but not to make money. That they also made money was incidental.

We should like to comment here that while the photographic field is overcrowded, as Colonel Steichen said, so is many another field; but for the person with superior ability and a new idea, there is always room in any field, and that includes photography.

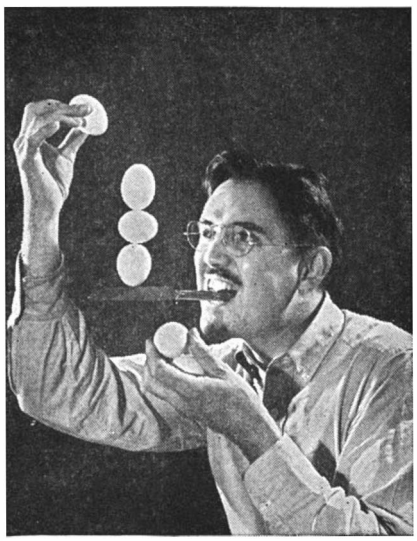
In our next issue, we plan to give a résumé of the various talks given during the Conference, in which speakers from many different fields outlined the opportunities for photographic careers.

Prize Winners

PRIZE winners in three amateur photographic contests have been announced since our last issue. These took top place in the Raygram Corporation's Ray-Del Developer Contest, the third annual Kalart Speed Flash Competition, and the Packard Amateur Photo Contest.

The first contest, which called for pho-

First Prize: Field

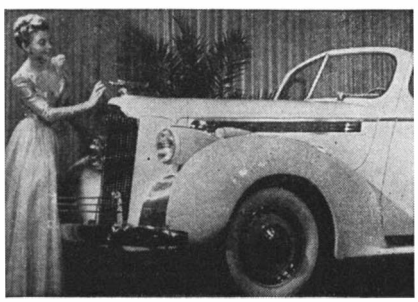


Second Prize: Steinmetz

tographs illustrating the idea of balance, and made from negatives developed in Ray-Del, was judged by Willard D. Morgan, Kip Ross, and Herbert C. McKay. Prize winners were Nathaniel Field, Brooklyn, New York, who took first prize of $50; Joseph Janney Steinmetz, Philadelphia, Pennsylvania, second prize of $25; and Edmund Janke, Jr., Middletown, Connecticut, third prize. Nine others received honorable mention and cash awards of $5 each.

Twenty-five entries, representing practically every section of the United States, won cash prizes totaling $250 in the third annual Kalart contest. More than 2000 prints were received, a 130 percent increase over last year's contest. Subjects ranged from the familiar child pictures to spinning gyroscopes.

Murray Hoffstein, of New York City, employing a recently purchased Automatic Rolleiflex, took first prize in the Packard Amateur Photo Contest. The picture he



Packard winner

made and the car he won are both shown in the accompanying illustration. Shortly after the judging was completed and the winners were announced, Mr. Hoffstein rolled away in his new "One-Ten" Packard convertible coupe. The judges found the picture pleasing from both the artistic and the illustrative angles.

NEW SOLAR MODELS

IMPROVED models of the Solar enlarger are now available possessing a number of features designed to make them adaptable to various uses other than straight enlarging. The enlarger, which comes in three models covering all negative sizes from 35mm to 2¼ by 3¼ inches, now permits easy adjustment of the equipment for ver-

tical or horizontal projection; for use as a copy stand, employing your own camera; for straight photography and photomicrography; and other needs. Lenses and lens boards are interchangeable, and the lamp house may be used as a lighting unit in tabletop and similar work.

Hypo Caution

ORDINARILY, the mixing of a hypo solution is by no means a critical proposition. However, if—through neglect or through some notion that, by making the hypo bath stronger, fixing will be more rapid or more effective—the formula is not followed, it will sometimes be found that the strong hypo solution will tend to bleach the image.

We Make The Millionth

THE nearest we shall ever get to a million of anything is reported in a story in the Kansas City Star announcing that our recent book, "Finding New Subjects for Your Camera," was the 1,000,000th book added to the Kansas City Public Library. The event was marked by the publication of a picture showing a library staff member stamping the number in the book. The story adds that the book arrived 66 years to the month from the beginning of the public library and that the book which had been numbered 1, "The American Cyclopedia," was long since worn out and discarded.

The library, the story adds, possesses more than 100 titles on photography and, as indicative of interest in the field, the file cards are soiled with thumb marks.

"We can't find enough books on the subject," said Louis Nourse, the librarian.

Metal Alloy For Sinks

WHAT'S good enough for the professional is good enough for the amateur photographer. One of these is a metal known as Inconel, 80 percent nickel and 20 percent chromium. If you are looking about for a metal darkroom sink that will withstand the corrosive tendency of photographic solutions, we would suggest your investigating Inconel. We have been advised that it "stops fogging, metallic contamination, corrosion, chipping, cracking, and rusting," and that as a result it is being used extensively in the processing of motion-picture film, as well as in some large photo-finishing plants. Also, photographic trays made of this metal are available in various sizes.

Enlarger Prices Down

PRICE reductions on all models of the Praxidos and Bee Bee Enlargers are announced by the distributors, Burleigh Brooks, Inc. The prices have been cut as much as 42 percent in some cases.

Stolen Cameras

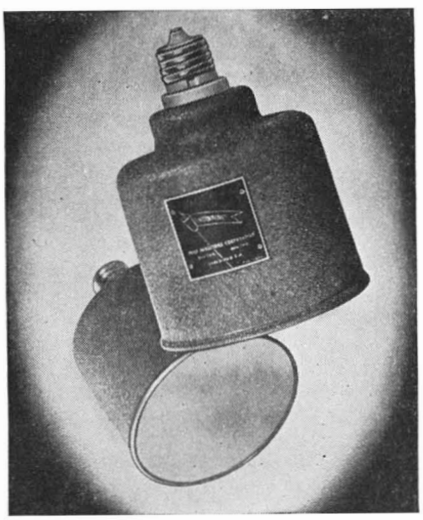
THE wave of camera thieving goes on apace. Every once in a while we hear about another member of the photographic fraternity whose studio or home has been broken into by thieves and robbed of expensive cameras and equipment. Recently,

the thieves have made several large "hauls." These losses are seldom recovered and when they are it is usually in a pawnshop.

With thieves gunning for cameras and equipment, every owner of cameras having reasonably high value should guard his equipment by using strong locks, never leaving the equipment carelessly about and, above all, taking out camera insurance. If insured, at least you have the feeling that your camera is protected—even against your own oversights!

Cold Light In Darkroom

WITH fluorescent lighting as one of the big features of the day, the introduction of a new-type enlarging lamp that employs a fluorescent gaseous discharge tube makes interesting news. The unit, known as the Princeton Fluorescent Enlarging Lamp, comes equipped with a light-equalizing screen and is no more trouble to install in the enlarger housing than the ordinary light bulb. The makers claim that the unit is "so cold that it can be held in the hand after ten hours continuous operation with no discomfort whatsoever."



The unit produces white light "extremely close to daylight in its color characteristics." It is reported that the unit "provides a soft, white light evenly diffused, which gives a peculiarly fine print quality which combines tonal gradation with true brilliance."

Using alternating current only, the unit has a minimum life of 2000 hours. It consists of a small metal housing 4 inches high and 3¾ inches in diameter, fitted with a standard screw plug that fits the socket of the enlarger. The light may be used for all negatives from 35mm up to 3¼ by 3¼ inches. The unit is adjusted so that the diffusing screen is close to the upper condenser face.

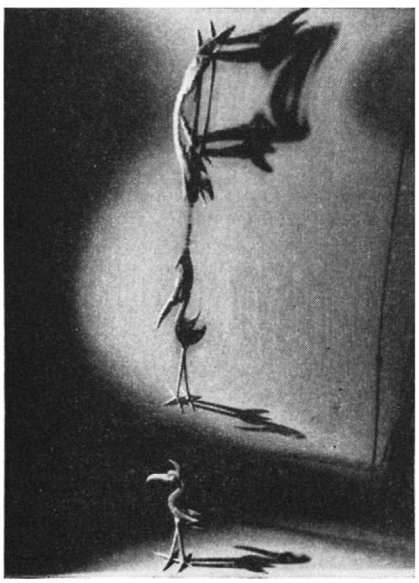
Printing Harsh Negatives

THE best way to correct harsh negatives is not to make them in the first place; but having made a harshly lighted negative, here is one way of making the best of the situation. Place a piece of ground-glass of the right size next to the emulsion side of the negative and project or contact-print through the negative. The ground glass,

coming between negative and paper, will break up the direct rays of the light and cause a light dispersion that will bring about the desired diffusion, avoiding abruptness between the shadows and strong highlights.

Chromium Tin Distortion

CREATED simply by bending a chromium tin and photographing the tin reflection at an angle, "Something New in Headgear," may provide an impulse for



"Something New in Headgear"

working out comical notions. The distortion effect achieved depends on the subject used, the degree to which the tin is bent and tilted, and the camera angle. The tin is held rigid in any given shape by the use of string on each side.

This is one of a large number of tricks, comprising a sort of "trick encyclopaedia," included in a little book on trick photography by "yours truly," soon to be published.

Cleaning Trays Overnight

IF you have your own darkroom, sink and all, here is a tray-cleaning tip that has been handed on to us by an old timer. After a day's work he pours the stop bath into the emptied developer tray and leaves it that way overnight. When he comes in the next morning, he tears a sheet from his newspaper before walking into the darkroom and, after emptying the stop bath from the developer tray, crumples the newspaper and uses it to wipe out the thin layer of sediment on the bottom and sides of the tray. The tray is then thoroughly washed before use.

Washing Roll Film In Tray

IN these days of film developing tanks, which serve for developing, rinsing, and fixing, plus washing, the "see-saw" method of developing film rolls in a tray is rather passé. However, there are doubtless many persons who still do not own tanks; also there may be some who would not have one as a gift but prefer the old ways to the new. On the other hand, it may sometimes be found convenient to develop see-saw fashion in a tray. At any rate, if and when you do, here's a washing tip. Form the film into a horizontal circle with the emulsion (now negative) side out. Overlap the ends and fasten them with a pin or clips. So joined, the film will stand on edge and will be washed clean of hypo in 20 or 30 minutes.

WHAT'S NEW
In Photographic Equipment

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

KODAK FLASH SYNCHRONIZER ($7.50): For use with current model Kodak cameras having shutters accepting cable release. Battery case of black molded material holds two 1½-volt cells. Lamp socket, of quick-action type with four springs, holds No. 7, 11A, 16, or 16A Photoflash lamps in correct position in front of highly polished spherical reflector. Housing on side of battery case contains operating plunger, adjustable switch contact, and container for head of cable release. Cable releases to fit cameras with which Kodak Flash Synchronizer are to be used must be purchased separately. Longer cable release necessary for some cameras than ordinarily used. Recommended procedure: set for bulb exposures. May be adjusted to 1/50 of a second shutter synchronization. A 2½-volt lamp, miniature socket, cord and plug to fit lamp socket in battery case, plus instructions, supplied for this purpose. Camera is attached to metal camera support bracket by large knurl-headed screw fitted in camera's tripod socket. Battery case of synchronizer attached beside camera on same bracket.

FEDERAL ENLARGER MODEL 440 ($27.50): Takes negatives from 35mm to 2¼ by 3¼ inches and intermediate sizes. Supplied with *f*/6.3 anastigmat lens. Features: condenser lens and illuminating system includes 4½-inch condenser lens and ground diffusion plate and special parabolic reflector; convertible glass or dustless metal plate negative carrier; new adjustable metal mask; quick-acting clutch; double spiral focusing; lens mounted with click diaphragm and built-in red filter; cool lamp housing; 36-inch steel upright post mounted on heavy 16 by 22-inch hardwood baseboard. Accessories included: projector lamp, underwriters' approved control switch, cord, and plug. Works on AC or DC.

RAYGRAM BOX-TYPE BEADED SCREENS ($10 to $20): Made of Dupont screen cloth, with coated back and beaded with graded blue-white glass beads. Important feature: semi-automatic frame. When screen is pulled out of case, it automatically stands erect. Slight pull on release cord all that is necessary to close it. Made in four sizes.

PERFEX FIFTY-FIVE ($39.50, $49.50): Latest addition to Perfex line of miniature cameras. Supplied with *f*/3.5 or *f*/2.8 lens. Features same as Perfex Forty-Four, plus

GEM TRANSPARENT PHOTO COLORS (25 cents per package): For painting and tinting photographs. Eight different colors packed in small folder. To use, simply tear small strip from colored sheet and place in water. Supplied with folder are small cotton sticks which are used as brushes.

PARA FILTERS: Combination sunshade and filter set. Base arranged on revolving lens flange, slotted to permit insertion or removal of filter; a half turn of sunshade opens or closes slot. Designed to slip over regular camera lens. Two types of mounting available: one having set screw, other with six spring tension points which grip lens barrel. Set complete with five color-fused optically flat glass filters, light yellow, medium yellow, orange, green, and red. Heavily constructed, chrome-plated. Instructions supplied covering filter factors for five filters in either day or artificial light, with information on type of film.

FEDERAL ENLARGER MODEL 246 ($49.50): Takes negatives from 35mm to 2¼ by 3¼ inches and intermediate sizes. Complete with *f*/4.5 anastigmat lens. Specifications: double extension bellows (takes lenses from 2-inch focal length to 5 inches); double condenser lens system; enlarger convertible to condenser or diffusion illumination or combination of both; opal lamp on adjustable slide, with special parabolic reflector, supplies even light distribution; convertible glass or dustless metal plate negative carrier; new adjustable four slide metal mask; dustless metal negative pressure plates; negative pressure release permits negatives to be removed while in machine without scratching; micrometer focusing control; four-element 3½-inch *f*/4.5 anastigmat mounted in removable lens board; counter-balance adjustment; double ventilation radiation fans in lamp housing; rigid steel 36-inch upright post mounted on heavy 16 by 22-inch baseboard; enlargements from 1½ to more than 8 times on baseboard with 3½-inch lens, greater by projecting on floor; enlargements up to 18 times on baseboard with 2-inch lens. Accessories included: large red filter, 75-watt opal enlarging lamp, focusing target, approved cord and switch. Works on AC or DC.

RAYGRAM RUBBER DARKROOM APRON ($1): Made of rubber-coated fabric, light in weight but durable. Unique feature: trough at hem to catch any hypo or developer that might otherwise stain shoes or clothing. Breast pocket provided for carrying thermometers, pencils, and so on.

FILMOLEEN: Cleaning fluid for color film and black and white. Removes slight surplus of dye from surface, giving yellowish tinge to cleaning cloth, but not affecting the colors. After first tinge of color is removed, it is said, subsequent cleanings with Filmoleen have no further effect of this sort.

CAMERA ANGLES ROUND TABLE

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

Q. Can you advise me about taking snapshots indoors in daytime with light from windows and doors? I usually use orthochromatic film.—C. M. M.

A. One of the fast panchromatic film emulsions would be more suited to this purpose, especially where it is necessary to keep exposures at a minimum, as in the case of portraits. An extinction type exposure meter will frequently be more useful in taking indoor readings than the photoelectric type. Of course, the reading should be made from the shadow side in order to make certain that shadow details, where wanted, will be recorded. In making snapshots of persons indoors by daylight, have the subject seated a couple of feet or so away from the window rather than close to it, and at an angle of 45 degrees to the light coming from the window. For the shadow side, provide a reflector of some sort to catch the window light and throw some of it into the shadows. A newspaper or pillow case, for example, will do. In taking interiors, the lightness or darkness of the walls and furnishings will make a considerable difference in the required exposure.

Q. Will you please tell me how I may treat my table so that hypo and developer will not harm the paint?—H. S. McC.

A. An efficient protective covering would be a strip of linoleum or sheet rubber. Oilcloth has been used, but this is usually too thin, cracks easily and is generally not very reliable if you are particularly anxious to protect the paint on your table.

Q. I would like to make some money with my camera hobby. Would you recommend some books? What is the best way for someone living out here in the Far East (Java) to make contacts with the right people. I have a lot of pictures about mountain trips, trips to the seacoast, the natives, and so on. Some of them have been accepted by local illustrated papers.—W. A. C.

A. Among several of the more popular books on the subject are "Camera Journalism With the Miniature Camera," by George W. Hesse; "Free-Lance Journalism With a Camera," by Rufus H. Mallinson (an English publication); "Making Amateur Photography Pay," by A. J. Ezickson; and "Where and How to Sell Photographs," by H. Rossiter Snyder. A valuable guide to markets is the Universal Photo Almanac and Market Guide. Probably the best way to make market contacts for a person in your situation is to deal through a reliable picture syndicate. A long list of these is included in the Almanac's market guide, the current (1940) issue of which also contains some articles on the subject of making money with the camera.

Q. Is 35mm Kodachrome obtainable unnotched? What is the finest fine-grained black and white 35mm film obtainable?—F. C.

A. To our knowledge, all 35mm Kodachrome film is notched both for the purpose of fitting the sprockets of miniature cameras and to facilitate processing in Rochester. Several film manufacturers make what they claim is tops in fine grain; we would suggest, therefore, that you make tests with the various films and settle the matter for yourself.

Q. Would you kindly inform me of some authoritative source of information on the reversal process for cine film? Also, I would like to know where I can get hold of 16mm film without paying the processing price at the same time.—N. G. A.

A. "Motion Picture Laboratory Practice," published by the Eastman Kodak Company and "Home Processing," by P. W. Harris, are reliable texts on this subject. Of course, you know that positive film can be purchased but this will have limited possibilities. At the present time 16mm motion-picture film cannot be purchased without paying the processing charge, but it is expected that the Gevaert Company of America will shortly have available movie film for home processing.

Q. I would like to know the formula for a film cleaning solution containing ethyl alcohol.—R. S. J.

A. Here it is, thanks to the "Leica Manual":

Ethyl alcohol (pure grain alcohol)..85%
Methyl alcohol (wood alcohol).....10%
Strong ammonia..... 5%

The solution is applied to both surfaces of the film with a clean, lintless fine linen cloth, soft chamois, or lens tissue.

OUR BOOK CORNER

THE Book Department of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

THE MICROSCOPE

By R. M. Allen

MICROSCOPIC methods have shown their utility in the greatest diversity of fields. Partly this has resulted from the ingenuity of users in applying it to new purposes and partly from the increasing convenience of the improved products of the instrument makers. In devoting a large section of the book to descriptions of instruments, the author makes opportunities to guide the user in manipulative methods, which with accounts of available accessories occupy most of the book. Particularly aimed at the layman, the book's treatment will be of great value to experts in specialized fields who are called upon to work outside their specialties. (VII — 286 pages. 6 by 9¼ inches. 82 illustrations in text and 18 full page plates.) $3.10 postpaid.—*D. H. K.*

MASTERING THE RIFLE

By Morris Fisher

POSSESSION of three world's Championships, the Olympic Individual Championship and dozens of other rifle marksmanship honors, places the author, a member of the United States Marine Corps, in a position to lend authority to his work which deals with sight adjustments, firing positions, use of the sling, breathing, trigger squeeze, wind allowances, 'scope sight elevations, choice and care of a rifle, and many other items of importance to both beginner and experienced shot. For the new rifleman, the procedure of shooting is carefully outlined with a view to assuring prompt results. (206 pages, 8 by 5¼ inches, 26 line drawings, 14 photographs.)—$2.60 postpaid.— *A. D. R., IV.*

GRAPHIC GRAFLEX PHOTOGRAPHY

By Willard D. Morgan, Henry M. Lester, and 20 other contributors

THE editors, whose names have for some years been associated with miniature photography, now bring out a book for the "big camera" enthusiasts. (Whatever may be the pros and cons concerning miniature photography, there is no doubt that the large camera is making a definite comeback.) Subjects covered include negative exposure and development, advice on how to choose a lens, how to use filters, practical guidance on successful printing methods, synchroflash photography, and lighting control. How to use a view camera is covered as the first modern treatise on the subject. Kodachrome photography is fully treated. An important chapter deals with the photographic darkroom. (416 pages, 7½ by 10 inches, hundreds of illustrations.) — $4.10 postpaid. — *J. D.*

LOVE PROBLEMS OF ADOLESCENCE

By Oliver M. Butterfield, Ph.D.

ROMANTIC interests and love problems of a homogeneous group of 1500 American youths between 13 and 25, distributed over the nation, were the objects of this research. The youths, including girls, came to the author and discussed their troubles almost without inhibition. The book reveals the minds and attitudes of the present younger generation but is more in the nature of a sociological study than a practical work of advice. (212 pages, 6 by 9 inches, unillustrated.)—$2.35 postpaid.—*A. G. I.*

PERSPECTIVE MADE EASY

By Ernest R. Norling

DRAFTSMEN and artists supposedly learn perspective early in their studies, but actually a surprising number of them know scarcely more than the fundamentals. This author has attacked the problem in such a simple fashion that a complete knowledge of all the rules of perspective may be easily grasped. Progressively the author takes up the various details of perspective from simplest forms to complicated and unusual figures—roofs, furniture, and the like. (203 pages, 5¾ by 8½ inches, copiously illustrated with drawings.)—$1.85 postpaid. —*F. D. M.*

NATURAL HISTORY OF THE BIRDS OF EASTERN AND CENTRAL NORTH AMERICA

By Edward Howe Forbush, revised and abridged by Dr. John Bichard May

ORIGINALLY compiled in 1925 in three volumes by Mr. Forbush at the instigation of the Commonwealth of Massachusetts, the present condensed publication was prepared by Dr. May under the direction of the Massachusetts Audubon Society. Dr. May, who assisted in the initial compilation, has included 530 species of birds in the present book, an increase of more than 100 over those shown in the original three-volume work. The 97 four-color plates are from original paintings by Louis Agassiz Fuertes, Allan Brooks, and Roger Tory Peterson. Two indices, one of scientific and one of common names, are cross referenced with both text and illustrations. This is undoubtedly one of the finest of bird books, worth several times the price asked. (554 pages, 7¼ by 11¼ inches, 97 color plates.)—$5.05 postpaid. —*A.D.R., IV.*

STARS AND MEN

By Stephen A. and Margaret L. Ionides

THOUGH it is about astronomy, this is neither a textbook nor a systematic popular coverage of astronomy; it is a collection of discussions, entertaining and readable, of things astronomical, largely of historical nature. Typical subjects are: the design of the pyramids, early sundials, the astrolabe, the cult of the solstice; sun symbols and their origins; reasons for naming the constellations; laughing the astrologers off the face of the earth; the calendar; planets, stars, comets; and very many others. In short, a fine collection of astronomical lore that is otherwise difficult to look up. Written by two Denver amateur astronomers. (460 pages, 6 by 9 inches, about 70 illustrations.) —$4.10 postpaid.—*A. G. I.*

A SHORT HISTORY OF THE STEAM ENGINE

By H. W. Dickinson

FROM the early but ineffective efforts of several experimenters, through Savery, Newcomen, Watt and on up; and through the low-pressure and high-pressure engines of the first half of the last century, also the land boilers of the same period, and up to the present the author conducts the reader. He knows his engines as well as his builders, and can talk engines correctly—is not just a rewrite author. He is the accepted biographer of Watt, Boulton, and Trevethick and has spent 30 years in contact with his subject. Part II of this book is a history of the steam turbine. (255 pages, 6 by 9½ inches, 78 illustrations.)—$3.60 postpaid.— *A. G. I.*

A HANDBOOK OF SALT WATER FISHING

By O. H. P. Rodman

REALIZING the salt-water angler's long-felt need for a ready reference library condensed to pocket size, yet replete with detailed information on this many-sided sport, the author has compressed the knowledge acquired from his years of fishing between the covers of this volume in an attractive and absorbing style. It covers all common species of salt-water fish, presents connotations on each as to synonymous names, range, habits, seasons, fishing

We can supply our readers with any of the books reviewed in this department. Prices quoted include domestic postage. Foreign prices are necessarily higher due to increased shipping charges.

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FOR OTHER BOOKS YOU WANT, SEE PAGES 228 AND 244

methods, recommended tackle, food or sport value, size and catch records. How, where, and when to angle for all kinds of salt-water denizens is well and interestingly told for the benefit of both neophyte and expert. (274 pages, 4¼ by 6¾ inches, 37 line drawings of fish, 19 of tackle items.)—$1.85 postpaid.—*A. D. R., IV.*

THE PHILOSOPHY OF PHYSICAL SCIENCE

By Sir Arthur Eddington

THOSE who enjoy Eddington's philosophy as previously set forth in smaller pieces will find here a good big chunk to chew on and, unless they are a bit above average in masticating ability, they will find it tough chewing. In fact, he says so himself: "Some parts of the book introduce matters of considerable technical difficulty." It is not, however mathematical; at least it avoids formulas. A fuller title for the book might have been "The Nature of Physical Knowledge, with Application to the Physical Universe." He calls his philosophy "structuralism," or "subjective selectivism." Epistemology is the subject largely dealt with. (230 pages, 5½ by 8½ inches, unillustrated.)—$2.60 postpaid—*A. G. I.*

CAMPS AND COTTAGES—HOW TO BUILD THEM YOURSELF

By Charles D. White

JUST the book for the man who can use woodworking tools moderately well and about half understands the principles of house construction. It supplies the other half of the knowledge of such things as how to assemble a simple building (neat sketches of correct construction), plan and execute the trim, lay out the roof, and other items. It is a crutch by means of which the average man can put up a neat, correct, $400 or $500 or $700 camp cottage himself (saving several hundred dollars thereby) without risk that a real carpenter will grin when he sees the job. Practical chapters deal with materials, tools, roofing, fireplaces and chimneys, paints, water supply, and just the things a camp cottage builder will be up against. The author is an architect and builder who likes simple camps. His book is friendly. (235 pages, 6 by 8¾ inches, 69 illustrations.)—$2.10 postpaid.—*A. G. I.*

PHOTOGRAPHIC CHEMICALS AND SOLUTIONS

By J. I. Crabtree and G. E. Matthews

REPRESENTING, as the authors state in their preface, "some of the knowledge acquired during the past twenty-five years in compounding photographic solutions and studying their application to photography in the Research Laboratories of the Eastman Kodak Company," this book needs no further recommendation. The atmosphere of authority fills every page of this thoroughly practical reference work, one that was written for both the amateur and the professional. An "index of formulas by purpose" is one of the most useful features of the book. The authors have made every effort to write in non-technical language wherever possible so that the book may be read and understood by all photographic workers. (360 pages, 6½ by 9½.)—$4.10 postpaid.—*J. D.*

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

TELESCOPE makers who plan lightweight and spindly-legged tripods are urged to study the proportions of the tripod in Figure 1. With the heavy mounting and 4″ refractor the total weight is 288 pounds. John McLennan, 1424 Oakwood Ave., Akron, Ohio, is the maker and he says the four main castings are of bronze with proportion 85 percent copper, 15 percent tin. The rugged axes are 2″ and 2⅛″ in diameter, respectively, and both turn in precision ball bearings filled with grease.

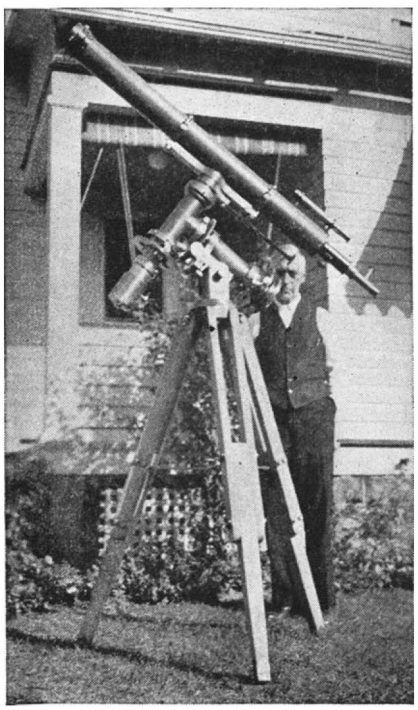


Figure 1: McLennan and telescope

There are setting circles on both axes and the polar axis has a slip ring for setting on sidereal time when starting to observe.

"When making the working drawings for the mounting I did not think it would work out so heavy," McLennan writes, "but I am very well pleased with it. I am not a machinist—just a home-trained mechanic."

Not only is this mounting rugged but it also is clean, regarded as a piece of design. Excellent proportion.

REFRACTOR making is beginning to catch on. A decade ago it was being discouraged for amateurs. When "ATM" was first put together, largely from Ellison's book "The Amateur's Telescope," the full American reprint rights of which were purchased, Ellison's chapters on the refractor were omitted. The reflector, not the refractor, is the amateur's meat, we said then. By 1928 (second edition of "ATM") we had softened enough to insert a guarded note on "The Objective Lens" (page 258, 2nd ed.), pointing out the difficulty of the work, and that same note, only lukewarm on refractors, was reprinted in the third and fourth editions (page 333). Last year, when we reprinted the fourth edition, we slipped out that old discouraging note and substituted one that now encourages the amateur to make a refractor. Thus, 13 years produced a complete about face. Just a diplomatic way of saying that in 13 years the amateur has steadily risen, risen, risen in his ability.

Speaking of refractors, the next item may throw some added light on them—literally.

IN Figure 2 are two pairs of superposed, flat-faced disks of flint glass. You can see far more clearly through the pair on the right. This is because the latter have been coated with the new metallic fluorides, and the day may come when amateur objective lens makers will send their components away to be treated, or do it themselves if equipped. This should add about 20 percent to the light transmission through a two-element objective. Refractors give steadier images than reflectors but lower illumination, hence this will be a big help. Here is the background, assembled from different sources, published and unpublished.

In 1892, H. Dennis Taylor, a noted British lens designer, began to take notice of the effect of tarnished films on lenses when some flint elements were returned for repolishing. His tests showed that, if a photographic plate was exposed under identical conditions, through a tarnished and an untarnished lens, more light would reach the plate through the former. Said he: "Whereas a thin plate of dense flint glass of the type usually used for objectives will, when freshly polished, reflect back from its two surfaces about 11 percent of the light falling upon it, and transmit 89 percent, the same plate when tarnished . . . will reflect back only about 5 percent, and transmit 95 percent." He therefore attempted to tarnish lenses artificially by immersing them in various solutions, and found that hydrogen sulfide and alkaline sulfides reduced reflection appreciably.

In 1916, Kollmorgen, "acting upon the hints contained in Taylor's description, experimented a good deal with different chemicals along the same lines and found means of oxidizing most of the glasses used in optical work," according to a paper delivered before the Illuminating Engineering Society.

At about the same time, Dr. Hermann Kellner, who was head of the Scientific Bureau of Bausch and Lomb, was working along similar lines. He mentioned his experiments to Dr. F. E. Wright, during the latter's labors at the Bausch and Lomb plant in 1917, as a member of the group of silicate chemists aiding the Government in securing its requirements. Dr. Wright began a series of experiments with Dr. J. B. Ferguson. Although these were never concluded, reflectivity was definitely decreased and Dr. Wright offered three hypotheses to account for the phenomenon, the most likely one being that, in the process of etching by the attacking solution, the surface becomes covered with minute pits which are small compared with the wavelength of light.

In 1936, John Strong described a physical method of coating films to produce the same effect as the chemical method. His process involved the evaporation of metallic fluorides in a high vacuum. He described the use of a film of decreasing index of refraction which starts out with the full index next to the glass. This was done by depositing a film of fluorite, solid below and porous above. Agreeing with the Wright hypothesis, he states that "the grain of this porosity is small compared with a wavelength of light, as evidenced by the fact that it does not scatter light." With such a film he noted decreases in reflection of from 54 percent to 85 percent, depending on the angle of incident light.

Since Strong's work several physicists have used this technique, among them being Cartwright and Turner who have used various metallic fluorides to produce imperceptible films on glass to increase the transmission of light.

Simultaneously, Dr. Katherine Blodgett, working on a project originally instituted by Dr. Irving Langmuir, employed films of barium stearate and other fatty acids to form a thin molecular surface on glass. The glass was dipped into a tank of liquid on the surface of which an insoluble soap one molecule thick was placed. As the glass was dipped down, one layer of film was attached, and on withdrawal another layer was applied, each full immersion adding two layers, each one molecule thick. It took 44 successive layers to build up a film to a thickness of a quarter wavelength of light. Dr. Blodgett came to the conclusion that, except for the loss of light by absorption in the glass itself, film treated lenses could be made to transmit 100 percent of the incident light.

The metallic fluorides, however, are much tougher films than the fatty acid types. In the long series of investigations conducted by Dr. W. B. Rayton in the Bausch and Lomb laboratories during this period, it was evident that a combination of two processes could be used to greatest advantage. On lenses having an exposed outer surface a corrosive chemical process is used in which oxides of high refractive index are removed from the surface, leaving an in-

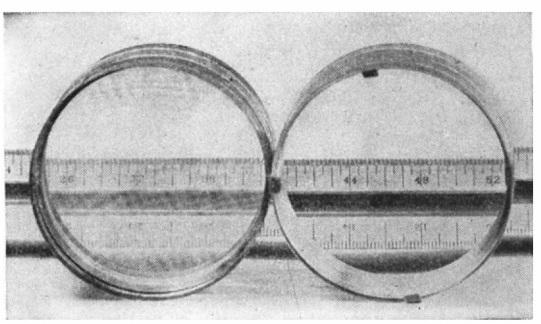


Figure 2: Contrast—the old and the new

visible structure of silica, while the inner glass-air surfaces are coated by the deposition of a metallic fluoride in a high vacuum.

In both processes the coating is held to a thickness of a quarter wavelength of light, or about four millionths of an inch. The film must be intermediate in refractive index between air and glass. Since both the film and the lens surface reflect light, it is necessary that the crests of the waves from one beam shall fall into the troughs of the other. Thus, being out of phase, the waves neutralize each other and reflection is decreased or entirely eliminated. The missing radiation reappears in the transmitted beam which has been shown to contain as much as 99.6 percent of the original radiation.

From 4 to 6 percent of the incident light is lost at each glass-air surface of a lens, the precise amount depending upon the type of glass used and the color of the light. A crown glass-air surface reflects about 4 percent of the light, whereas flint reflects 6 percent. It will readily be seen that, in a lens with a number of elements, or in optical instruments with complex systems of optical parts, light transmission can be increased tremendously. Equally important is the reduction of halo and the improvement in image contrast.

The new coating processes are at present being confined to a limited number of products but the progress so far attained offers a wide field for experiment which may prove a great step forward in optics. One advanced amateur who has seen some experimentally coated binoculars says the difference is striking, as binoculars have from 10 to 15 surfaces, giving fine opportunity for the beneficial effects to pile up.

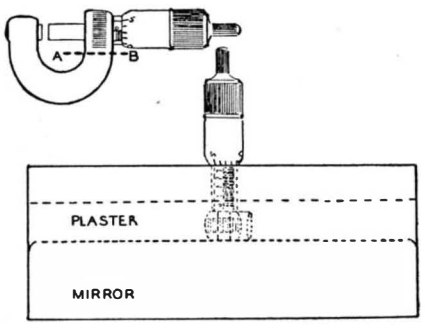
HIGH cost of gas for melting quartz was one big reason for giving up the original intention of making the 200″ mirror disk of that material, as the melting point of quartz is very high. Behind the following communication from John Ferguson, consulting engineer, 4 E. 194th St., Cleveland, Ohio, may be something new and significant.

"I send you," he writes, "a photograph (Figure 3) of a paraboloidal mirror which is unique. It is made of borosilicate glass, is 15″ in diameter, 3″ deep, and of cellular construction. I believe it to be the first mirror ever to be made from glass which

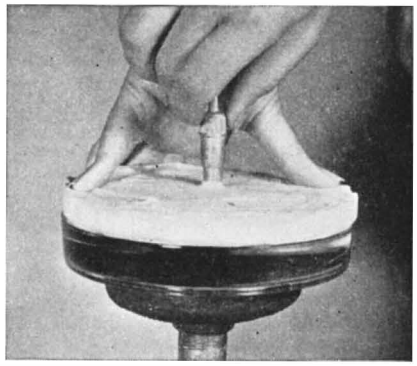
Figure 3: Ferguson and unique disk

THE BEGINNER'S CORNER

ALMOST the first concern of the beginner is to tell how deep the curve of his mirror has been ground. The classic way to do this is by means of a curved template but there are shorter, better methods. The illustrations show the simple yet efficient one devised by Paul G. Blaisdell, M.D., 102 N. Madison, Pasadena, Calif., and are almost self-explanatory. The anvil



part of a five-and-ten-cent store micrometer calipers reading to a thousandth of an inch was sawed off along line *A—B*, in the Doctor's drawing, and discarded, leaving a stub for anchorage. A paper collar was fastened around the mirror disk, just



as in preparing to make a pitch lap, as described in the book "Amateur Telescope Making," except much higher. The spindle of the micrometer was run back till its end was flush with the remaining part of the frame, the micrometer was centered and held accurately on the glass, and plaster of Paris was poured around it. Before any grinding was done the actual reading of the spherometer was noted and used thereafter as its zero point. The photograph shows how it is used: the other hand holds the plaster disk in accurate register with the glass.

Dr. Blaisdell states that this spherometer gave readings that checked with solar focus readings and cost only 35 cents to make. He obtained his micrometer from The Pep Boys, 169 W. Colorado St., Pasadena, for a little less than a quarter.

TELESCOPTICS

(*Continued from preceding page*)

was melted electrically, as distinguished from fuel fired furnace melting. The process of melting the glass was developed by the writer, the heat for melting being generated by the flow of electric current through the glass material itself, acting as a resistor.

"Glass at normal temperature is a good insulator, but it is capable of conducting current when heated. In this respect it is classed as an unstable resistor; its resistance becomes progressively lower as it is heated. Being a liquid, it cannot burn out, as solid resistors will do at high temperatures, so the melting temperatures can be pressed up to as high values as the refractory containers will withstand, and one of the advantages of this is that very refractory glasses can be melted.

"It may, of course, occur to the reader to wonder how the glass ingredients—sand, borax, soda, lime and so on—are brought to an initial temperature condition where they will begin to conduct the current in appreciable quantity. They become conductive at 500° to 600° C. and there are several methods of producing this temperature; after which the flow of molten glass and the entire process becomes continuous.

"The electrical process of melting glass appears to promise glasses of superior characteristics for mirrors. Glasses have been successfully melted with a silica content as high as 87 percent, with quite low expansion factors. The nature of the operation also will lend itself to the production of quite large mirrors at considerably less cost than has heretofore been possible."

It is said that the process is already in use by two large American glass companies making glass for purposes other than mirror disks. A detailed account is to appear in the *Journal of the American Ceramic Society*. What effect this process may have on the availability of mirror disks having a higher silica content, and therefore less expansion effect, than those now available, this department knows not at the present writing. Pyrex disks of the sizes most commonly sold to amateur telescope makers (under 12½") contain 80 percent silica, the larger ones 87 percent.

TO all quarters of the earth goes Scientific American and many of its readers obtain "ATM" afterward. One is the Rev. Emil W. Menzel, of the American Evangelical Mission, Bisrampur, C.P., *Via* Bhatapara (B.N.Ry.), India, whose telescope is shown in Figure 4. It has a 10" mirror made of a port-hole glass and the mounting is of the open, "spinal column" type, the neat column being a piece of steel channel. It is equipped with setting circles. "Since I live in the jungle it has been hard to get machined parts," its maker states, "and so the mounting is about as primitive as it can be and still do service. The long focus gives plenty of exercise climbing on boxes and tables. The telescope is mighty good company on lonely, hot nights when you sleep outdoors under the stars with it at your bed-side." Note the low angle of the polar axis, designed for the latitude of India's Central Provinces, in about 20° North.

ALL mirror makers have been asked whether the rouge they use is "the same kind." One answer might be obtainable simply by inviting the ladies in your circle to apply some of your rouge to their faces; no doubt they just wouldn't. Or by trying some of theirs on your mirror. Even

so, how many users of red optical rouge, which is ferric oxide (Fe_2O_3), can say with assurance what, if anything, the two genders of rouge have in common, besides the color red, rouge being simply the French word for red (which, incidentally, makes one ask why some people call Levigated Alumina "white rouge").

These weighty questions having kept your scribe awake nights for the past dozen years, he asked Horace H. Selby, author of the chapter on making optical rouge, as well as other chapters, in "ATMA," and who is a professional chemist, for the answers. Here is what Selby replied: "You got me curious with your inquiry; so I got some samples—three kinds—and went to work. Was I surprised! Not a mil-

Figure 4: Menzel and reflector

ligram of red Fe_2O_3 in the lot! In two of the seven shades, I found approximately 3 percent of a yellow iron oxide—presumably ocher. In general, all were dried cakes of gums (acacia, tragacanth or India) holding together mixtures of magnesium silicate ("French chalk," "talc" and so on), aluminum silicate (colloidal kaolin or clay), calcium carbonate (chalk), zinc oxide and colors. Of the colors, I identified the following: ammonium carminate, carminic acid, a fluorescein salt, yellow ocher, a nitrofluorescein—possibly eosin scarlet. Some other colors were present which I couldn't spot easily. They were lakes, and some were blue, some yellowish. The preponderant colors were of the cochineal group, however (carminic acid and salts and crude carmin.)"

Accompanying this learned report, Selby sent a table showing that seven rouge compacts were tested by him for 20 components each. To keep the peace we suppress the makes; you wouldn't know them if you saw them, anyway (or would you?). Selby says he did about $100 worth of work on the job. Knowing, however, that he would not be interested in mere money, we have decided to award him, instead, and on behalf of all amateur telescopedom, an honorary degree. Now the degree of J. U. D. *(Juris utriusque Doctor)* stands for "Doctor of Both Laws," that is, canon and civil, so why not create for Selby the degree of R. U. D. *(Rubrorum utriusque Doctor)*, which means "Doctor of Both Rouges". So be it, and Selby is ennobled for his rouge research.

CURRENT BULLETIN BRIEFS

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

ELIZABETHAN MYSTERY MAN, by Charles Wisner Barrell, is a 24-page digest of evidence connecting Edward de Vere, 17th Earl of Oxford, with the literary activities of "Mr. William Shakespeare." The author, Mr. Barrell, prepared the widely quoted article, "Identifying Shakespeare," which was published in the January, 1940, issue of Scientific American. *August Gauthier, 17 East 48th Street, New York, New York.— 25 cents.*

INFRA-RED PHOTOGRAPHY WITH KODAK MATERIALS, is a 34-page copiously illustrated paper-bound booklet. Covering the subject from both the theoretical and practical aspects, the booklet is complete with specification tables for the various emulsions available. The text treats of the nature of infra-red radiation and photographic applications in many fields. Also included are data on lenses and filters suitable for infra-red work, hypersensitizing techniques, exposure for landscape pictures, and shots by artificial light. *Eastman Kodak Company, Rochester, New York. — 25 cents.*

ARITHMETIC MADE EASY, by Alva Cole, C.E., is a 42-page, compact, meaty compendium of short rules and instructions for solving numerous, everyday commercial problems by new methods that largely eliminate the use of a pencil. *Neighbor and Riggs, Inc., 11 South Fourth St., Newark, Ohio. — 95 cents.*

RADIO AND EDUCATION, by David Sarnoff, is a 27-page reprint of a recent address in which Mr. Sarnoff outlined the educational services offered by radio in all its phases, and touched briefly on the possibilities of education by television. An appendix lists sustaining public-service programs on NBC networks. *Radio Corporation of America, 30 Rockefeller Plaza, New York, New York. — Gratis.*

AUTOMOTIVE, PORTABLE AND SPECIALTY EQUIPMENT is a 44-page illustrated catalog that presents, in condensed form, details of complete spray-painting equipment for exterior and interior use as well as automobile refinishing. It also lists equipment for automobile service work as well as air and fluid hose and other specialties. *The DeVilbiss Company, Toledo, Ohio. — Gratis.*

SELECTED EDITORIALS FROM LINK-BELT NEWS is a 64-page digest of editorial material which has appeared in past issues of a monthly trade paper. The editorials are of wide interest to business in general, and are mainly of a philosophical and inspiration nature. *Link-Belt Company, 307 N. Michigan Avenue, Chicago, Illinois. — Gratis.*

COLOR PRINTING SIMPLIFIED, by Thomas S. Curtis, Sc.D., is a 63-page booklet which aims "to reduce to the simplest common denominator the basic factors which govern the making of the color print and to point out those common errors, the elimination of which converts color printing into a pleasurable hobby." *Thomas S. Curtis Laboratories, 2063-2065 East Gage Avenue, Huntington Park, Calif. — 25 cents.*

? is a pocket-size booklet which answers a wide variety of questions regarding the operation of railroads. In eminently readable form it gives data regarding rails, freight and passenger movements, freight rates, tunnels, railway taxes, railway refrigeration, and so on. *Association of American Railroads, Washington, D. C. — Gratis.*

AMERICA TAKES A TEST is a 12-page illustrated pamphlet which gives specific data regarding airline air travel in the United States. It presents facts regarding safety factors, flight conditions, schedules fulfilled, effects of storms, and so on. *American Airlines, Inc., New York Municipal Airport, New York, New York. — Gratis.*

EMERSON-ELECTRIC FANS is a 24-page thoroughly illustrated catalog issued in commemoration of the 50th Anniversary of the company. It lists nearly a hundred types of fans including desk and stand fans, air circulators, ceiling fans, ventilating fans, and so on. Request your copy on business stationery. *The Emerson Electric Mfg. Company, St. Louis, Missouri. — Gratis.*

SCRAP IRON AND STEEL is a 40-page booklet which presents an outline of the many ramifications and developments of the scrap-iron industry. It contains statistics, formulas, and other data pertaining to scrap iron and, also, gives a description of the manufacture of steel. *Jack Gutstadt, 12 East Grand Avenue, Chicago, Illinois. — $1.00.*

$200,000 INDUSTRIAL PROGRESS AWARD PROGRAM is a 48-page brochure which presents the results of more than a year of planning and development aimed toward the formulation of a program of industrial study and research which would be productive of the greatest possible benefit not only to industry but to society at large. Request your copy on business stationery. *The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. — Gratis.*

ART IN EYEGLASSES, by Frank Graham Murphy, M.D., is a treatise on the art of selecting eyeglasses that conform to the rythmic lines of the face; in other words, if you must wear glasses, carefully select those which don't wholly spoil your good looks. *Frank G. Murphy, M.D., 305 First National Bank Bldg., Mason City, Iowa. — $1.00.*

PITTSBURGH PLATE PRODUCTS is a by-monthly publication devoted to the industrial and home uses of glass and paint. It is thoroughly illustrated. *Pittsburgh Plate Glass Company, Pittsburgh, Pennsylvania.*

THE MECHANICAL INVENTIONS OF EMANUEL SWEDENBORG, edited by Alfred Acton, describes in their true light and without the common exaggeration all the mechanical inventions of the philosopher Swedenborg. *Swedenborg Scientific Association, Bryn Athen, Pennsylvania. — 60 cents.*

LEGAL HIGH-LIGHTS

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

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
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Crown Caps

A CROWN cap is not a valve. This is probably not news of a startling character to most of our readers. However, it has been judicially determined for the first time in a suit involving a patent on a tin can.

The patent related to a tin can having a discharge nozzle and manually operated valve controlling the nozzle. The patentee brought suit for patent infringement against the manufacturer of a beer can having a pouring opening closed by a crown cap. It was contended by the patentee that the crown cap constituted a valve. The court however, after considering the dictionary definition of a valve, rejected this contention and held that a crown cap was not a valve and that the beer can did not infringe the patent in suit.

Bubble Tower

A PROCESS patent cannot be based merely upon the apparatus employed in carrying out a process. This principle is illustrated by a recent case for infringement of two patents relating to the distillation of fatty acids. Fatty acids are derived from animal and vegetable fats and oils. The first step in removing the fatty acids from the fats and oils is to separate or split the oils and fats into glycerine and fatty acids and then to extract the glycerine by physical means. The remaining product is a mixture of fatty acids and impurities. The impurities are removed from the acids by means of a distillation process.

In the distillation process care must be exercised because the fatty acids decompose before reaching distillation temperature at normal atmospheric pressure. Therefore, it has been customary to distill the fatty acids under a partial vacuum or with a volitalization agent such as steam. Prior to the inventions covered by the patents in suit, it was customary to distill the fatty acids in pot stills. The patent in suit disclosed the use of distillation columns or towers rather than pot stills. The first patent disclosed a distilling column or tower known as a baffle tower and the second patent disclosed a bubble tower. Apparently the patentees were the first ones to use baffle towers and bubble towers in connection with the distillation of fatty acids, although they had been used for many years in connection with the distillation of other products, such as petroleum.

The court found that the only difference between the prior distilling process and the patented processes resided in the inherent nature and operation of the baffle tower and the bubble tower. The court also found that the substitution of bubble towers and baffle towers, which were well-known in analogous arts, did not constitute invention. As a result, the court concluded that the two patents were invalid. In this connection, the court observed:

"The difference between pot-still distillation and continuous-still distillation is in reality a difference inherent in different types of apparatus. A process in the patent sense is a series of steps involving physical or chemical changes in the material operated upon. It converts that material into something of different physical and chemical characteristics. Invention must be found in the sequence of steps performed on the material treated, not in the apparatus necessary to carry out the process."

Thatched Roof

EVEN our quaint and ancient modes of life are not free from the encroachments of modern industrial development. Thus a recent suit in a federal court involved a patent covering a thatched roof. The patent disclosed an asbestos paper envelope impregnated with asphalt, having suitable brush material such as straw or fiber strands inserted in the envelope and protruding from it.

In applying the roofing material to the roof, the envelopes of successive courses were arranged in overlapping relationship and the protruding portion of the brush was of sufficient length to cover and conceal the envelope of the adjacent course. The impregnated envelopes thus formed an effective water-proof covering for the roof and the brush merely served a decorative or ornamental purpose. In the old-fashioned thatched roof, it was necessary to provide a mass of thatch fibers of sufficient thickness to cause the water to drain along the fibers and off of the roof before penetrating to the roof boards beneath the fibers.

The court acknowledged the improved character of the patented thatched roof but nevertheless declared that the patent was invalid because of its close similarity to two earlier patents, one of which related to a roofing material consisting of a plurality of wires having their ends imbedded in water-proof envelopes.

O-Ke-Doke

IN an opposition proceeding involving the trade mark O-Ke-Doke, soft drinks were held to be goods of different descriptive properties from cheese and cheese-coated popcorn.

A beverage manufacturer attempted to register the trade mark O-Ke-Dokee for soft drinks and the registration was opposed by a cheese manufacturer on the grounds that it was deceptively similar to his trade mark, O-Ke-Doke, for cheese and cheese-coated popcorn. It was contended by the beverage manufacturer that soft drinks were so different in character from cheese and popcorn that there was no danger of confusion.

In an attempt to rebut this contention, the cheese manufacturer argued that cheese-covered popcorn is sold and distributed in taverns along with soft drinks. In this connection, it was pointed out that the popcorn was advertised as a thirst creator and accordingly was used in taverns for the purpose of increasing the sale of beverages. The cheese manufacturer also contended that soft drinks and popcorn were frequently sold in the same stores, namely, drug stores and chain stores.

The court, however, concluded that the merchandise of the respective parties were of different descriptive properties and that there was no danger of confusion in the trade.

In reaching the above conclusion the court made the following interesting comments with regard to taverns and drug and chain stores:

"It does not appear from the record that taverns, which are alleged to be the principal outlet for opposer's goods, cater especially to the soft drink trade; and, with respect to the drug and chain stores where the goods of both parties appear to be sold, it is a matter of common knowledge that such institutions sell an almost unlimited variety of articles in distinct and substantially unrelated lines of trade."

Mammy

A RESTAURANT proprietor was accorded the exclusive right to use the name Mammy in connection with the operation of a restaurant in a particular locality by a recent decision of the New York State Supreme Court.

The decision discloses that the plaintiff in the case used the name Mammy's Chicken Farm on his restaurant and he prominently displayed the word Mammy in connection with a picture or caricature of a southern negress of the type generally known as a Mammy. The defendant opened a restaurant in the same neighborhood and also prominently displayed the word Mammy and a similar picture. Both establishments featured southern cooking of the type generally referred to as Mammy cooking.

The court concluded that the use by the defendant of a name and picture similar to the plaintiff's constituted unfair competition, and awarded an injunction restraining the defendant from displaying or using the name or picture.

Parcheesi

THE game known as "Parcheesi" has been popular in the United States for many years. Many will be surprised to learn that the name "Parcheesi" is a registered trade mark owned by one manufacturer. Recently, a competing manufacturer manufactured and sold a similar game under the name "Parchesi" and the original manufacturer filed suit for trade-mark infringement and unfair competition. Pending the trial of the suit the court granted a preliminary injunction restraining the use by the second manufacturer of the name "Parchesi" or any similar name.

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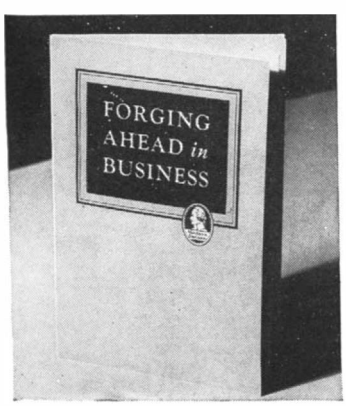

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"Rain-In-The-Face" might have been Liquidated *by Radio*

Misled by faulty information from his scouts, General Custer was trapped in ambush at the junction of the Big Horn and Little Big Horn rivers on June 25, 1876. Modern communications might have prevented this tragedy. Scouts could have reported the vast number of Indians present under the command of the Chief, Rain-In-The-Face, and stayed Custer's attack. Custer could have sent word back to the main army of which he was the advance guard.

How the Family of RCA would save Custer

WHEN General Custer arrived at the junction of the Big Horn and Little Big Horn rivers, he'd send up scouting planes immediately. Pilots noting the vast numbers of the enemy, would report back to Custer by means of a light efficient airplane radio transmitter designed in RCA Laboratories built by the RCA Manufacturing Company, one of the members of the family of the Radio Corporation of America. General Custer would, of course, abandon his intention to attack. Using portable RCA broadcasting equipment he'd radio back to the main army for help, and dig in to await rescue.

Word of his plight would be broadcast to the whole nation by the two great NBC networks which provide the broadcasting service of the Radio Corporation of America. Forty-three foreign nations would listen via RCA Communications, the world-wide radio message service of RCA.

Tens of thousands of listeners would sit glued by their RCA Victor Radios. And shortly motion picture audiences throughout the world would see and hear talking pictures describing the rescue of General Custer . . . the scenes voiced by the RCA Photophone Magic Voice of the Screen.

Naturally there would be a great rush on Victor Record Dealers for Victor and Bluebird Records of patriotic character. And Americans everywhere would play these records on RCA Victrolas.

. . . Since, fortunately, no American General is now in need of rescue . . . RCA stands ready to serve the American people in every other respect in every field of radio.