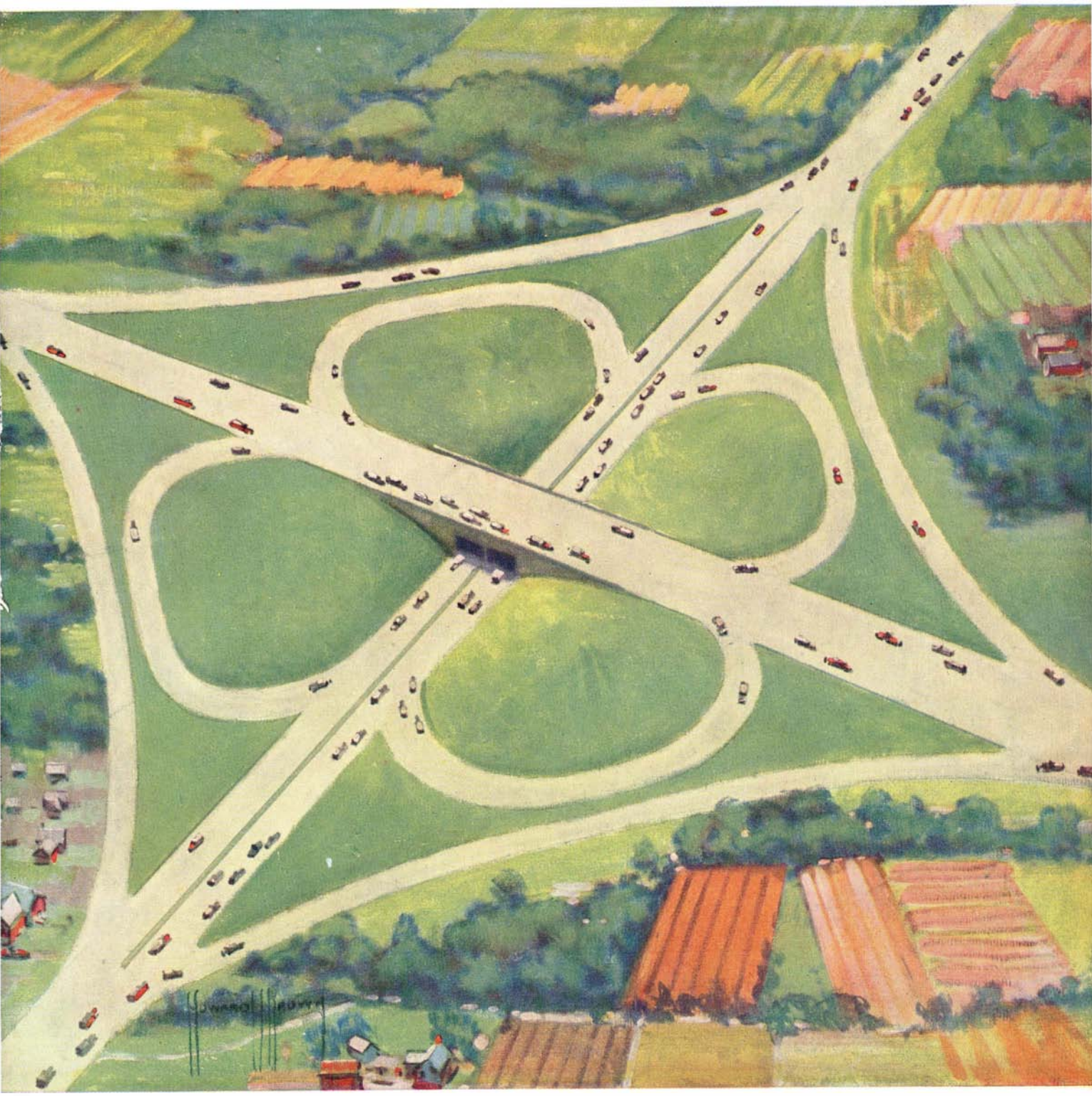
AUTOMOBILE NUMBER

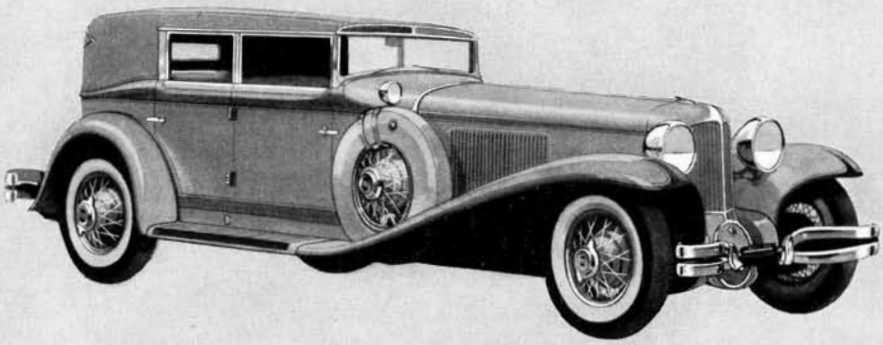
Motor Car Review • • Diesel Bus • • Trailers

SCIENTIFIC AMERICAN

February • 1931 ★ 35c A Copy



"KEEP TO THE RIGHT"



FOREIGN TO EUROPE

So foreign is the originality of the Cord design, that it stands out with sharp contrast against the background of the finest motor equipage that Europe has to offer. As a result, in competition in the important Continental Rallyes, the Cord has emerged victorious in thirty-nine events.* No other American automobile has ever gained such overseas renown. In Europe, as elsewhere, the influence of the Cord is felt as the model for others to pattern after. Cord dealers are now showing models of the winning Cord cars chosen by various members of Royalty for their personal use.

*Included are such outstanding awards as: Grand Prix, plus Cup of Honor, at Monte Carlo; Grand Concours d'Elegance Prize at Jaun Les Pins; First Grand Prize, Concours d'Elegance, Cannes, France; First Prize, Concours d'Elegance, Berlin, Germany; Gold Band, Concours d'Elegance, Prague

Sedan · Brougham · Cabriolet · Phaeton Sedan · Auburn Automobile Company, Auburn, Indiana

CORD

FRONT DRIVE

If it Climbs this HILL *it will climb anything*

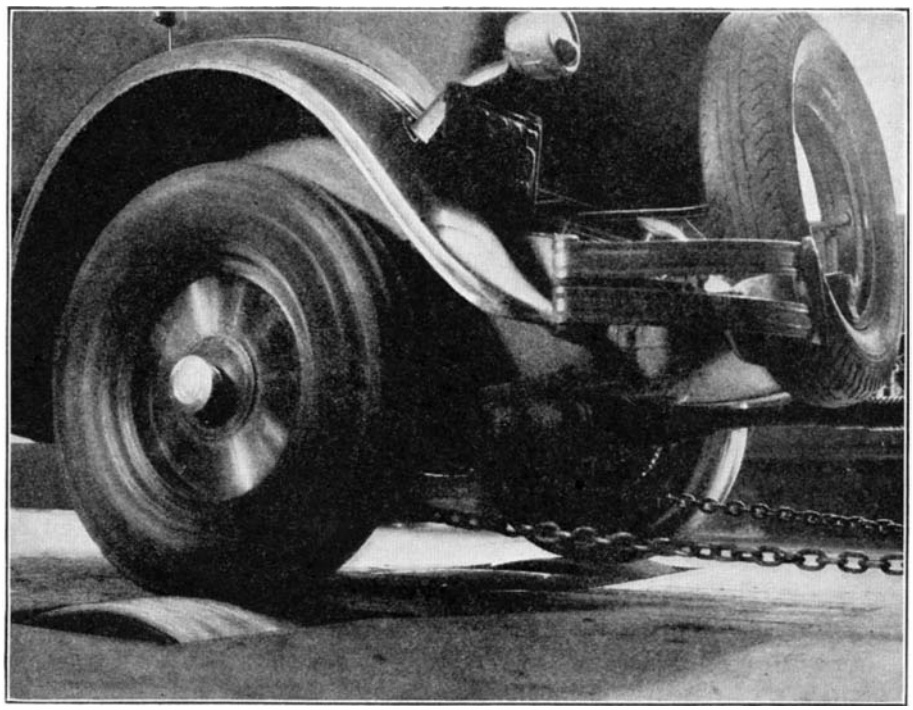
GOOD, ordinary gasoline is in the tank, and yet the engine is "knocking" as if it were on one of the steepest hills in the world. It is.

Those rollers under the rear wheels are harder to climb than Pike's Peak. The dynamometer shows their resistance is equal to a 20% grade.

But switch the gas feed from ordinary gasoline to Ethyl Gasoline. The "knocking" stops, the wheels begin to roll faster, and the driver shifts back to high.

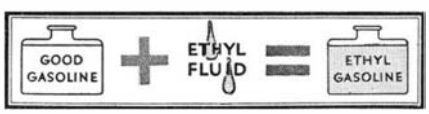
What is the difference? A gallon of good gasoline was used for fuel at first. Another gallon of identical gasoline *plus* a teaspoonful of Ethyl fluid was used for the second test.

These few drops of Ethyl fluid prevent the uneven explosions of gasoline that cause power-waste, "knock" and over-heating. They *control* combustion so Ethyl Gasoline delivers its power to the pistons with smoothly increasing pressure.



The mounds under the wheels are braked to tax pulling power more than the steepest hill you will ever drive

This isn't a dynamo in the left of the picture; it is a dynamometer which measures the pull on the rollers under the wheels of the car.



The active ingredient used in Ethyl fluid is lead

This test does *more* than prove that Ethyl Gasoline prevents "knocking" under strain. It proves that the greater power Ethyl Gasoline gives on any kind of road is not only greater engine power, but greater rear-wheel power.

Try Ethyl Gasoline in your car. See how it increases power, gives you quick get-away and sends you zooming up hills in high. You will find pumps everywhere marked with the Ethyl emblem. Ethyl Gasoline Corporation, Chrysler Building, New York City.

WITH ETHYL BRAND OF ANTI-KNOCK COMPOUND — ETHYL GASOLINE CORPORATION NEW YORK, U.S.A. — Knocks out that knock

ETHYL GASOLINE

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EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

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SCIENTIFIC AMERICAN DIGEST

Of General Interest

Aviation

Chemistry In Industry

The Month In Medical Science

THIS MONTH'S COVER

The rapid increase in the number of automobiles in this country has necessitated not only the development of new methods of highway construction but also the laying out of intricate new systems to eliminate traffic congestion. Of the latter, perhaps the most striking is that pictured in pastel shades by our artist Howard V. Brown. This "clover-leaf" cross-roads is part of the New Jersey Highway System and lies between Rahway and Woodbridge. To make a turn either to the right or the left or even to reverse one's direction on either of the roads at this crossing, a right turn or two does the trick; a left turn is never necessary, in fact is not permissible. Study the painting and prove it for yourself.

ACROSS THE EDITOR'S DESK

TO the motorist who takes an interest in automobiles aside from their use for transportation, the beginning of a new year holds forth the promise of developments in the automotive field that will affect him directly, either in the purchase of a new car at once or in the replacement of his present car in the near future. What improvements or innovations are to be found in this or that car? Will my car be rendered obsolete by the newer models? What is this new feature called "free-wheeling"? How are the 16-cylinder cars coming along? These and a host of other questions come to his mind. In this, our Annual Automobile Number, we have collected material on many of the branches of the automotive field that either gives the direct answer to questions such as these or lays down data from which definite conclusions may be drawn.

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One thing is certain: manufacturers of automobile accessories are going to be affected by the general trend toward complete equipment on the newer cars. No longer need the new-car buyer invest a substantial sum in heat indicators, mirrors, ash trays, air cleaners, oiling systems, and so on. They are all there when the car is delivered. On the other hand, those of us who have, of necessity or choice, to keep our old cars for another season, constitute a potential market for "gadgets" of various kinds that have been developed since our cars were made.

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To avoid a straight diet of automotive news in this issue, we have scattered through it articles of general interest. Our old friend Harold Cook has written another description of archeological finds that strongly suggest the existence of early man in America. It is odd—some readers may call it significant and others merely accidental—that none of the finds purporting to establish ancient man in America stands out as absolute proof of it. Conservatives tell us that the explanation is simple: the proof is lacking because early New World man was lacking. Perhaps, but it is early yet to dogmatize. Until the balance of knowledge swings one way or the other, every suspicious sign should be investigated.

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One mile of vacuum. A mile is not such a long distance, as distances go, but try to keep all of the air out of a tube three feet in diameter and a mile in length! That is the engineering problem that had to be solved before Professor Michelson's latest experiment on the velocity of light could be started. And it was solved in a remarkably simple yet effective manner. The writer who tells of the work in this issue is a member of the scientific-technical staff of the institution that planned and executed the installation of the pipe that "holds a mile-long vacuum." So far as we know—correct us if we are wrong—this is the biggest man-made vacuum on record.

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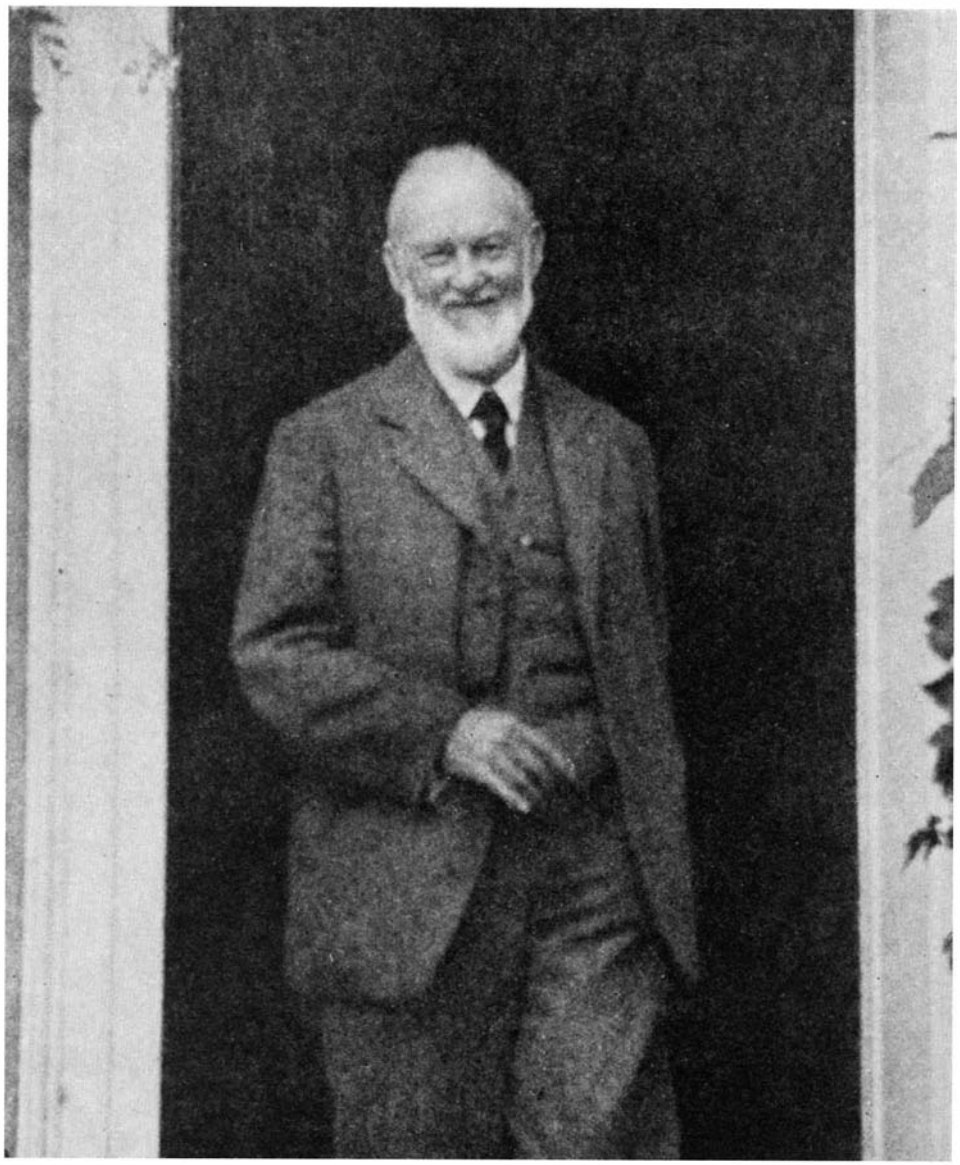
Over in Egypt the Metropolitan Museum of Art has been conducting excavations for several years, and the results have been most gratifying. One intriguing statue of Hat-shepsut was found—all but the head. Eventually that was found—in Germany. It had been located and removed by former excavators. Negotiations were opened and, with the fine unselfish spirit of science, arrangements were made whereby the body and head were once more joined. The final chapter of this running story of archeological triumph is in this issue.

●

The tentative schedule for our March issue presents a diversified collection of material. First there is the mystery of the aurora borealis. What is it? There are several theories that attempt to answer this question, but all lack the proof that science demands. At our request, a scientist of note has written an article outlining the various hypotheses, old and new. The mystery still remains, but the attempts at explanation afford intriguing food for thought.

●

Then there is an article about a new system of aerial photography whereby promising sites for oil wells are located. How are miniature and life-sized groups of animals prepared for museums? A series of photographs and a short, meaty article will reveal the secrets of the art. Fish ladders have been constructed around large dams so that fish can go upstream to spawn. The largest meteor ever located after it was seen to fall is now on exhibition. The hardiness of winter wheat can be determined electrically. A floating power plant has been designed to help out, when needed, local power plants along the coast of Maine. More about the pre-historic inhabitants of North America. . . . We could go on and on telling about the features of our March number, but the limits of this page close in and, after all, only the issue itself can do proper justice to its contents.



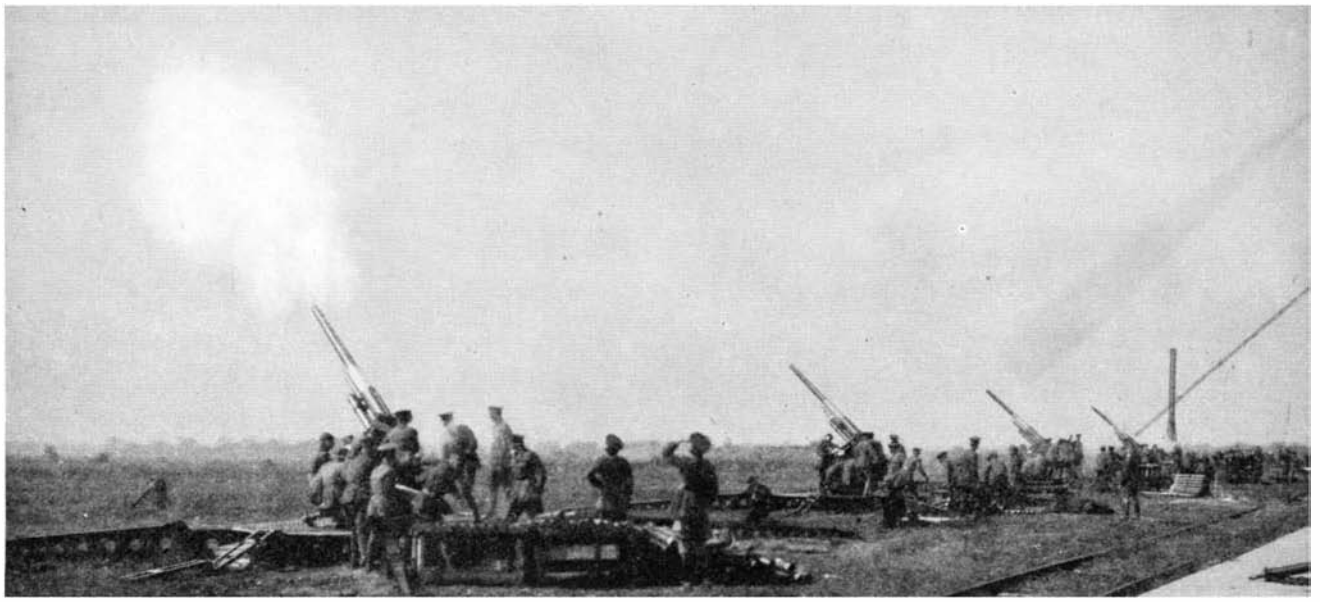
F. HENRY ROYCE

IN 1903, Mr. Royce, an Englishman, bought his first automobile but, terrified at its noise and lack of reliability, took it to pieces and was amazed at the absence of the fundamentals of sound engineering principles in which he had been schooled under the famous builder of locomotives, Patrick Stirling. In his exasperation, he designed a car for himself, and built three from the working drawings. One he kept, one was given to the chairman of Royce, Ltd., makers of electric cranes, and the third was lent to the Hon. C. S. Rolls, famous amateur sportsman, racing driver, and balloonist. Mr. Rolls was so enchanted with his new car that he offered to help Mr. Royce finance a company to build fine motor cars and to assume responsibility for the sale of the total output. So the Rolls-Royce Company was formed and the world-wide reputation of its product is evidence of the reward of devotion to high ideals. Mr. Rolls later became interested in aviation and was killed in a plane crash in 1910.

The evolution of the Rolls-Royce aero engine is an epic in itself, and is marked with notable achievement. The first flight across the Atlantic, from Newfoundland to Ireland in 1919, was made in a Vickers Vimy biplane equipped with Rolls-Royce engines. In 1929, the Rolls-Royce Supermarine S-6 seaplane won the Schneider Trophy contest and now holds, unchallenged, the world's speed record at 357.4 miles an hour.

CONCENTRATED "POISON" FOR AIRCRAFT

FOUR .50-caliber machine guns together with stereoscopic height finder and Vickers data computer are mounted on the rotating platform of this mount which is described on page 84. At the top is shown the business end, or front, of the guns, and below is shown the back. The chassis is a specially designed Diamond T with 12 service tires and two spares on idler shafts



A battery of three-inch anti-aircraft guns in action at Aberdeen

PREPAREDNESS FOR PEACE

By F. D. McHUGH

SPEAKING of war, in a recent interview, General Pershing said: "With all my soul I hate it!" but added that well-meaning people think that we can abolish war by disarming. "We do not believe in war," he said, "but there are others who do. . . . Unfortunately wars do come, and sometimes when we are thinking least of them. . . . And so we must maintain an effective instrument of national defense. We must be ready should any nation choose to force a war upon us."

One does not have to hold militaristic ideas to agree with this thesis. Despite the Kellogg Pact and the strenuous endeavors of far-sighted statesmen to achieve a lasting peace, competent observers tell us that the world right now is rank with intrigue, international jealousies and hate, and that the slightest spark might possibly start a world conflagration more disastrous than the World War. No nation *expects* war, but students of world affairs since the War are, we believe, convinced that our greatest insurance against future wars lies in preparedness; and by that term we do not mean preponderant strength but rather quality and effectiveness in all things of a military nature. "Quality—not quantity" may, in fact, be called the keynote of the post-war work of our military forces. They have more than ever before placed their faith in science rather than in strength, for science is a vital factor in military power.

The Army Ordnance Department, perhaps above all other branches of the service, has taken full cognizance of this fact; and some of its more important applications of science to its problems were shown in a spectacular demonstration at Aberdeen Proving Ground, Maryland, last October. Conducted by that branch of the service, with infantry and Army and Navy aviators participating, the demonstration marked the 12th annual meeting of the Army Ordnance Association.

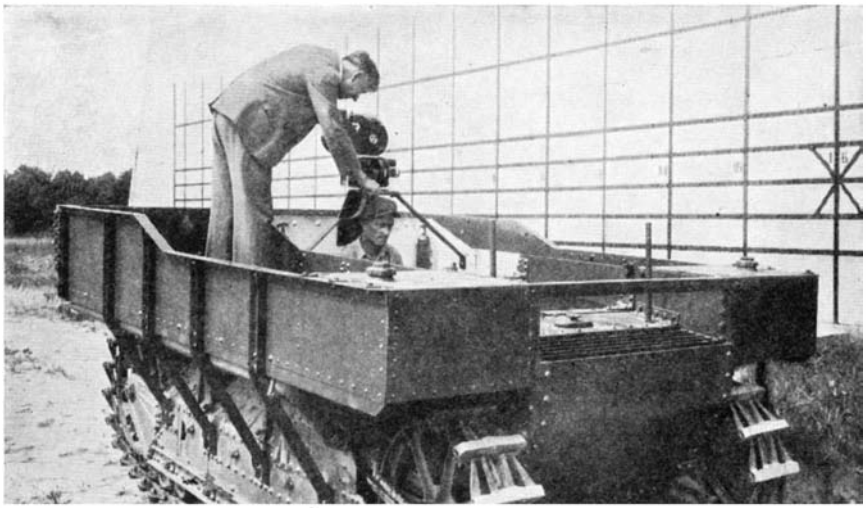
THE Army Ordnance Association is a nation-wide organization of executives and engineers of American industry who are pledged to industrial preparedness for war as our nation's strongest guarantee of peace. It is the antithesis of militarism, its sole aim being to assist in keeping American industry in readiness to produce the munitions that would be required by the fighting forces in case of a major war emergency. This it endeavors to do by keeping alive an interest in and a knowledge of the design, maintenance, and supply of munitions. This problem is one of vital concern because of the facts that we have no peace-time industry for the manufacture of ordnance, that we have only six manufacturing arsenals, and that, in the event of an armed conflict, time would not permit careful study or long preparation for the production of munitions.

The Army Ordnance Association believes that the solution of this problem lies in an active organization co-operating at all times with the government, and its objective is an active membership of American citizens on whom the duty of design and production of munitions will fall in time of war, who will have an accurate and authentic knowledge of the complex requirements of ordnance.

Each year in October many members of this organization journey to the Aberdeen Proving Ground in Maryland in order to get a composite picture of developments that have been made, and to learn what new problems are being worked out and what others must be tackled.

The last meeting was particularly interesting and instructive since members and their guests had the privilege of seeing demonstrated for the first time publicly several developments that mark a distinct advance over past practice. In describing some of these, we shall abstract, by permission, much technical material from a recent article by Lieutenant-Colonel E. M. Shinkle, Commanding Officer of the Proving Ground. His article was published in *Army Ordnance*, the official magazine of the Army Ordnance Association. And, since the demonstration at Aberdeen is less important, *per se*, than the story of developments, it will be discussed toward the end of this article.

In the province of exterior ballistics, the actual resistance functions of projectiles have been determined with what is believed to be a high degree of accuracy. If the greatest accuracy is to



A movie camera used in place of a gun to determine the stability of a tank chassis as a gun mount. The movies constitute an accurate, permanent record

be obtained in making up firing tables showing the effect of abnormal conditions on the range—variations in wind, muzzle velocity, and air density—it is essential that these tables be based upon the knowledge of the particular projectile in question. The projectiles for which the resistance functions have been determined are a 75-millimeter shell with a moderately long point and a boat tail, the three-inch common steel anti-aircraft shell which has a blunt point and a flat base, the three-inch common steel shell which has a long point and a flat base, and the 4.7-inch, model E1 shell which has a long point and a boat-tailed base.

In studying the exterior ballistics of small arms bullets, photo-electric cells and spark photography are being put to use. The photo-electric cells are used in measuring the velocities and retardations of bullets, and the spark photography to obtain a picture of the bullet which will enable the yaw of the bullet to be determined.

The photo-electric cell, together with a powerful amplifier, has been made to serve as an instrument for obtaining an automatic record of the time of flight of anti-aircraft projectiles. The amplifier in this apparatus is so arranged that it causes a spark to perforate a piece of paper which is carried on the drum of a chronograph. When the gun is fired, the light of the muzzle flash causes the first spark to jump, and the burst of the projectile at a remote point of the trajectory causes the second spark. The photo-electric cell has also been applied to the measurement of velocity of projectiles. The apparatus for this purpose is so constructed that when the projectile passes overhead, a reduction in the light impinging on the cell is recorded by means of an amplifier on an oscillograph or other instrument.

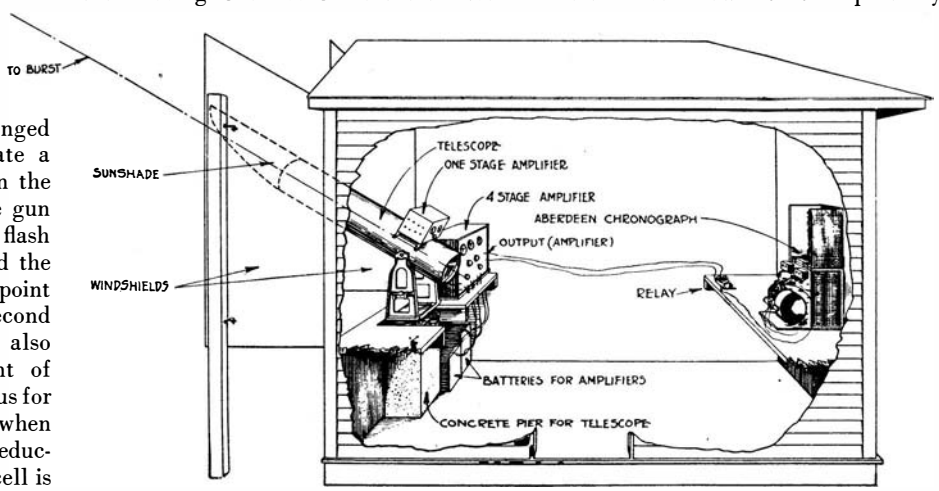
Science has also been applied to the problem of obtaining a record of the impact of inert bombs on the ground, and also to record the delay of bomb fuses. For this purpose a very sensitive apparatus based upon the vacuum tube oscillating circuit has been made. The ground shock from the impact of bombs, slight as it is, causes a change in the separation between two metal plates, the capacity between which forms part of the capacity of the oscillating circuit. When this capacity changes, the plate current of the vacuum tube changes. This change in the plate current is amplified by an audio-frequency amplifier which finally causes a record to be made by a pen on a chronograph drum. This apparatus has been found so sensitive that records have been obtained with it of the impact of 17-pound bombs on rather soft ground at a distance of 1200 feet from the apparatus.

Since the World War a wide variety of automotive equipment including tractors, tanks, self-propelled gun mounts, and trucks suitable for prime movers for guns, have been tested at the Proving Ground. Since these have been covered more or less fully in past issues of SCIENTIFIC AMERICAN, we shall limit ourselves here to the description of a recent test made to determine the suitability of a tank as a moving gun-platform. The relative stability of the tank was first shown by running various tanks over a course at different speeds, the gunner successfully making a number of hits on the target in this test. A more successful method was to mount a high-speed motion picture camera on a tank chassis as a gun and take with it moving pictures of a grid system painted on the side of a building while the tank was in motion. Measurement and analysis of these pictures give much information of importance as to the suitability of the platform as a gun mount.

The program at Aberdeen last fall began with a demonstration of small arms. Caliber-.30 Browning machine guns fired tracer bullets; caliber-.50 machine guns and three-pounder guns were fired from tanks; and semi-automatic shoulder rifles were exhibited in action.

THE most marked development in small arms since the World War is in the high state of efficiency to which semi-automatic shoulder rifles have been brought experimentally. Until recently it was believed impracticable to design such a rifle firing a caliber-.30 bullet at service velocity within a weight approximating that of the Springfield Model 1903 rifle. Accordingly, extensive experiments were undertaken to determine the effect at various ranges of a bullet of smaller caliber—namely, .276 inch. At the direction of the War Department, tests were conducted on semi-automatic rifles of this caliber in 1929, seven such rifles being submitted and five of these being tested. Of those tested, three were American—two having been designed and manufactured at the Springfield Armory—and two were of foreign manufacture.

Tests have shown that a partially



Apparatus utilizing the ubiquitous photo-electric cell and vacuum tube to obtain an automatic record of the time of flight of various anti-aircraft projectiles

trained rifleman can obtain twice as many hits per minute with a satisfactory semi-automatic rifle as with a separate loading rifle of the bolt type. Colonel Shinkle says that it seems not too optimistic to say that in case of necessity, production can be started at once on a satisfactory type of semi-automatic shoulder rifle; and, further, that at least four such exist in experimental form at this time.

Following the demonstration of small arms matériel a 75-millimeter gun was fired, first with black powder which flashed brightly and gave off a quantity of heavy smoke, then with smokeless powder, and finally with a smokeless and flashless powder, this exhibition demonstrating the progress that has been made in the development of propellant powders.

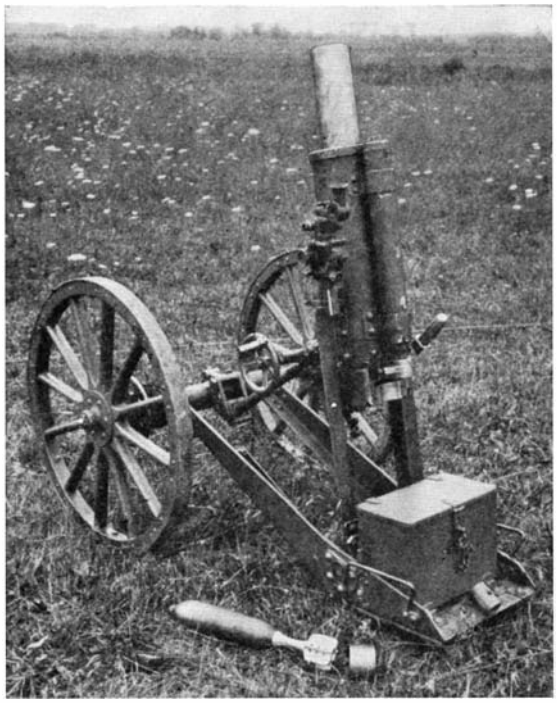
IN developing flashless non-hygroscopic powder—FNH powder, the last named in the paragraph above—it was found that ignition methods used with other powders were less satisfactory with this new type. The size of the primer necessary for proper ignition—according to chamber and bore of the gun—has required much study. Much firing has been done on a carefully arranged experimental program to determine fundamental data on the conditions essential to the ignition of FNH powders to secure uniform interior ballistics and flashlessness without an objectionable amount of smoke. The smoke is objectionable for day firing and the flash is objectionable at night. This problem is still being studied and it is thought that the ultimate solution may be the use of a larger primer to give complete ignition and no excessive smoke, with the provision that a small amount of flash reducer be added to secure flashlessness at night. At the present time a complete solution of this problem for the three-inch anti-aircraft gun is being sought.

After the demonstration of powders, the trajectory of the 75-millimeter gun was shown by firing rapidly a number of shrapnel shells with their fuses set in such a manner that the bursts of the shrapnel were approximately simultaneous despite the fact that they were fired one after the other from the same gun.

Mobile artillery matériel were next shown in action. These included the infantry mortar M1, the pack howitzer M1, and the M1 gun, all of 75-millimeter caliber; and the 75-millimeter gun on truck mount T3 which was described in our October, 1930, issue.

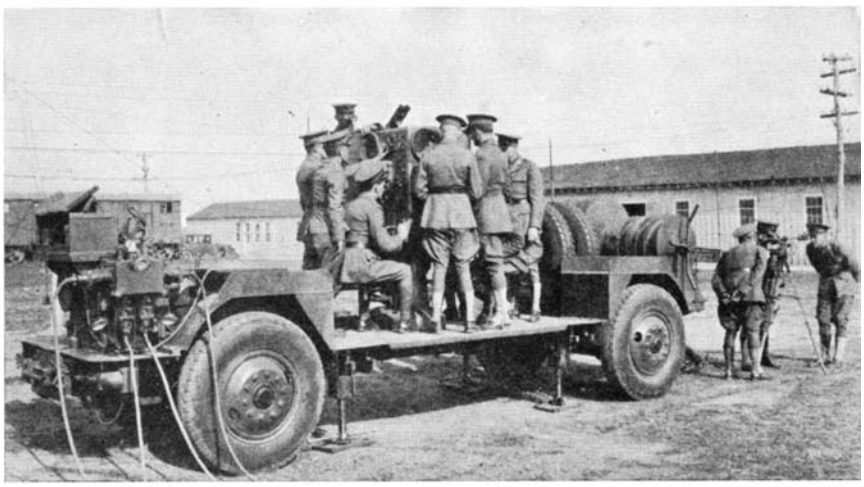
The 75-millimeter infantry mortar mentioned above is the latest development in this type of weapon. It is a smooth bore gun, firing a vaned projectile weighing about 10⅝ pounds to a range of 2000 yards. The mounting allows a traverse of 13 degrees without moving the trail, and an elevation of 80 degrees. In firing position it weighs 362 pounds and with accessories, 422 pounds; and is so built that it can be broken down into five one-man loads for transportation. In demonstrating it, the difficulties confronting the experts who are developing ammunition for it were indicated when a poorly designed and a well designed projectile were fired from it. Since the speed of this projectile is slow, its flight could be followed by the eye to the peak of its trajectory. The poorly designed projectile was seen to tumble over and over like a stick of wood when thrown, while the properly designed projectile went ahead on a straight, nose-forward course.

Ammunition for this mortar has not been standardized, but will probably be a shell equipped with cast aluminum or steel fins. Ignition is obtained with a shotgun shell and it has a short brass cartridge case which will probably be fastened to the fins by crimping. It has greater accuracy and range than the Stokes mortar used in the World War, but its fire is slower due to the breech loading.



The 75-millimeter infantry mortar is the latest development of a weapon of this special type

A 105-millimeter howitzer was next fired, followed by a 75-millimeter gun which was developed for division artillery, and a 155-millimeter howitzer for use in the corps artillery. The last-named piece was designed to fire a 95-pound projectile to a range of 16,390 yards, but recent tests have indicated that a range of over 18,000 yards can be safely obtained. Actual practice therefore improves upon the designers' calculations.



The Sperry director, manned. This photograph was taken while this complex instrument was directing the fire of the guns shown in operation on page 81

AFTER further artillery demonstrations, mimic warfare of a most spectacular nature took place. This was the special "show" of the mechanized forces. First, there was heard overhead the drone of observation planes which observed "enemy" positions in a distant field before us, and then made their report. Fast armored cars advanced to obtain further, more detailed information. Then the long range artillery—the 4.7-inch gun, and eight-inch howitzer on self-propelled mounts; anti-aircraft elements represented by four-gun and two-gun, caliber-.50 machine gun mounts; light artillery; and chemical mortars, moved, or were moved, rapidly into position to prepare for and to support the infantry attack. After a terrific fire by all these units a

A medium tank entering a trench in a Proving Ground test. A recent development, this tank is formidable, speedy, and not so cumbrous as wartime heavies

fast medium tank—the Christie tank which has been described in SCIENTIFIC AMERICAN—followed successively by medium tank T2, light tanks, and a Mark VIII tank, rushed the principal "enemy" positions to crush machine gun nests and pill boxes. Firing the .50- and .30-caliber machine guns, 37-millimeter guns, and three-pounders, they rapidly crossed the rough terrain, scoring many hits, being supported from the rear by artillery.

The tanks having effectively eliminated the strongest concentrated positions, fast cross-country cars and cargo carriers brought up platoons of infantry to strategic points where they were unloaded to "mop up" with automatic rifles and to emplace machine guns. The divisional infantry then deployed and moved forward to hold the positions.

THIS spectacular demonstration is significant in that it showed strikingly the perfect co-ordination between air, artillery, mechanized, and infantry forces that might be expected in an actual battle. It showed further the amount of study that has been involved in correcting one serious fault common during the World War; that is, lack of co-operation between various units.

While on the subject of the mechanized forces it is appropriate that one other recent development be described. This is the T1 multiple machine gun mount. It consists of a truck chassis carrying a pedestal-mounted platform with a 360-degree traverse, which mounts four .50-caliber machine guns together with fire control instruments. A four-wheel driving bogie in the rear has great flexibility, while on each of the front, or steering wheels, there are two tires of different diameters. The outer tires are smaller by two inches than the inner ones so that only one tire of each front wheel bears on hard ground, and both tires of each wheel make contact when on soft ground, increasing the effective tire area. An added, unique feature is that the two spare wheels with tires are mounted on each side of the chassis "amidships" on freely turning idler shafts so that they bear on obstructions over which the truck may be traveling and prevent the chassis from striking such obstructions.

On the firing platform with the four machine guns is a three-meter stereoscopic height-finder and a Vickers data computer. The height-finder aims the guns; and predictions of the future positions of the moving aircraft target are made automatically and directly to the guns by the data computer.

AS the program continued, airplanes made their appearance and gave a splendid account of themselves, flying in formation, stunting, "dog fighting," firing machine guns at land targets, and bombing.

After a single round fired from a 16-inch gun on a barbette carriage and a round fired from a 14-inch gun on a railway mount, the demonstration was continued on the anti-aircraft range. The 69th Coast Artillery (A.A.) fired anti-aircraft guns of the following types: .30-caliber and .50-caliber multiple-mount machine guns; 37-millimeter guns, 105-millimeter guns, and three-inch guns.

Both the three-inch and the 105-millimeter anti-aircraft guns are equipped with removable linings which have been mentioned previously in SCIENTIFIC AMERICAN, representing a marked advance in gun construction. When the lining of the gun has been scored by a great number of shots so that its accuracy is impaired, these reliners are inserted on the spot, thus obviating the necessity of returning the gun to an arsenal for relining.

The fire of both types of these guns is controlled from an anti-aircraft director, a complex instrument which, with a height-finder, determines the instantaneous positions of the target, predicts the location of the target at the end of the time of flight of the projectile, computes the firing data necessary to hit that location, corrects the data for any abnormal ballistic conditions, and transmits the corrected firing data to the guns. All of these operations go on continuously so that the guns are correctly laid at all times by matching the pointers of the electrical data receivers.

THESE guns were fired at a sleeve target towed several hundred yards behind an airplane flying at a high altitude. The location of each burst with reference to the target was accurately determined by motion pictures taken by two cameras. It was later computed that, during the firing, an average of one hit was made every 10 seconds. As a dramatic conclusion to this event, the towing cable was hit as the airplane made its last flight before the guns, and the target fell to the ground.

The demonstration was brought to a close by further anti-aircraft firing after dark. It was then necessary for searchlights to illuminate the targets. The direction of the target was accurately determined by sound locaters. The predicted position of the target was continuously computed and transmitted to the searchlights electrically, so that they were correctly pointed by matching the pointers of the instruments. When the lights were switched on, the target was found in or near the beam from one of the several lights. All the beams were then kept on the target by observers who could train the searchlights from stations somewhat removed from the light positions. Application of this control apparatus to searchlights is a recent development.

The night firing was very spectacular, for in addition to the cross beams of several searchlights piercing the sky, streams of tracer bullets mounted skyward from the .50-caliber machine guns and the 37-millimeter guns. From a position to the rear of the firing line it seemed that many hits must have been made not only by these guns but also by the three-inch guns, the projectiles from which seemed to burst all around the target.

Major-General Samuel Hof, Chief of Ordnance, made a statement in his recent annual report to the effect that our tanks "equal, if they do not surpass, those of any other nation." Guests at the Aberdeen demonstration feel that this statement could be broadened to include many other units of our mechanized force and a wide range of munitions as well. A review of the developments should convince anyone that, in the application of scientific principles to the solution of its problems, the Ordnance Department has made praiseworthy, tremendous progress in the interests of peace.

OUR POINT OF VIEW

A Bright Future?

WHAT of the automobile industry for 1931? This question, so vital to the country at large because the business of making automobiles is our largest industry and therefore has a direct bearing on our future prosperity, has been, and still is, on the lips of millions.

We cannot answer it. Our talks with automobile manufacturers, however, lead us to believe that the industry is entering upon a fairly prosperous year. Replacements alone, as has been so often remarked lately, should account for a very large percentage of the 3,750,000 cars one manufacturer told us the other day would be produced this year. With just a little encouragement in the way of increased business activity, the man who has kept his old car an extra year already, will quickly replace it with a new one. And the same sort of encouragement will tear loose from many people the money they have unwisely hoarded.

If the gods help those who help themselves, the industry should profit this year; for it has certainly helped itself —witness the improvements and developments reviewed elsewhere in this issue. As a result of the industry's desire to make a better car, the pre-war dollar which is worth only 66 cents in the purchase of certain commodities, is worth $1.40 in the car market. Besides this, we are told by an automobile manufacturer, the slack business period has enabled manufacturers to reorganize their plants for more economical production. It seems reasonable to believe that the greater economy will rapidly be reflected in still better cars for the same money or lower prices for present productions. Indeed, a number of manufacturers have already announced reductions in prices.

No, we do not know what will happen to the automobile industry in 1931; but if people show a reasonable amount of common sense in spending—not hoarding—their money, we venture the prediction that it will enjoy a banner year.

On the whole, the outlook is quite hopeful.

Highway Safety

ONE cannot read the newspapers nor ride on the highways in any section of the United States without being appalled at the rapidly increasing number of automobile accidents, particularly those with fatal results. Just where to place the blame for this condition is difficult to determine, because of the many factors involved. There is, however, one phase of the situation that we desire to bring to the attention of motor car drivers, highway engineers, state legislators, and law enforcement officers alike. This is the number of head-on collisions on "super" highways of the east which, in the main, are constructed for three lanes of traffic.

At frequent intervals neat signs sound the warning "Keep to the Right. Center Lane for Passing Only." And in theory, the system works. But then that variable and unpredictable factor of human element enters the picture and the trouble begins. There being, theoretically, only one lane for traffic in each direction, trucks and other slow-moving vehicles hold up the faster cars. Each driver who wishes to pass the car ahead assumes that he has the right-of-way in the center lane, as does also the passing driver coming in the opposite direction. The wrecker and ambulance remove the obstructions to traffic and the stage is set for the next accident.

Consider on the other hand the two- and the four-lane highways. On the former, the driver knows that he has no right-of-way over oncoming traffic when he desires to pass, and therefore he exercises a certain amount of caution before he slips out of line. On the four-lane road, slow moving traffic keeps to the right-hand lane and faster vehicles travel down a clear stretch at reasonable speed. Here the desire to pass the driver ahead is greatly lessened by the fact that he also is traveling at a fair rate of speed. If he is not, at a horn signal he will usually move over to the right-hand lane.

Of course many three-lane roads have been constructed and it is absurd from a financial standpoint to expect that they will be rebuilt. However, before more of them are planned the matter should be given far more careful study. And in the meantime, more attention should be paid to the patrolling of the three-lane highways. It is quite possible that on these roads in stretches of open country a minimum speed limit, enforced, will do much to overcome the tendency for drivers to desire to travel faster than the man ahead, and thus automatically in many cases eliminate the cause of accidents.

BUSY PLANTS

"WE will keep our plants in operation until spring no matter how bad conditions may be," said M. E. Coyle, vice president and general auditor of the Chevrolet Motor Company, in announcing that his company would guarantee jobs for at least 30,000 men. "Our plan to improve conditions," he continued, "is an eight-hour day and a four-day week. If our employment reaches 40,000 we will increase the working hours to 50 a week." To carry out this plan, the company will underwrite the sale of their cars, according to Mr. Coyle.

We have heard of many plans to remedy the unemployment situation and aid business recovery, but previously none so deserving of unstinted praise as this. To our knowledge it is the finest, most humanitarian move that has been taken since the beginning of the depression. It will mean work not only for 30,000 or 40,000 in the Chevrolet plants, but also for as many more who must produce materials which will go into the cars, and for thousands of others indirectly.

What difference does it make if, ultimately, the increased buying power of these workers results in the sale of more of the company's cars? The thing that counts is that, right now, thousands of families are given the means of clothing and feeding themselves, and, furthermore, business recovery will be stimulated in a big way.

International Affairs

Our New Naval Program

THE President has submitted to the Congress the construction program for the Navy during the coming fiscal year, embracing a total of 18 vessels to be laid down between July 1, 1931 and July 1, 1932. These vessels are divided into the following classes:

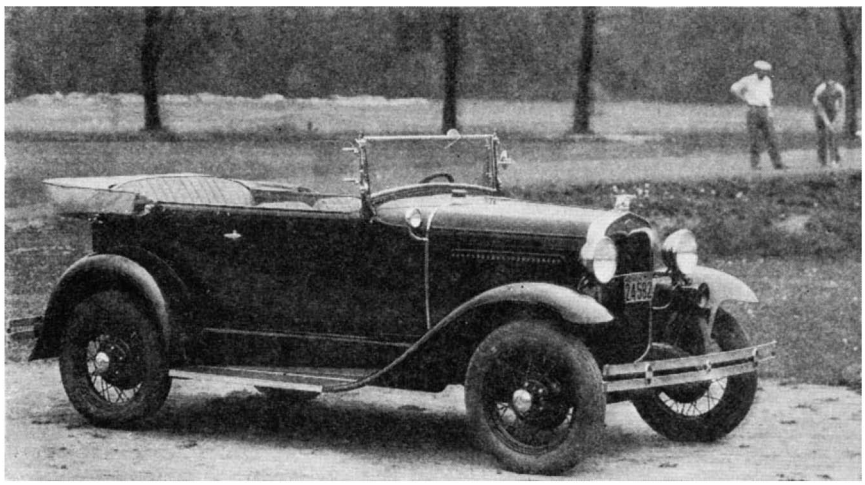
1 airplane carrier, 13,800 tons, to carry 114 planes.

1 flying-deck cruiser, 10,000 tons, six-inch guns, to carry 36 planes.

(*Please turn to page* 135)

AUTOMOBILES FOR 1931 IN REVIEW

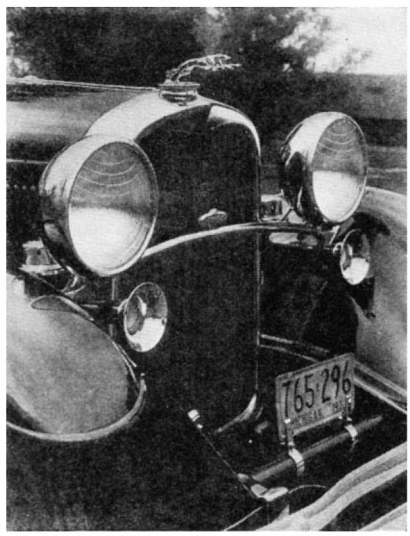
BECAUSE the automobile industry gives employment to one out of every ten persons in this country, directly or indirectly, and because it is the largest industry in the country, attention will be more closely focused on it during the coming months of recuperation from depression than ever before. Many important things have taken place in the industry and it is felt that they will influence American life greatly. There have been price cuts, radical changes in body designs, and introduction of mechanical improvements and innovations to satisfy the increasing demand for both swank and transportation.



The de luxe phaeton, a relatively new Ford model, is distinguished by its low, rakish lines, a single door on each side, and genuine leather upholstery

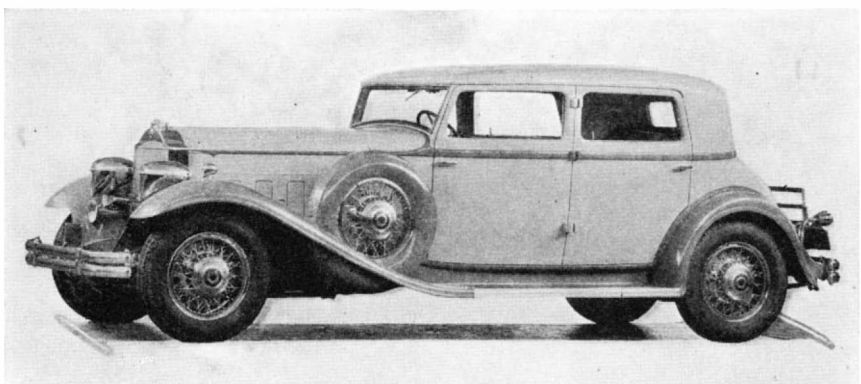
GREAT progress made in steel and aluminum fabrication during recent years is responsible for the better bodies that will be seen on 1931 cars. There will be less drumming, fewer squeaks and extraneous noises. New methods of attachment and suspension of bodies, lowering of the center of gravity by an increasing use of the drop-frame construction and the joining of constituent sections into rigid bodies have made this possible. Steel all-welded bodies have been introduced for the first time by Chrysler and it is reported on reliable authority that Durant will adopt the frameless all-metal body construction pioneered successfully in Europe by Viscaya.

As a rule, car bodies are lower this year but so far not one has been able to compete with the Cord in this respect. Many of the new cars have longer hoods, this effect being achieved by making the front compartment resemble an airplane cockpit. More elaborate bracing and the increased use of sound-deadening material represent the efforts of those progressive manufacturers who build automobile bodies of steel and wood.

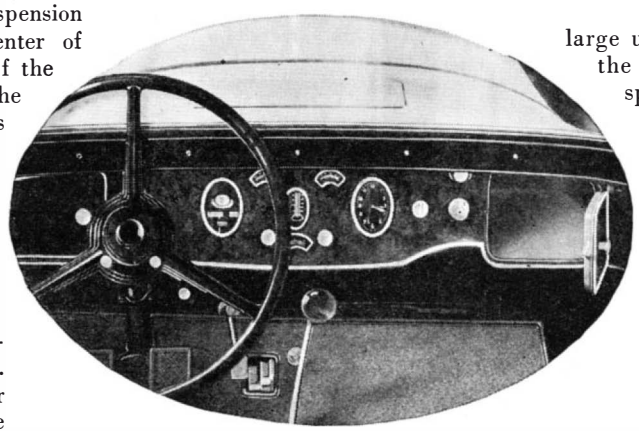


Front view of the new Lincoln. A new painted radiator is featured

Saving of weight is another item that is becoming increasingly important not only in the body but in the engine and accessories. For example an unusually large use of aluminum is expected in the car Peerless will offer in the spring. Incidentally, although Peerless owns the French Bucali front-drive patents it is denied that this new Peerless will be a 12-cylinder front drive but, instead, will be a strikingly different multi-cylinder rear drive.



Packard individual custom eight sport sedan. This is of particular interest because it shows one of the new bodies designed in the Packard custom body shops



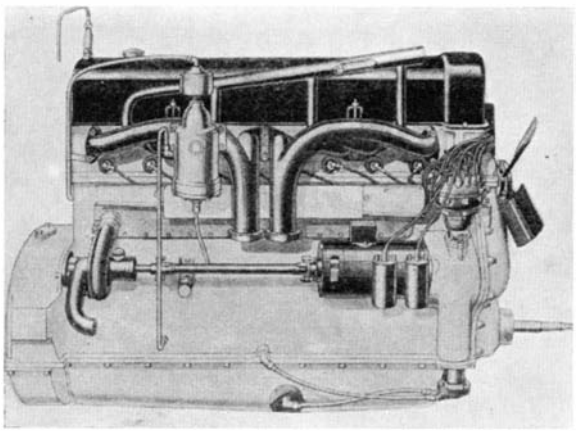
Instrument board of the new Packard, evidence of the attention that has been given to details of this car

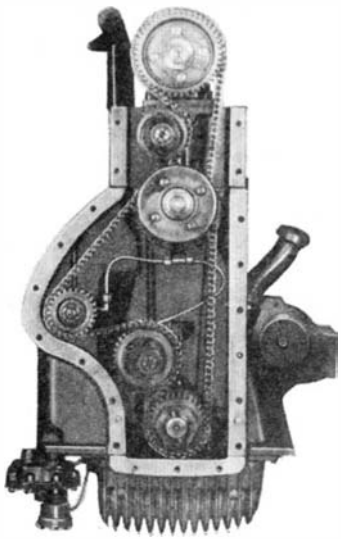
Again this year there is a strong trend toward eights to replace six-cylinder cars. Buick, in fact, has entirely abandoned the six-cylinder engine in favor of the eight. Marmon is producing a sixteen-cylinder car for the

first time and Cadillac a twelve to supplement its line of sixteens announced in January 1930, and its eights. It is said that still another sixteen is to be announced about the time of the New York Automobile Show by a manufacturer who has hitherto never touched the high-priced car field. At this writing no details are available.

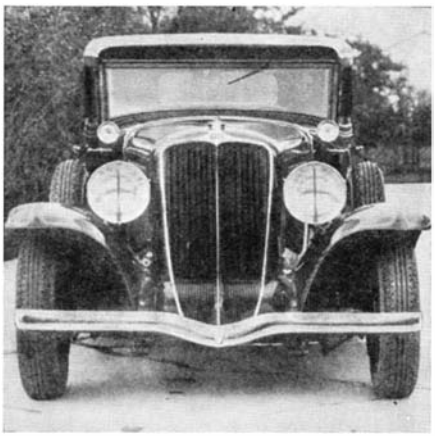
With increased numbers of cylinders has come increased horsepower, both rated and developed. Also greater piston displacement is noticeable in some of the new models and greater horsepower is developed by improved engines in many cars. Piston displacements of the larger Packard and of the Chrysler Imperial closely approach 400 cubic inches, with 384.8 cubic inches each. In line with the increases in horsepower and displacement many cars have lengthened wheelbases. The Cadillac V-16 leads in this respect with a wheelbase of 148 inches while the Packard eight is a close second with 145½ inches.

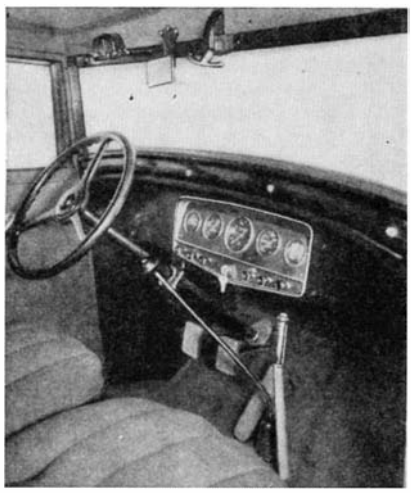
Transmissions have been greatly improved this year. The synchro-mesh transmission, first introduced on the Cadillac and LaSalle lines, is now to be found on the Buick line with the exception of the 8-50 and on a number of others that will be discussed later. In this transmission, designed to correct the clashing of gears and thus add to pleasurable driving, there is a clutch which operates as a synchronizer of any two sets of gears that are to be enmeshed. Another radical change in transmissions is the free-wheeling feature introduced in 1930 for the first time on an American car by Studebaker. This free-wheeling transmission has been added to the 1931 Lincolns and Pierce-Arrows.





Above: **The Stutz silent timing chain which not only operates the overhead cam-shaft but also turns the fan.** ***Left:*** **Right side of engine**

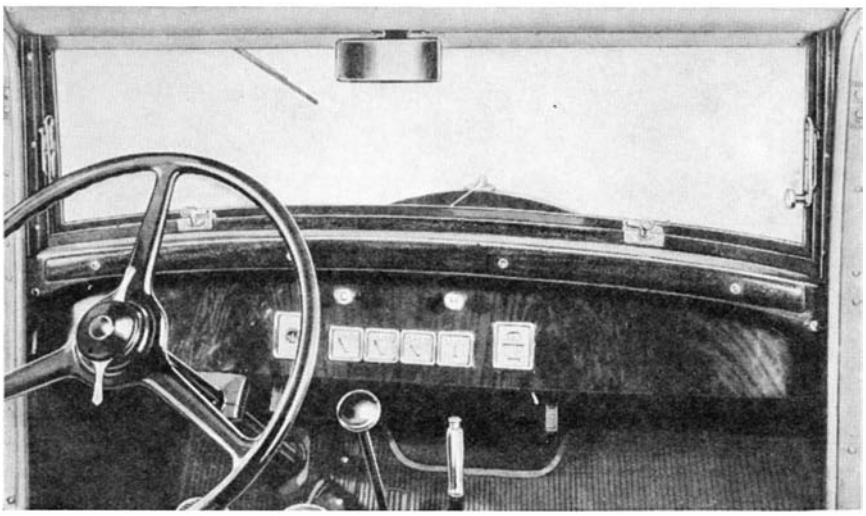


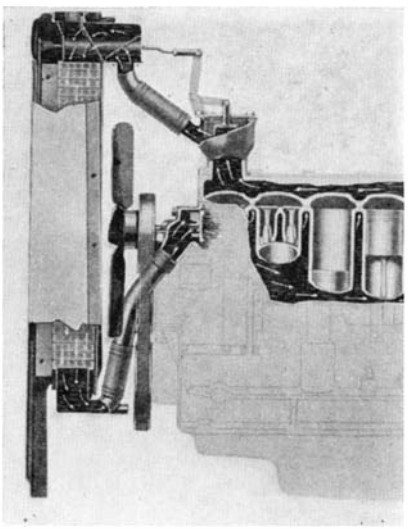


At left: **Front compartment of the new Auburn 8-98 brougham showing aviation type instruments.** ***At right:*** **Head-on view of the same car showing the distinctive design**

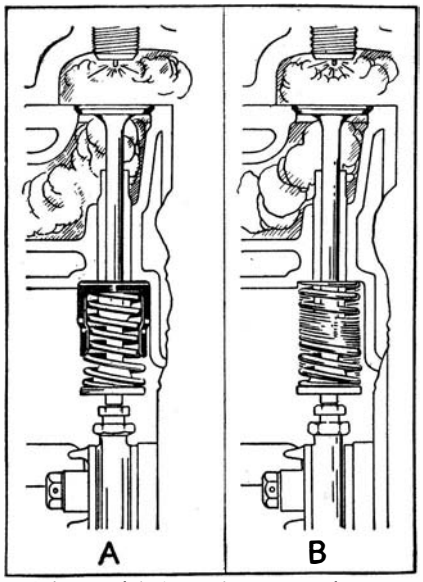
Dual and down-draft carbureters are on the increase and several cars have developed special intake manifolds and fuel systems.

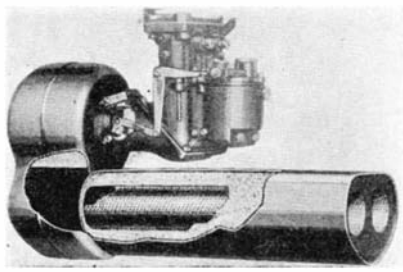
Traditionally conservative in several respects, Lincoln this year has changed considerably. First of all, the manufacturer took a radical step forward in adopting the free-wheeling transmission. This device is a small revolving unit mounted on the transmission shaft. It consists of two members, one within the other. The inner member slides on the transmission shaft while the outer





Dodge Brothers eight instrument board ***(left)*** **and the thermostatically controlled water-cooling system**





The Studebaker valve spring damper at left and the carbureter silencer at right. In the former, A shows spring action with damper and B without damper

member connects through the gears with the drive shaft. Between the two are eight rollers, each set in a wedge-shaped slot. When the speed of the motor equals or tends to exceed that of the car the torque of the engine wedges these rollers between the inner member and the outer member, transmitting power to the drive shaft through the over-running clutch. Upon deceleration, however, or when the car speed exceeds the engine speed, the connection through the over-running clutch is broken and the engine slows at once to idling speed. Provision is made for neutralizing the over-running clutch when it is desirable to utilize the braking effect of the engine in descending sharp grades.

In body design, the Lincoln follows somewhat the trend toward lower, longer bodies, its wheelbase being 145 inches, or nine inches longer than the previous Lincoln. With the added length and the lower body, pointed radiator shell, and slanting windshield, the car has a fleeter appearance. The lower bodies were made possible by hanging them on brackets on the outside of the frame instead of on top of it, and because of a one-inch decrease in diameter of tires.

The re-designed engine of the Lincoln is of the eight-cylinder "V" type, and is rated at 120 horsepower compared to 90 horsepower in the old Lincoln. It has a carbureter of the down-draft, double-throat type, a fuel pump, and a combination air cleaner and silencer which is attached to the carbureter intake.

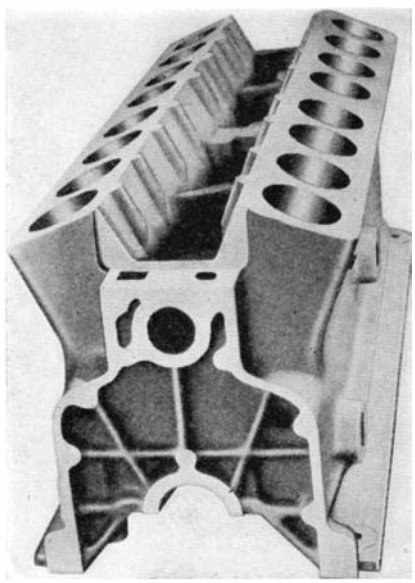
To the Ford line there have been added the new de luxe models, the Victoria and the two-door sport phaeton. The distinctive Victoria, which is mounted on the standard model-A chassis, seats four passengers. Mechanically the entire line of Fords is fundamentally the same as that of 1930.

PACKARD'S new cars are presented in two groups, the standard and de luxe models, in each of which there are 11 cars. The newcomers retain the characteristic Packard appearance, but despite improvements that have been made, the de luxe models are priced at approximately 1000 dollars less than the former de luxe cars. Announcement of the new cars also discloses the fact that Packard has expanded body building within its own factories to include a plant for manufacturing custom bodies formerly supplied by custom body builders. This marks an entirely new departure in the industry.

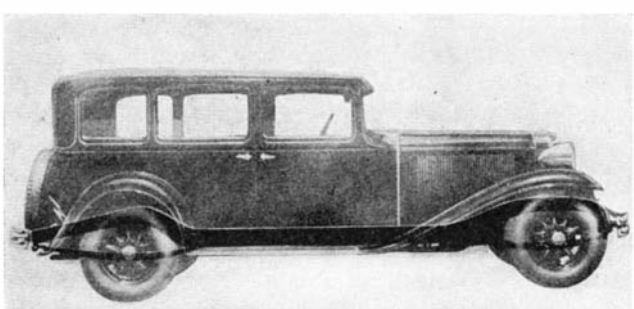
The Packard engine has been given more power principally by means of a new system of intake and exhaust manifolding. A new type of vibration damper lends further smoothness to the engine. Gasoline is conveyed to the carbureter by a mechanically driven fuel pump equipped with a strainer and sediment bowl. The four-speed transmission adopted a year ago has been further refined. Motor exhaust noise is reduced materially by an expansion chamber that has been added to the exhaust line to the rear of the muffler. Among the many other important mechanical refinements of the new Packard is an improved chassis lubricating system. The system which was adopted some time ago to oil all moving chassis joints by pulling a handle under the instrument board now operates automatically through vacuum from the motor.

Low center of gravity with its attendant safety, comfort, and riding ease is an outstanding characteristic of the new Stutz cars. This is obtained through the continued use of the worm drive rear axle in conjunction with the double-drop frame. An exceptionally low car without sacrifice of road clearance or head room is therefore possible.

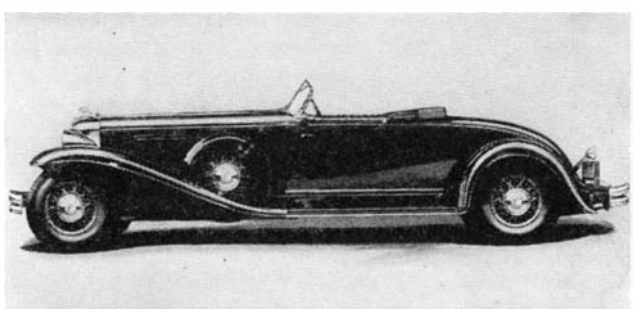
In its efforts to build safety into its cars, Stutz has adopted steel running boards which are said to be, in effect, side bumpers. The first to use safety, non-shatterable glass, Stutz this year is using laminated glass of "plate" quality. Numerous general body improvements have been introduced. Bodies are more strongly braced; body framing has been



Aluminum alloy cylinder block of the new Marmon 16-cylinder car



Phantom view of a Chrysler eight showing the double-drop frame. This is similar to the frame which is used by many cars this year and is rapidly coming into general use. ***At right:*** **A Chrysler Imperial custom eight roadster**



given more attention; and a greater quantity of anti-squeak material has been used.

A brake booster is standard on all Stutz models, so that the hydraulic brakes are operated by only a slight touch. The four-speed transmission has been retained in a redesigned form for greater ease of operation. Among other improvements are dual ignition, in which two spark plugs in each cylinder fire simultaneously, and dual carburetion and manifolding.

The Gardner Motor Company, Inc. has just announced an improved line of straight eights known as model "148" which comprises five body styles. Style is the keynote in these new offerings but from a mechanical standpoint they are basically the same as the company's 1930 line. Several mechanical changes, however, materially increase riding and driving comfort. These include rubber motor mounting, noiseless rubber-mounted spring shackles, and the four-speed transmission.

Duesenberg was represented by 12 cars at the salons and while several of the designs were of a more conservative type following the general lines of custom coach work, the majority of them were individual and unique.

The Cord front-drive which in the space of little over a year has achieved notable success for this revolutionary type, was shown in three custom models at the salon. Mechanically the Cord is practically the same as when described in our January, 1930, issue.

Comfort, spacious interiors, increased power, and quietness are characteristics of the totally new line of cars by Auburn. In general, the bodies introduce a new motif in automobile design, and in their construction, scores of innovations have been introduced to add to the beauty, strength, and rigidity, and to decrease weight. Cars of the new line have a wheelbase of 127 inches and are lower because of the underslung front springs, double-drop frame construction, and the decreased wheel diameter. The rear-axle tread has been increased to 61 inches compared to the average car's 58.

The Lycoming engine in the Auburn has been given increased power. The cylinder block has been redesigned to provide more water space around the valves for better cooling. A new single plane, tube type, Schebler carbureter is used, and a suction control economizer has been introduced to make possible more rapid acceleration in the low-speed range. Other improvements have been made to insure easier starting, especially in cold weather, and to minimize the possibility of flooding the carbureter.

The transmission unit is of the silent-mesh synchronized-gear type with coaster control device. This coaster control unit contains only three parts compared to 15 to 25 parts for most others. Brakes are steel-draulic, self-energizing, and require light pedal effort. One other innovation stands out from the scores on the "8-98" Auburn. This is the Bijur chassis lubricating system which operates automatically through the vacuum in the intake manifold. This operates at regular intervals and reaches 12 points on the spring shackles, two on the front king pins, and one on the clutch throw-out bearing.

No very great changes have been made in the Plymouth but in line with the general trend, brake horsepower of the engine has been increased from 45 to 48. This has been made possible by increasing the size of the inlet valves, increasing the lift of the camshaft and of the intake manifold, and by improving carbureter calibration. The vane type of oil pump has been replaced by

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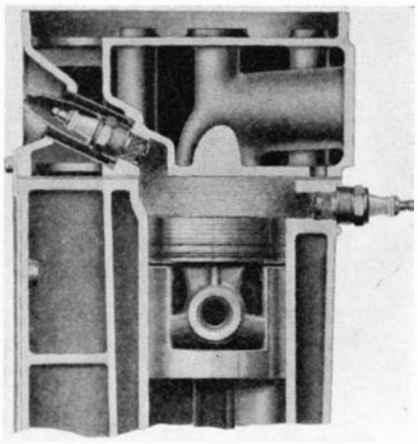
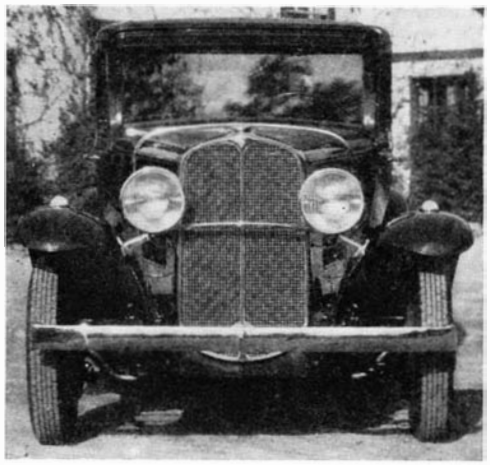
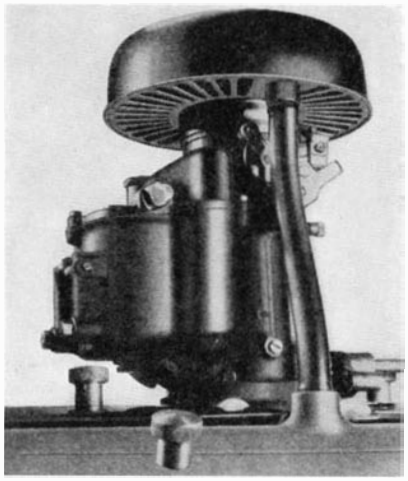


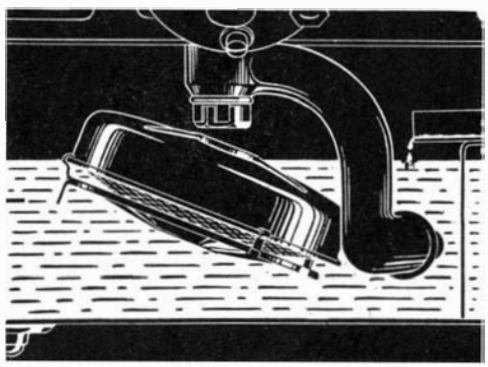
Combustion chamber and twin-ignition system of the new Nash models



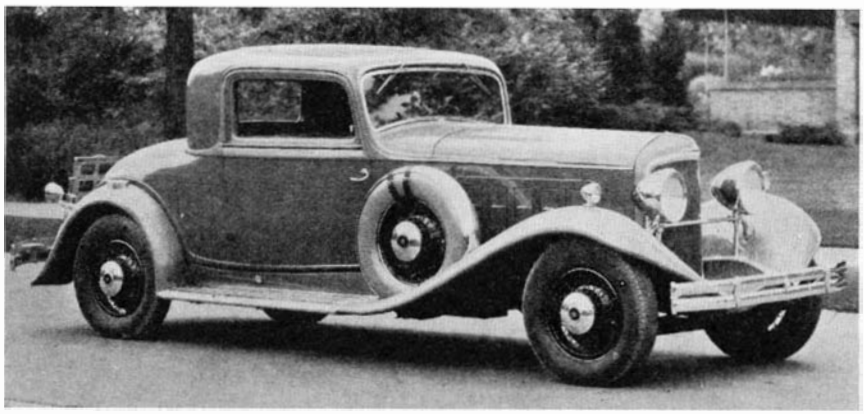
Distinctive front view of the Oakland eight



Duplex down-draft carbureter with air cleaner and crankcase ventilating intake tubes on the Marmon 16



The Willys Float-O oil device



Reo makes its début for 1931 in improved dress

REFINING PLUTO'S ORBIT

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

PLUTO continues to figure in the astronomical news, and with good reason. By the generosity of Dr. S. B. Nicholson of the Mount Wilson Observatory the writer is permitted the privilege of telling here of some of his results which will be presented at the scientific meetings later in the present month. Dr. Nicholson, the discoverer of the ninth satellite of Jupiter, and Mr. Mayall have been at work upon Pluto since its discovery was announced. They discovered the faint images of the Planet on the plates taken in 1919, which have been of so much importance in determining its orbit, and computed the first accurate orbit from these.

Now, utilizing the numerous observations of the spring and autumn of 1930 and the pre-discovery photographic positions of 1927, 1921, and 1919, they have completed a very accurate calculation which should leave but a small margin of outstanding uncertainty. These agree so closely with the elements derived by Bower and Whipple at Berkeley, which form the basis of the article which appeared in the December number, that the differences would be practically imperceptible in the diagrams which were there given. Small as the differences are, however, they are interesting, for they illustrate still more of the rather entertaining complications which the calculator has to face.

THE planets as well as the sun are attracting Pluto. In preliminary computations for this or any other planet this influence is simply ignored, but enough is known about the planet's motion now to justify and indeed to demand some better procedure. There are, however, several ways of doing this. In the first place, since all the planets are inside Pluto's orbit, they are attracting it roughly in the same direction as the sun and we may take account of this roughly by assuming that they are all lumped with the sun itself, adding their masses to the sun's. This is what Bower and Whipple did and it was altogether the correct procedure at that stage of the work when the real period and the form of the orbit were still considerably uncertain.

After a good first orbit was available the way was open to calculate by well known though laborious methods just what the attraction of the planets upon Pluto was year by year and how much it altered the planet's motion. But here we must ask a new question. What do we mean by the "unaltered" motion? Pluto has never moved in an "unaltered" orbit and to define one we must get rid of the other planets and their action by some imaginary process and then calculate how much the planet's position in its real orbit differs from that which it would have had under the simpler conditions which we have invented.

The standard way of doing this is to

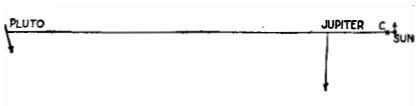
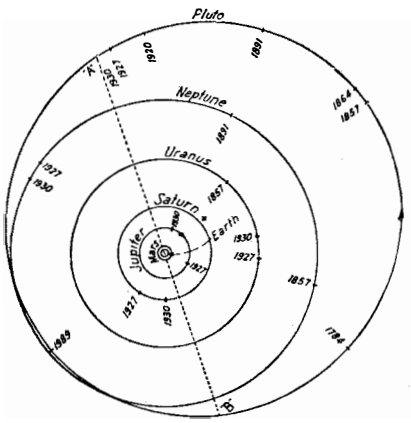


Figure 1

suppose that at a given instant all the planets were annihilated, leaving Pluto and the sun alone in the system but with exactly the same mutual distance and relative motion. After this imaginary catastrophe Pluto's orbit would be



Pluto's orbit drawn to scale with the orbits of the other planets. Reproduced from Leaflet 30 of the Astronomical Society of the Pacific by Dr. F. C. Leonard, this drawing was adapted from a diagram made by Mr. F. L. Whipple. Since it was issued in August, it was based on earlier data than the author's diagrams and differs very slightly

an exact and unchangeable ellipse and its motion could be easily computed. With this as a standard it is then possible to work out just how far the real planet will deviate at any other time from the position which it would have had under the fictitious but simply calculable conditions. At the moment of our supposititious change the position and velocity of the planet are exactly the same in the two systems, hence the real and artificially simplified orbit run very close together in the neighborhood of this time—which, by the way, is called the "epoch of osculation" (the word is borrowed from the mathematicians, who have long employed it to describe a close type of contact between two curves!).

But other simplifications of the solar system can be imagined. For example one might suppose that at a given instant the planets were not annihilated but were combined with the sun into a single mass. The best point at which to put this mass is obviously at the center of gravity of the whole system and not the one where the sun's center happens to be. Taking the surviving planet's motion about the new increased attracting mass, we derive another idealized orbit known as the "barycentric" orbit (about the center of gravity) instead of the previous heliocentric orbit (about the sun as attracting center).

EACH of these processes is mathematically quite legitimate, provided that it is clearly explained just what hypothesis has been adopted. But the two orbits will never agree, for the central attracting mass differs and so does the planet's position and motion at the given time. Which one will give the better idea of the planet's subsequent motion? This depends on where the planet is in the solar system. For the earth, or for an asteroid like Eros whose orbit lies far inside those of Jupiter and Saturn, the heliocentric orbit will evidently be the best, because these planets tend on the average, though not always, to pull the asteroid away from the sun and their influence could be better represented by diminishing the sun's mass than by increasing it. But for Pluto the reverse is the case and the barycentric orbit is to be preferred.

The differences between the two are far from negligible, the greatest discrepancy being in the period, for which Nicholson and Mayall find 249.20 years in the heliocentric orbit and 247.69 in the barycentric. These differ by one part in 164—a surprisingly large amount at first sight. The perplexity grows when one realizes that by Kepler's laws an increase in the attracting mass of 1 percent will, other things being equal, decrease the period by ½ of 1 percent.

The combined mass of the planets is about 1/700th that of the sun and we should therefore expect the barycentric period to be shorter by 1/1400th part, or two months instead of 18.

BUT the principal difference between our two hypotheses is not that we have altered the *magnitude* of the attracting mass but that we have changed its *motion*. At the epoch of osculation of the orbit (1930) Jupiter was almost in line between Pluto and the sun. It was moving in the same direction as Pluto (Figure 1) while the sun, which lies on the opposite side of the center of gravity C, must therefore have been moving in the opposite direction. The motion of Pluto relative to the sun was therefore more rapid than its motion relative to the center of gravity. Now a more rapid motion at a given point in the orbit implies a larger orbit—so much so that it takes longer than before to make the whole circuit. Hence the heliocentric period should be the longer. We can easily figure out how much. The average orbital velocity of Jupiter is 2.76 times more rapid than Pluto's, the sun is 1047 times more massive than Jupiter, and so its velocity about the center of gravity is proportionately slower or 1/380th of Pluto's. Hence the change in our scheme of reference speeds up Pluto by one part in 380.

Now it follows from Kepler's laws that an increase in orbital speed by 1 percent (in a nearly circular orbit) will increase the period by 3 percent. Hence we should expect the heliocentric period of Pluto to be longer than the other by 3/380ths of its amount, or 1.96 years. This is almost six months more than the actual computations give.

But we have so far taken account only of the influence of Jupiter. Saturn in 1930 was on the opposite side of the sun and acted in the opposite direction and almost to the maximum possible amount. Owing to its smaller mass and lower orbital velocity its effect is only 22 percent of Jupiter's, and in this case decreases the heliocentric period by 0.44 year. The combined effect is an increase by 1.55 years or, allowing also for the change in the assumed mass, 1.72 years. The difference given by the precise calculations is 1.51 years. It is by no means usual to find a case in which such elementary calculation gives so good an approximation.

FROM what has been said it is clear that if the true orbit of Pluto about the center of gravity of the solar system did not change at all, the orbit calculated by considering the sun alone would sometimes come out with a period more than two years too long and again as much too short.

Even the barycentric orbit is not free from variations. The attraction of the planets and especially of Neptune, which has been fairly near Pluto during the last century, will alter it considerably—though by much less than the amounts just considered. It is possible by much more extensive calculations to get rid of these changes also, and to find a "mean orbit" which gives the true mean value of the period, but the time for this has not yet arrived.

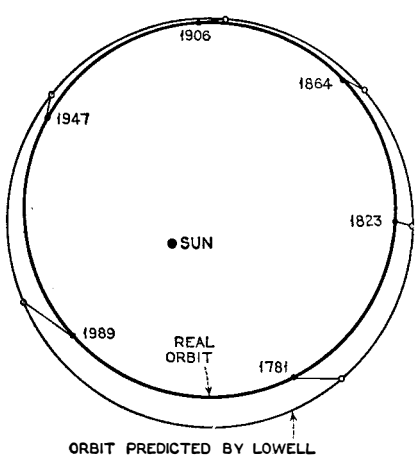
Meanwhile we may note that with the new period of 247.69 years, which should be much nearer the truth than any previous value, is also much nearer to being 1½ times Neptune's period of 164.77 years. After three revolutions of Neptune and two of Pluto the former is only one year's motion ahead instead of four. The interval between the close approaches of the two planets is therefore about four times as long as was previously estimated and probably exceeds 40,000 years, while the last such conjunction happened more than 10,000 years ago.

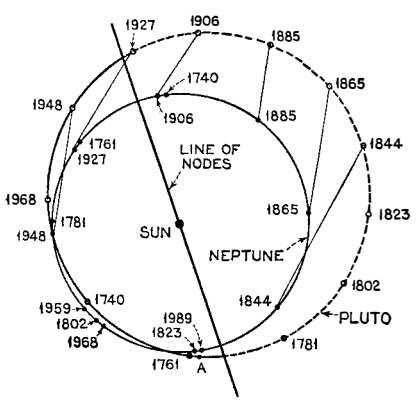
Of wider interest than these calculations is another result which Nicholson and Mayall have reached. They have made the first determination of the mass of Pluto. From the observations of Neptune, proceeding in the usual way, they find that definite evidence of the influence of Pluto's attraction is present, and that its mass is comparable with that of the earth. There is a continuous series of observations of Neptune from the discovery in 1847 to 1930, and two isolated observations in 1795 by Lalande who recorded the planet's position while observing the places of faint stars and supposed it to be only one more of the thousands which he had measured. Observing methods were less precise in those days and this position is less accurate than the others. If it is included in the solution the mass of Pluto comes out 1.08±0.23 times the earth's. If it is excluded the remaining observation give the value 0.72±0.05. The remarkable diminution in the probable error for the second result shows that the later observations are much better represented if the early one is disregarded. Whether so drastic a course is justified cannot be settled till we have a decade or two more of observation or until the perturbations of Uranus by Pluto have been worked up. In any case it is clear that the new planet has a considerable mass and is capable of producing easily perceptible influences on the others by its attraction.

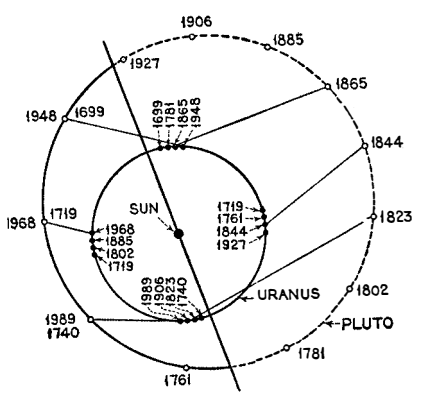
WITH this mass it is probable that its diameter is not very different from the earth's. If so, its apparent disk should be less than 0″.5 in diameter. To detect this in so faint an object would tax the powers of the greatest telescopes and demand the very best conditions of seeing which have not yet apparently been available.

The planet's faintness, too, is no longer seriously puzzling. Pluto reflects a little more light than Mars would do in his place. If his diameter equals the earth's his albedo would be one third that of Mars. This is two fifths the average value for the moon, or about equal to that of the moon's darker area.

So all contradictions vanish and we may welcome Pluto to a fully accredited place among the major planets of our system.—*Mount Wilson Observatory, Dec. 2, 1930.*







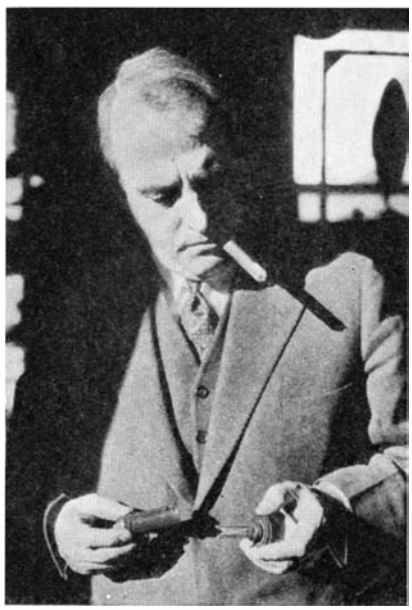
The diagrams to which the author refers, reproduced from our December number. At the left is Lowell's predicted orbit of the planet, with the "first approximation" orbit of Pluto based on earlier data. Above is Neptune's orbit with that of Pluto, the dotted part properly being below the plane of the paper. At right are the relative positions of Pluto and Uranus

A WATCH-DOG FOR THE CARBURETER

ON THE afternoon of December 3, last, Captain Frank Hawks arrived in Memphis, Tennessee, after a fast flight from New York in an airplane equipped with the Moto-vita which is described in the accompanying article. Its use, according to the flier, enabled him to reduce gasoline consumption of his engine for the distance flown by 40 percent. The claims made for the device are therefore substantiated by the incontrovertible proof of actual use in a 950-mile flight.

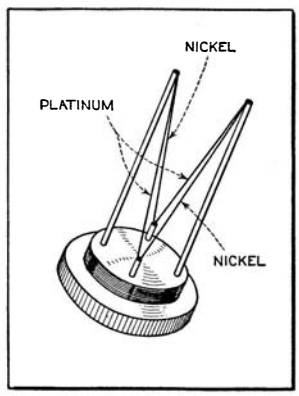
GUESSING the proper fuel-air mixture for an automobile engine may be safe enough as a rule, even though it is a wasteful procedure, but in an airplane it may be dangerous. There is a story told of a well-known army pilot who, on a flight from Long Island to Washington, D. C., very nearly came to grief because of this practice. In order to get the greatest efficiency out of both fuel and motor, he was adjusting the mixture by guesswork when, at about 4500 feet altitude over Baltimore, he thinned his gasoline-air mixture too much and the motor sputtered and died. Since he was not within gliding distance of an airport it was necessary for him to prime his engine and perform the extremely dangerous stunt of diving toward the crowded city in order to start his engine again.

Dr. Miller Reese Hutchison, inventor



of the Klaxon horn and former chief engineer and personal representative of Thomas A. Edison, recently perfected a device called the Moto-vita, which eliminates such potentially dangerous and always wasteful guessing in the adjustment of carbureters for gasoline engines. With this device attached to an airplane engine the pilot will have on a small dial before him at all times an accurate analysis of his mixture as shown by the gases passing out of the engine exhaust. He can therefore adjust his carbureter as frequently as changes in altitude and atmospheric conditions demand.

On an automobile the new device would show the driver if his mixture is too lean to enable his car to climb a hill smoothly, or if it is so rich that the exhaust carries an appreciable percentage of carbon monoxide. Elimination of that deadly poisonous gas which is a rapidly increasing menace to public health, is indeed one of the most important jobs of the Moto-vita. It does this by continually keeping watch on the mixture so that the automobile driver can make necessary adjustments.

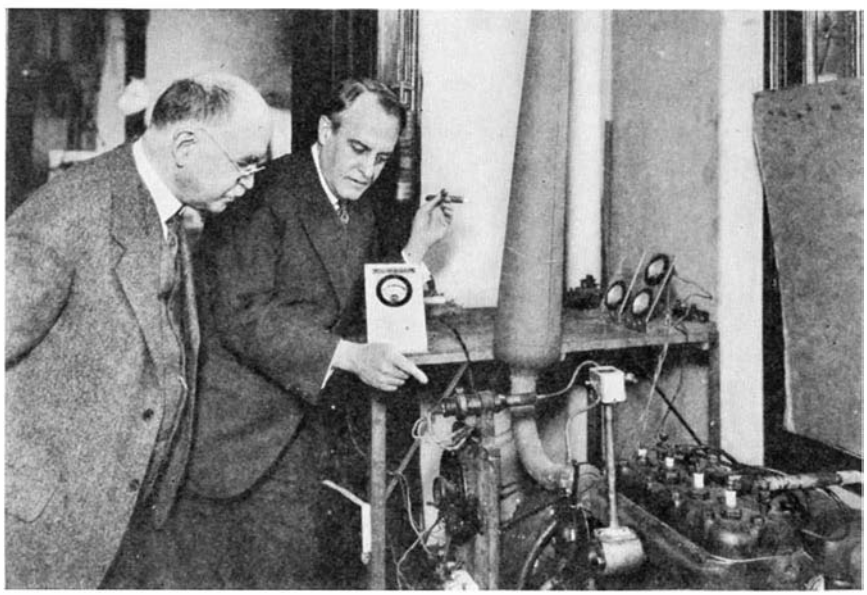


At the left Dr. Hutchison holds the platinum-nickel unit and its "cage" of woven copper wire. At the right its construction is shown. Below, the inventor explains to a member of our editorial staff how the unit indicates efficiency of combustion when the gases from the exhaust are drawn over it

Neither the driver nor the pilot needs to leave his seat, as the adjustment can be made while the vehicle or plane is in motion; and that adjustment will reduce carbonization of cylinders, fouling of spark plugs, and dilution of lubricating oil, besides the waste of fuel already mentioned, all of which are due to a mixture that is too rich. The fuel-saving feature alone is very important because of the part it may play in this country's oil conservation program.

THE Moto-vita is a small device that is quickly attachable to any existing automobile, bus, truck, airplane, or other vehicle using an internal combustion engine. It is inexpensive, and yet its use increases the cruising radius of a plane or vehicle to as high as one and three quarter times that heretofore attainable with the same amount of fuel. Thus an airplane equipped with it may safely leave behind one third the quantity of gasoline required at present and replace this weight—six pounds per gallon—with pay load. For each 30 gallons of gasoline reduction in fuel load, an additional 170-pound man and his hand luggage may be carried.

The operation of this ingenious invention is based upon catalysis which, for the benefit of those whose knowledge of it may be hazy, is defined as: a chemical change in a compound which is caused by the presence of an agent that remains unchanged.

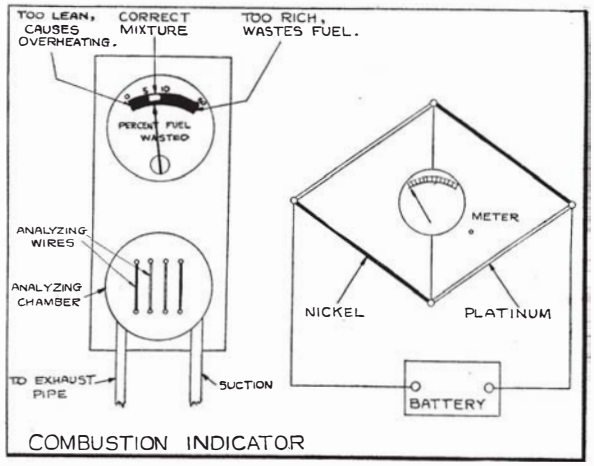


A fine platinum wire, held in an atmosphere of inflammable gas, is such an agent and is familiar to housewives in the form of a gas-stove lighter, and to some smokers in the form of a patented non-sparking cigar lighter. The former consists of a tiny crimped wire stretched across a loop at the end of a heavier steel wire which serves as a handle. Held in the flowing gas from a gas burner, this crimped wire quickly heats up, begins to glow, and ignites the gas. In this operation, catalysis has taken place; the peculiar reaction between the wire and the fuel has initiated combustion of the latter while the former has undergone no change.

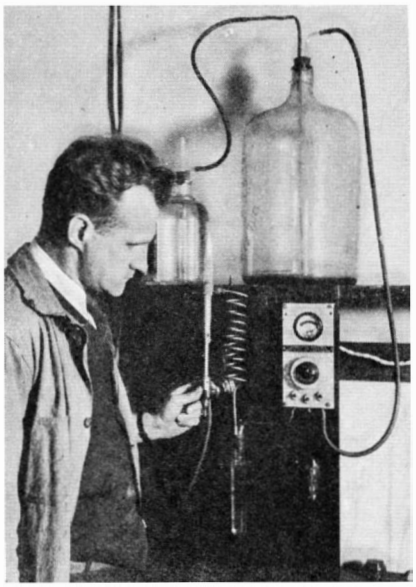
IN developing his new invention, Dr. Hutchison worked from the first on the idea of measuring the percentage of inflammable gases in the exhaust from an internal combustion engine. In endeavoring to find a way to secure proper combustion, he started with the result rather than the cause, for he reasoned that to improve present-day carburetion methods and equipment would be more difficult than to perfect a method of determining continually the efficiency of a carbureter so that it might be instantly adjusted for as high an efficiency as possible. The success he has achieved with his perfected device proves that his reasoning was correct.

When a carbureter is adjusted for too "lean" a mixture, anyone familiar with gasoline engines knows that the engine will sputter and stop as did that of the army pilot's plane previously mentioned. In such a case the combustion of the fuel is complete until the engine actually chokes, and the gas from the exhaust is principally inert, non-inflammable carbon dioxide. On the other hand if the mixture is too "rich" there is more fuel than can be consumed in the limited oxygen supply, the result being that combustion is only partially completed and quantities of inflammable, poisonous carbon monoxide pass out through the exhaust.

A fine platinum wire in contact with the exhaust gases would, therefore, rapidly heat up because of catalytic action, if those gases contain carbon monoxide. Furthermore, the degree of heating of the wire is in proportion to the percentage of this inflammable gas. Working on this basis, it remained for Dr. Hutchison to arrange some method of measuring the temperature rise of the wire. To do this by means of a thermocouple might be possible, of course, but would perhaps be too delicate and complicated.



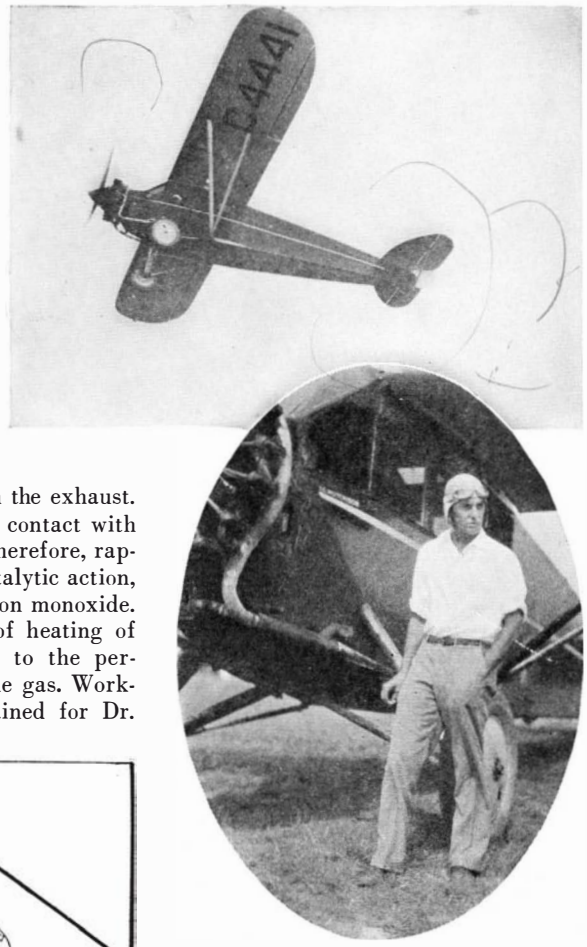
Schematic diagram of laboratory set-up



A test of the invention in the laboratory with chemically made gases

In elementary electricity, we learned that the resistance of most conductors to the flow of an electric current increases in a certain proportion as the conductor is heated. Dr. Hutchison applied this simple principle to his apparatus in order to show the temperature of his platinum wire at all times.

Thus the completed device consists of two fine platinum wires connected in a balanced bridge circuit with two nickel wires, as shown in accompanying illustrations, and a milliammeter which, for the sake of simplicity, is calibrated to indicate not current flow but corresponding degrees of efficiency of combustion. Current from the battery of the vehicle flows through the platinum and nickel wire connection continually and at a definite rate. Gases drawn from the exhaust pipe flow over the platinum wire and influence its resistance, the bridge circuit is unbalanced, and the milliammeter is affected accordingly. The carbon monoxide, however, is not ignited because there is no oxygen present.



The plane in which the Moto-vita has been thoroughly tested and, in the oval, the inventor's pilot son

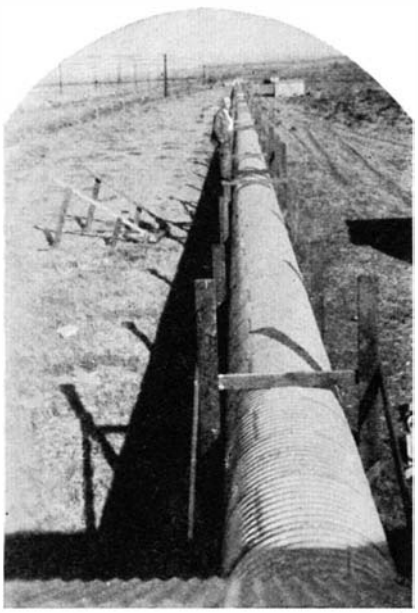
The airplane pilot or the car driver, by watching the milliammeter mounted conveniently before him, can tell at any instant just how his engine is behaving so far as efficiency of combustion is concerned. All that remains for the pilot to do is to reach forward and operate a small handle, knob, or lever, as the case may be, to "readjust" his fuel-air mixture. The surface vehicle driver will operate a control from his seat which will cause the injection of more air, in case a "rich" mixture is indicated, through an auxiliary air valve on the intake manifold of the engine, this being the only extra equipment necessary.

The inventor's eldest son, John C. Hutchison, who is an experienced pilot, has made many test flights using the Moto-vita in the family Fairchild airplane. He watched every drop of gasoline used in the plane and obtained valuable data by calibrating the results with the speed graphs of the engine and the plane.

ENGINEERING ASPECTS OF MICHELSON'S VELOCITY-OF-LIGHT EXPERIMENT

By EDGAR C. NICHOLS

Designing Engineer, Department of Instrument Design, Mount Wilson Observatory, Pasadena



The long vacuum pipe is about 35 miles to the southeast of Los Angeles

PHYSICISTS and astronomers from the time of Galileo have been interested in the determination of the velocity of light. Galileo was probably the first to attempt this measurement but because of lack of equipment he was unable to make a close calculation and decided that light was instantaneous. Foucault was the first to get a practical measurement. He used a rotating multi-sided mirror in his experiments. The most trustworthy measurement we have today is that obtained by Dr. Albert A. Michelson in his famous experiment which he made at the Mount Wilson Observatory in California in 1924. At that time he reflected a beam of light from Mount Wilson to Mount San Antonio, a distance of 22 miles, and back. The velocity then determined was 186,359 miles per second. Dr. Michelson desired to increase the accuracy of this measurement and set up a second series of experiments between Mount Wilson and Mount San Jacinto, a distance of 88 miles. This attempt was not a success because of atmospheric conditions and poor vision.

DR. MICHELSON then proposed the idea of measuring the velocity of light in vacuum, a condition which would give perfect seeing and direct accuracy in measuring the distance over which the light beam would travel. (Light travels slightly faster in a vacuum than it does in air.) In the optical set-up which he plans to use, the light from an arc light is reflected from a multi-sided mirror which rotates at a high rate of speed. The revolutions per second of this mirror are determined by a calibrated tuning fork. The mirror with its arc light is to be placed outside the vacuum tube and the light from one of the faces is reflected through a window into the vacuum tube where by a series of mirrors it is reflected back and forth ten times. The light finally passes back through the window of the vacuum tube to the rotating mirror. During the short interval that it has taken the light to travel back and forth, the faces of the rotating mirror have slightly changed their positions and the light that returns is reflected from the face at a slightly different angle than the one at which the light came to it from the original source. This angle, the distance over which the light has traveled, and the speed of the rotating mirror are the three determining factors from which the velocity of light may be calculated.

This optical set-up is particularly adaptable to the use of a pipe line for a vacuum tube. It was decided that a tube three feet in diameter and one mile in length should be used which, because of the reflecting back and forth, would give a total distance of 10 miles traveled by the light. In 1928 experiments were made at the University of Chicago by Mr. Fred Pearson, Dr. Michelson's assistant, to determine the best type and size of pipe to use for the vacuum tube. A pipe combining minimum weight and the strength to resist collapsing pressure was essential. After several tests Armco corrugated pipe of No. 14 gage was found to be perfectly satisfactory. Corrugating a 36-inch pipe of No. 14 gage metal increases the resistance to collapsing pressure 25 times. The factor of safety for a complete vacuum, or an external collapsing pressure of 2100 pounds per square foot, is 10.

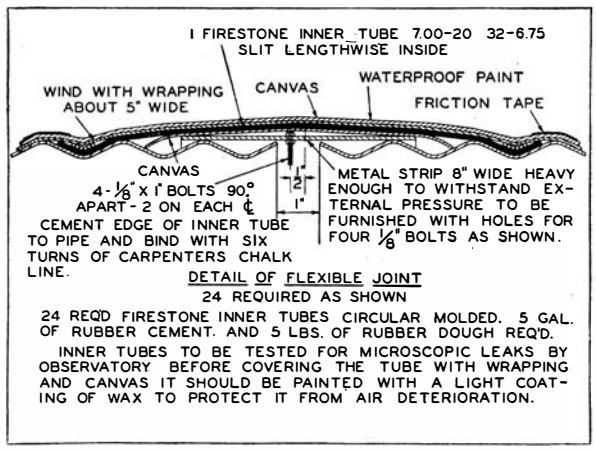
IN 1929 and 1930 a vacuum tube was built by the Mount Wilson Observatory on the Irvine Ranch near Santa Ana for Dr. Michelson's experiment. This vacuum tube is slightly over a mile long and consists of ninety 60-foot lengths and two 40-foot lengths of 36-inch diameter corrugated pipe as well as four welded steel "tanks," each six feet long, five feet wide, and five feet high, for housing the mirrors and their mountings. The total volume of the vacuum tube including the mirror tanks is approximately 40,000 cubic feet and the ratio of the enclosing surface to volume is rather high. The tubes and tanks have a surface area of approximately 53,000 square feet and when completely evacuated they resist an external collapsing pressure of 55,000 tons. The area of a sphere necessary to enclose a volume of 40,000 cubic feet would have a diameter of slightly more than 42

Dr. A. A. Michelson giving an explanation of the present experiment before the connected microphone and camera of the Pathé talking motion pictures

feet with an enclosing surface of approximately 5700 square feet. This gives a ratio of surface of tube to surface of sphere of 9.3 to 1, which gives some idea of the area of tube surface to be made air tight.

The corrugated pipe was delivered to the site of the experiment, double riveted and soldered, ready for installation. On the pipe alone there were 23,000 feet of soldering, not including rivet heads. When the pipe line was finally evacuated a very small number of leaks was discovered. In constructing the pipe line each individual 60-foot length of pipe was mounted independently on five wooden cradles. A space of one inch was left between pipe ends to allow for expansion. The pipes were sealed together and to the tanks with air-tight joints consisting of iron bands wrapped with canvas, and the whole joint was then enclosed by a band of rubber, made from a standard seven-inch balloon tire inner tube the edges of which were cemented with special rubber body cement to the pipe ends and then wrapped with heavy cord. The entire joint was then painted with Glyptal paint and finally wrapped with an outer covering of waterproof canvas for protection from air and sun. This method of connecting the pipes has proved entirely satisfactory as it has given a flexible as well as an air-tight joint which is not expensive to construct.

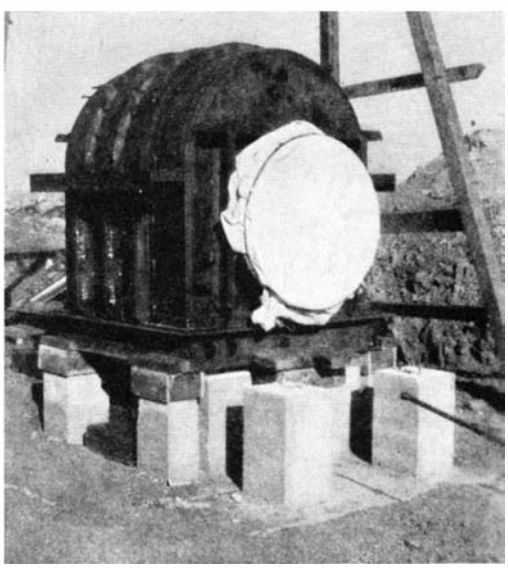
AT each end of the pipe line are two of the mirror tanks connected by a 40-foot length of pipe. The tanks are made of 5/16-inch steel plate and are reinforced on the outside with steel channels and I-beams, the whole construction being welded together to ensure an air-tight job. To facilitate the installation of the mirrors and mountings, the tanks were made in two parts. The tank proper is open on the bottom and has an angle running around the lower outside edge. This angle rests upon a flat base plate which is reinforced on the under side with I-beams. The lower edge of the tank is defined on the base plate by a 2 by ¾-inch steel bar extending entirely around the inside of the bottom of the tank. This bar is welded to the base plate and when the tank is evacuated it carries the collapsing load on the lower sides and ends of the tanks. The joint formed by the base plate, steel bar, and the angle make an ideal seal. The joint is filled with Hydroseal, a one-eighth-inch lead wire having been placed in the corner of the joint to keep the Hydroseal from sucking into the tank. No bolts are necessary to fasten the tank to the base plate for they are held together by the external collapsing pressure created by the vacuum. A 29-inch vacuum causes a pressure of about 50,000 pounds, holding the tank and base plate together.



REACTION heads are necessary on the tanks at each end of the pipe line in order to balance the external pressure on these tanks. These reaction heads are of the same area as the 36-inch corrugated pipe and are supported on struts on concrete piers, the thrust being taken care of by rods and turnbuckles connected to "dead men" buried in the ground.

The tanks are supported on concrete piers entirely independent of the mirror mounting supports. The mirror mounting supports are three four-inch diameter steel columns mounted in concrete piers. They extend into the tanks through three sealed joints of five-inch diameter steel tubing welded to the tank base plate. The seal is made with sections of rubber inner tube cemented to the steel columns and five-inch diameter tubing. In the ends of each tank are holes of two-inch diameter covered with glass which has been waxed on with Kotinsky cement. These windows are for the purpose of examining the mirror mountings from the outside.

On the mirror mountings there are 13 small motors and four electric lights for use in adjusting the mirrors. These are operated by remote control. Seven of the motors and four lights are at the north end of the tube and are operated from the main station at the south end of the tube over a mile away. The motors may be run in either direction of rotation and the lights turned on or off. This is accomplished with five wires from the main station. A Selsyn motor and generator are used. The observer, by turning a knob on the generator to the desired position, selects the motor or light which he wishes to operate. The motor a mile away at the north end precisely follows the generator and contacts the desired motor or light. After the motor or light has been so selected it is then operated through a relay by a push button at the main station. By means of relays the lights may be left on as long as desired but the motors will only operate as long as the push button is closed. Because of temperature changes, constant adjustment of the mirrors is necessary during an observation. Manholes with covers and gaskets are provided in each of the 40-foot lengths of pipe at the ends of the pipe line. These are for access to the mirrors and mountings. A vent pipe with valve is provided to relieve any pressure that may be generated by heat when the line is not pumped out.



One of the built-up tanks designed to contain the mirrors (described in the text)

EVACUATION is accomplished by two Kinney vacuum pumps with capacity totaling 400 cubic feet of free air per minute. At peak load or 21-inches of vacuum, 20 horsepower is required to operate the pumps. As the vacuum in the tube increases the free air displacement of the pumps decreases and at 29-inch vacuum 12 cubic feet of free air per minute is being removed. In approximately 15 hours of pumping the tube is pumped down to a 29¾-inch vacuum. Besides the vacuum pumps, a motor-generator set is used for operating an arc light for a light source and an air compressor for driving the turbine of the rotating mirror.

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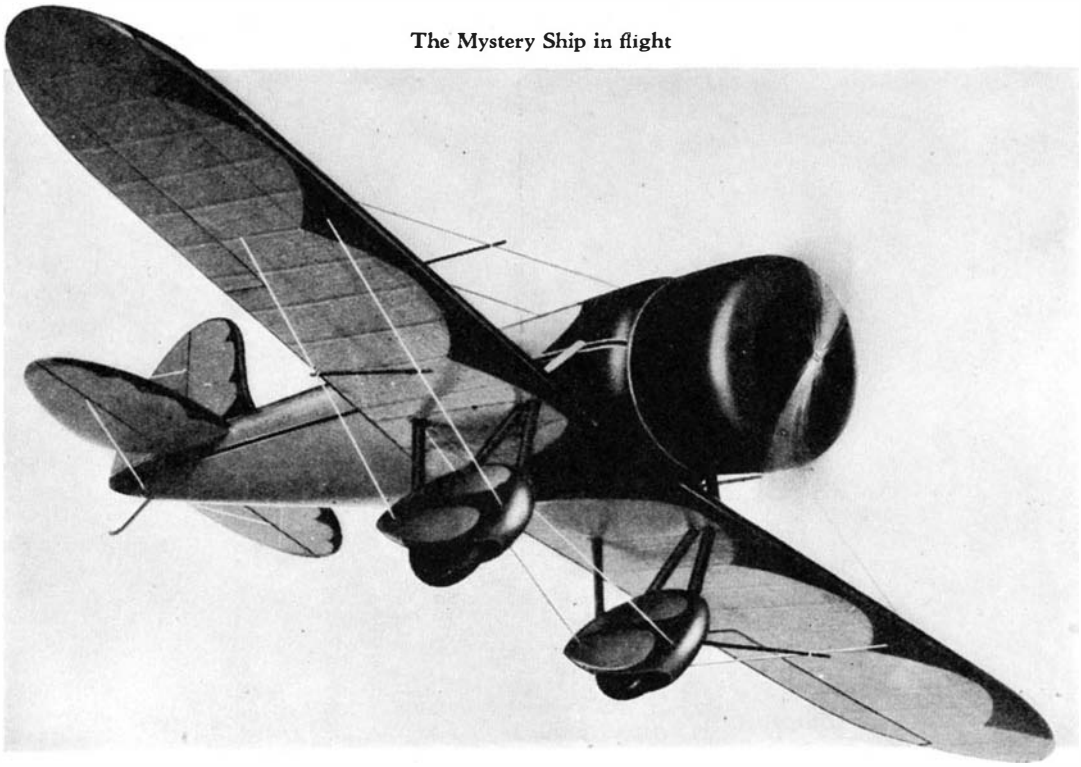
℄ If the apparatus is ready in time Professor Einstein may co-operate with Professor Michelson on the vacuum experiment. The origin of the Einstein theory itself was one of Michelson's experiments.—*The Editor.*

The Mystery Ship in flight



THE "MYSTERY SHIP" REVEALED

The Fastest Commercial Plane Yet Flown, It Has Out-Performed the Best Planes of the Army and Navy

WHAT is there about the "Mystery" airplane which has made it such a good subject for newspaper copy since it made its first public appearance at the National Air Races of 1929 at Cleveland, piloted by Douglas Davis of Atlanta, Georgia? At that time it was clocked at 228 miles per hour on one lap of a closed course race. Since then in Mystery Ships Lieutenant James H. Doolittle, former army ace, has given some impressive demonstrations, Captain Frank M. Hawks has made a number of records which are detailed later on, and Mrs. Florence Lowe Barnes is setting new world records for women, proving how easily this type of ship can be handled and flown by women as well as men.

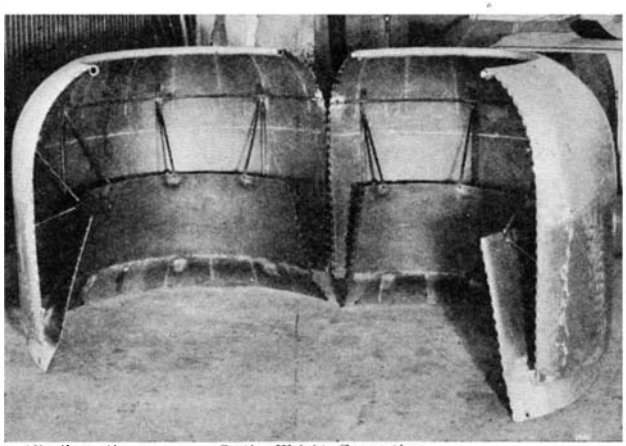
It is now possible to lift the veil of secrecy which has been so carefully wrapped around this plane. The details of its construction are as interesting to the layman as they are of importance to aviation engineers.

To a certain extent airplanes have become conventional in outer appearance. The man in the street is apt to say that all airplanes look alike and it is quite true that all airplanes look alike in that they have the same constituent parts and general arrangements which do not vary widely. The main difference between one airplane and another arises from the greater skill with which aerodynamical, structural, and power-plant elements are combined and in the degree of refined engineering which is put into a design.

Outstanding developments in airplane design still appear from time to time but during the year of 1930 perhaps the most outstanding success was that established by the Travel Air Mystery Ship, which engineers and laymen alike can visualize readily from the accompanying photographs and drawings.

Since its first appearance this ship has defeated the best planes of the Army and Navy, this being the first time that such a performance has been accomplished by a purely commercial plane.

In a little more than a year, the Mystery Ship has not only held its title of being the fastest commercial plane in the air, but it has appeared in all parts of the country and has set up many records, of which one of the most important is the coast-to-coast record by Captain Frank M. Hawks. This flight was made from Glendale Airport, Los Angeles, to Valley Stream, New York, on August 13th, 1930, in an elapsed time of 12 hours, 25 minutes, and 3 seconds, only 11 hours and 40 minutes of which was in the air. Captain Hawks also flew from Boston to New



All illustrations courtesy Curtiss-Wright Corporation

The Venturi cowl is constructed in two sections, shown here opened. The braces and air-deflectors are welded

York on October 7th in 54 minutes 15 seconds; from Philadelphia to New York on Oct. 9th, in 20 minutes; and from Detroit to New York on Sept. 30th, in 2 hours and 41 minutes. Just recently his spectacular flight to Havana again has broken all records.

The Travel Air Low-Wing Model "R," the full designation of the Mystery Ship, has demonstrated that by the use of the supercharger with high compression and speed, the power of the airplane can be considerably boosted with very little additional weight and complication in the power plant. The Wright nine-cylinder 300 horsepower engine was made to develop, with the use of the supercharger, 400 horsepower at 2300 revolutions per minute.

At the front end of the engine will be noticed a so-called Venturi cowl. This had already been found by prior experiment to be a great aid in decreasing resistance and increasing speed.

TWO of the photographs show the Venturi cowl. Cowl, engine, and fuselage blend into one streamline shape, as can be seen from the drawings reproduced on page 98.

The steel tube engine-mount is detachable and carries the engine on a 1¼ by .083-inch ring. The main fuel tank, located in the fuselage, is made of .040-inch aluminum and is supported on the longerons. A five-gallon reserve tank is located behind the main tank and is connected to the main tank only by a wobble pump. The capacity of the main tank is 42 gallons and the feed to the engine is by gravity. One-half inch gas lines are used throughout the installation.

The Venturi cowling is made of .040-inch aluminum and has no cooling baffles between cylinders. The inner cowling is aluminum of the same thickness and extends back to the cockpit. An oil radiator is mounted in the wing stub and the cooling fins form the walkway. The fire wall is .040-inch aluminum and is located at the front fuselage bulkhead.

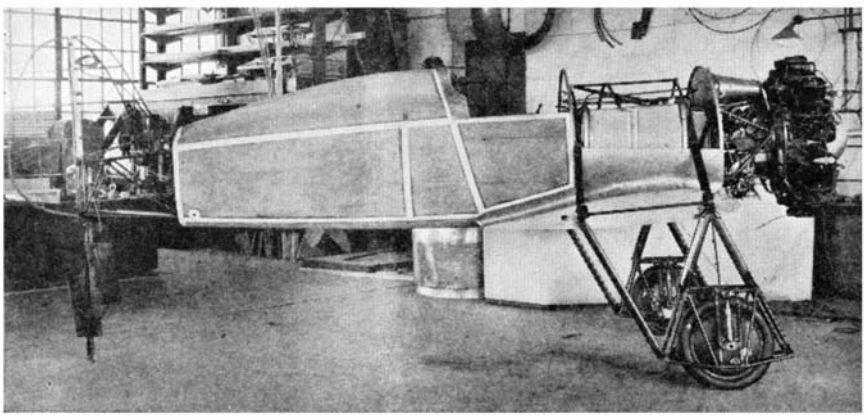
An eight-foot diameter Standard steel propeller is used, set at a pitch of 22.6 degrees.

The engine control bracket consisting of throttle, spark, and mixture is located at the pilot's left on the side of the cockpit.

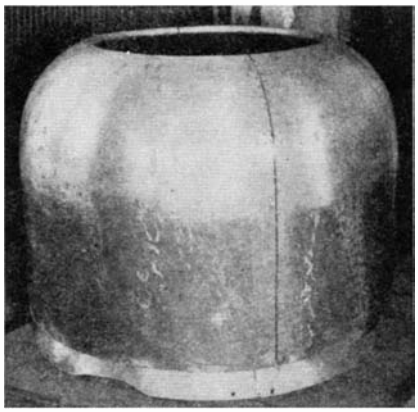
Another photograph shows the covering removed and the engine mounted on its rim. It gives a wonderful idea of the complexity of the installation and of the attention and care that has to be given the engine with its many accessories, controls, leads, and so on.

Specifications of the Mystery Ship

Length overall	20 ft. 2 in.
Height overall	7 ft. 9 in.
Airfoil (Wing Section)	R.A.F. 34
Span, each wing	29 ft. 2 in.
Chord, each wing	60 in.
Area of wings, total	125 sq. ft.
Area of ailerons	12.3 sq. ft.
Area of horizontal stabilizer	14.1 sq. ft.
Area of elevators	9.4 sq. ft.
Area of fin	4.1 sq. ft.
Area of rudder	5.7 sq. ft.
Weight empty	1475 lbs.
Disposable load	456 lbs.
Gross weight loaded	1940 lbs.
Power Plant	400 hp at 2300 rpm
Wing loading	15.5 lbs/sq. ft.
Power loading	4.6 lb/hp
High speed (full load, sea level, and in level flight)	235 mph
Cruising speed	150 mph at 1550 rpm
Landing speed	70 mph
Take off run (still air)	300 ft.
Climb at sea level	3200 ft. per min.
Service ceiling	30000 ft.
Absolute ceiling	31000 ft.
Gasoline consumption at cruising speed	13 gal/hr
Gasoline capacity (normal)	47 gal.
Range at cruising speed	525 miles
Endurance at cruising speed	3½ hours

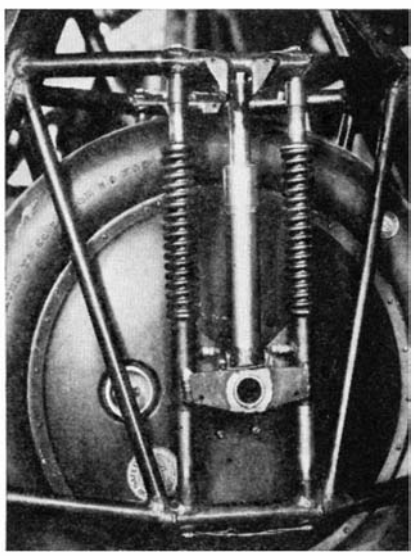


A view of a partially assembled Mystery Ship showing the uncovered landing gear and the N struts, as well as the method of mounting the motor on a ring



The Venturi cowl assembled

The landing gear is of unusual design. The shock absorbing device, in conformity with Travel Air practice, is a combination oil and coil-spring con-



A close-up view of the combination oil-and-spring shock-absorber unit

trivance. The oil cylinder is used to absorb the initial shock of landing and the spring is used to absorb the shocks of taxying. The method of mounting this shock absorber and of attaching the landing gear to the plane is also unusual. The wings are hinged to wing stubs which project out from the fuselage about 25 inches. The ends of these stubs extend to a point over the wheels. The wheels support the airplane by vertical "N" struts which attach to the ends of the wing stubs. The wheels are braced laterally by streamline wires running to the opposite wing stub. The external wing-bracing wires also are attached to the base of the "N" struts. The shock absorbing device, consisting of two oil cylinders and four coil-springs with the wheel slung between, is located at the

bottom of the "N" strut. The wheel and all the mechanism are enclosed in a streamline cover of .040-inch aluminum.

The extremely short tail skid is fitted with a shoe and is streamlined. An oil-and-spring shock absorber is fitted to the upper end of the tail skid beam which is hinged to the lower member of a bulkhead. The thrust line makes an angle of 13 degrees with the horizontal when the tail skid is on the ground.

The wing is one of constant center of pressure, the center of gravity being set far forward at 24 percent of the chord so as to give maximum stability. The gas tank is located exactly on this center of gravity and as the gasoline constitutes nearly all the variable load, the trim of the ship is constant.

Tapered in plan form and thickness from the wire point out, the airfoil section is R. A. F. No. 34. Its maximum ratio of lift to drag is 20.6 and the bracing is by streamline wires to the landing gear and to the cabane which is concealed under the cowling. Spruce and Haskelite three-ply one sixteenth inch mahogany plywood are used in constructing the plywood-covered wing, and the spars are built up of two spruce beams glued together and not routed. Fittings are all enclosed and are of chrome molybdenum steel. The compression ribs are built of spruce trussing boxed with plywood webs, nailed and glued in place on spars with angle blocks. The normal ribs are spruce trussed and have mahogany plywood gussets. Tie rods form the drag bracing in addition to the plywood covering which makes the wing extremely rigid. The leading edge is covered with two-inch tape to keep the plywood from breaking out over the bend. The trailing edge is of spruce. The ailerons are attached to a false spar by three inset hinges.

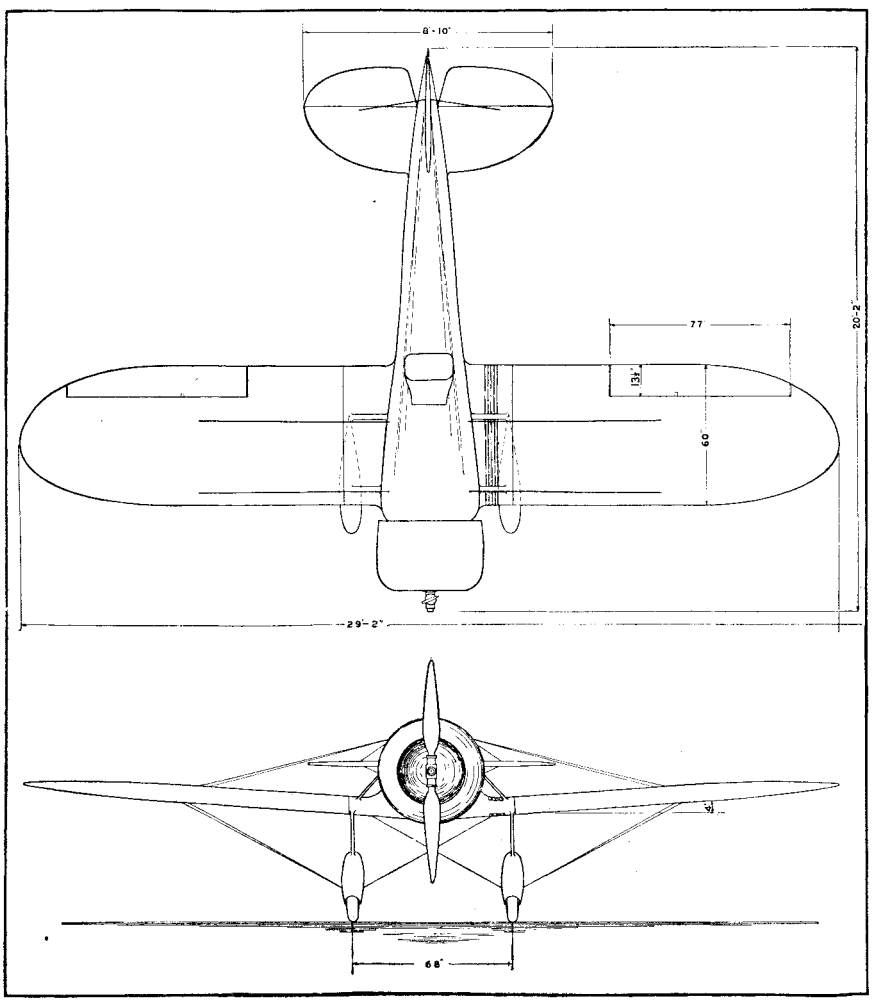
The welded steel tube used entirely in the fuselage is wedge-shaped to provide ample room and yet to be as economical of frontal area as possible, and is faired out to a well-rounded cross-section. The fairing and turtle deck are of spruce superstructure covered with mahogany plywood one sixteenth inch thick. The structure is tube braced throughout, and the longerons are made of 7/8 by .035 and 1 by .049-inch chrome molybdenum steel.

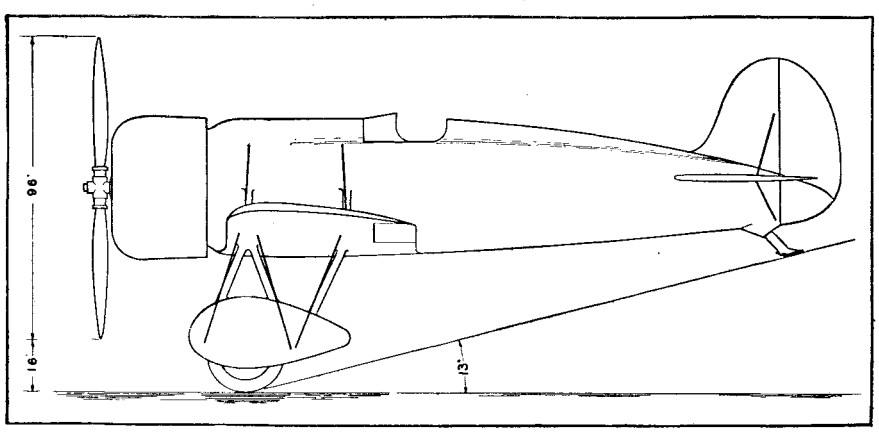
Ailerons are fabric-covered chrome molybdenum steel construction while the stabilizer is built of steel tube spars and stamped steel ribs. Elevator, fin, and rudder are of similar construction and all are fabric covered. The steel torque tube is operated by a differential push-and-pull tube system, and cable control is used for both rudder and elevators. The stabilizer is adjustable in the air and the fin is adjustable on the ground, while the elevator control linkage gives a differential action.

ANOTHER outstanding feature of this design is the very low power loading of only 4.6 pounds per horsepower. In the average automobile, the power loading is more likely to be something like 30 or 40 pounds per horsepower.

To get the speed and maneuverability very high load factors are compared: If the wing is at high angle of incidence, the airplane can stand 12 times its normal weight before breaking up. In a nose dive it can stand over four times its normal weight and in inverted flight it has the same factor. The horizontal control surfaces can withstand a load of 50 pounds per square foot and the vertical control surfaces can withstand a load of 37.5 pounds per square foot by actual test.

After considering all these engineering refinements one well may wonder wherein lies the value of building these exceptionally fast and high powered airplanes. The answer is that fast, record-making machines are the precursors of the fast commercial airplane of the future; they are test units for development of the science of aeronautics, just as the laboratory is the battleground of industry.





Dimensions and external details of a Mystery Ship

THE BABY OF THEM ALL

As trim and complete as a large car

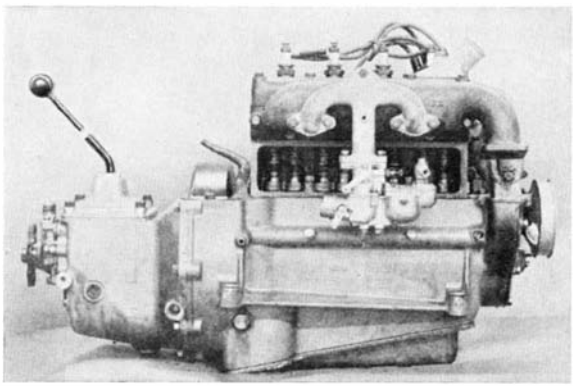
SHORTLY after the war the British Government, seeking new sources of revenue, placed a tax of one pound per rated horsepower on motor cars. British manufacturers naturally turned toward small motors, particularly motors with a low rating. The Austin 7 was the outcome of this trend so far as the Austin Company was concerned.

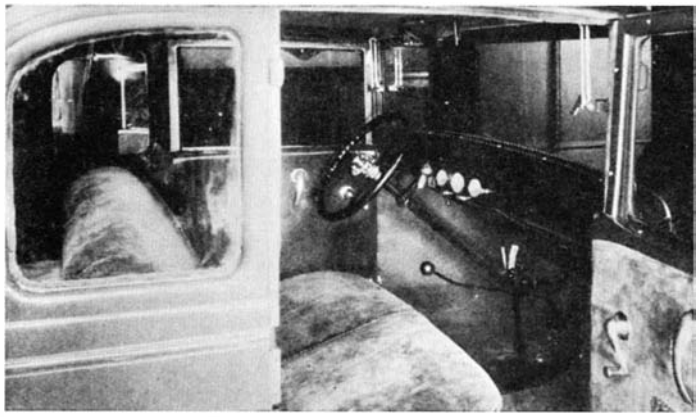
It is claimed that Sir Herbert Austin was the first of the British manufacturers to produce a car of this small size which would perform satisfactorily. Because of the success it has met with in the British Empire, America was considered to be a large potential market and accordingly, in 1930, the American Austin Car Company, Inc., was organized with a factory at Butler, Pennsylvania. Essentially the same as its British parent, the American "Austin Bantam" presents a redesigned, more graceful body, and is equipped with certain American parts.

The Austin Bantam has the remarkably short wheelbase of 63 inches, and its total weight is 1100 pounds. It has a four-cylinder, water-cooled, detachable L-head, seven horsepower engine with a 2.2-inch bore and a 3-inch stroke. Other specifications are: Autolite Bendix-drive starter; Autolite lighting and ignition; single plate clutch; transmission, three speeds forward and one reverse; four-wheel, internal expanding, equalized, and easily adjustable brakes; semi-floating rear axle, and torque tube drive, ratio 5.25 to 1; semi-elliptic transverse springs in front; two quarter-elliptic springs in rear; disk wheels; and drop center, demountable rims. Its oil capacity is five pints and the gasoline tank holds five gallons.

Its low relative center of gravity gives to the Austin great stability

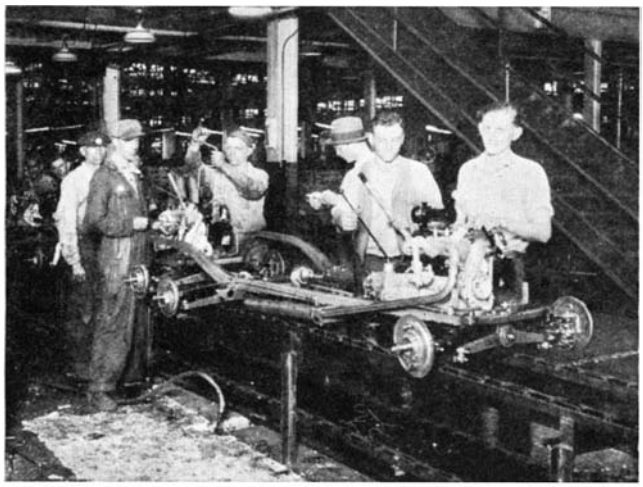
Fuel economy of the Austin Bantam is, without doubt, better than with any other car produced in this country, 40 to 45 miles to the gallon of gasoline being the usual figure.



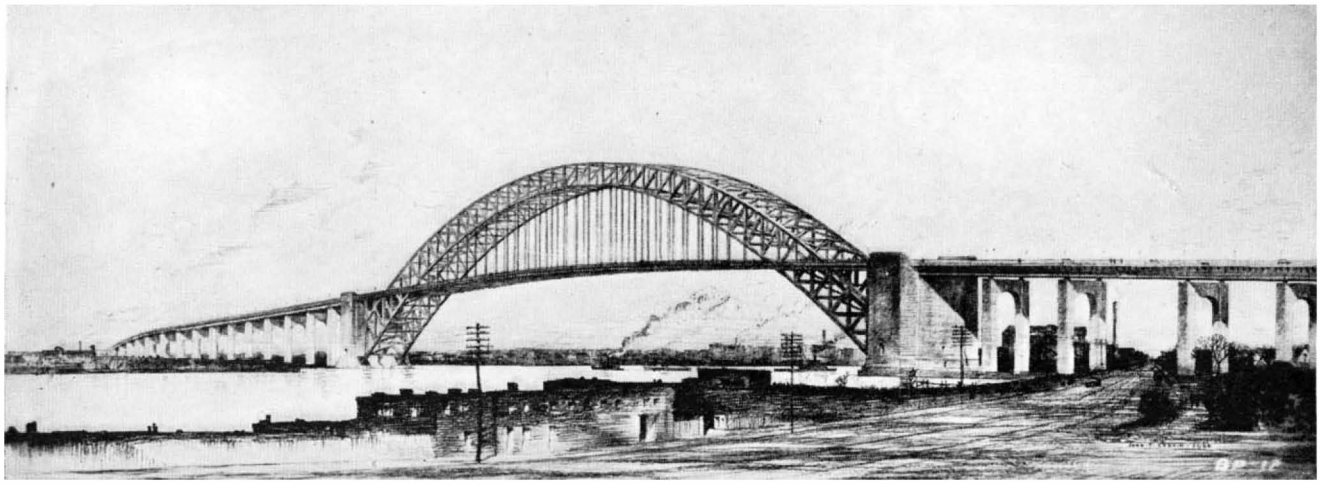


At the left is shown the compact engine which is rated at seven horsepower. Above is an interior view of the car showing the large luggage space behind the seat, and plenty of leg room

In the factory the tiny engines are assembled on a conveyor table which carries them to the general assembly



As the chassis is conveyed along the general assembly line, the motors are fitted and other parts of the car are attached



Beauty in every line. An artist's drawing of the Kill van Kull Bridge

BRIDGING THE KILL VAN KULL

By JOHN F. GALVIN
Chairman, The Port of New York Authority

IN September, 1928, ground was broken for a bridge over the waters of the Kill van Kull between Bayonne, New Jersey, and Port Richmond, Staten Island. A little more than two years later, on October 9, 1930, the great steel arch of this interstate span was joined at the center and the structure became the largest arch bridge in the world.

The arch crossing at Sydney, Australia, which is now in course of completion also, held the distinction and led all others in size for the brief space of two months. The Kill van Kull bridge surpasses the Sydney bridge by a few feet. The span should be at the service of the motoring public early in 1932.

The bridging of the Kill van Kull both for rapid transit and vehicular purposes was contemplated for a generation before it was possible actually to undertake the project. Creation of the Port Authority by treaty between the states of New York and New Jersey, with the approval of Congress, provided the means by which it was finally possible to finance and construct the crossing. The Port Authority is the agency through which the two states co-operate in developing interstate transportation links.

The Legislatures of 1925 and 1926 instructed the Port Authority to inquire into the merits and financial feasibility of uniting the Bayonne peninsula with Staten Island. A report submitted in 1927 contained a series of recommendations which met with approval and led to the passage of supplemental legislation specifically authorizing the Port Authority to proceed with the project.

Following the preparation of preliminary plans and their approval by the War Department in 1927, a 12,000,000-dollar bridge bond issue was sold by the Port Authority on advantageous terms. The two states of New York and New Jersey previously had agreed to advance 2,000,000 dollars each. This money will be repaid with interest out of the bridge revenues and completes the total estimated expense of 16,000,000 dollars. As with all Port Authority undertakings, the Kill van Kull bridge must be self-supporting and tolls, therefore, will be collected from bridge patrons.

An arm of the arch span reaches out to meet the other half way

A careful survey of traffic requirements was one of the most important phases of the preliminary studies made by the Port Authority. It was found that largely as a result of other transportation improvements, including indirect influences such as the Holland Tunnel and the new Hudson River Bridge, as well as the two Arthur Kill bridges between Staten Island and New Jersey and the proposed tunnel between Staten Island and Brooklyn, that the building of a Kill van Kull link was a vital necessity if the traffic problems of the region were to be successfully solved.

THE inquiry into the traffic situation led to an agreement on plans for a four lane roadway 40 feet in width. This, it was felt, would meet the necessities of vehicular traffic for the next 20 or 25 years. At the same time, a decision was reached to provide for a subsequent addition of two lanes.

The need of rapid transit facilities over the Kill van Kull also was investigated. Although such facilities might be extensively patronized by commuters and others traveling between Manhattan and Staten Island by way of the Bayonne peninsula, it was felt that the revenue would be insufficient for some years to come to warrant the extra expense.

It was decided, however, after consultation with the Suburban Transit Engineering Board to build a bridge big enough and strong enough to permit the laying of two rapid transit tracks

in some future year, if the latter form of service should then be preferred to an increase in the number of vehicular roadways.

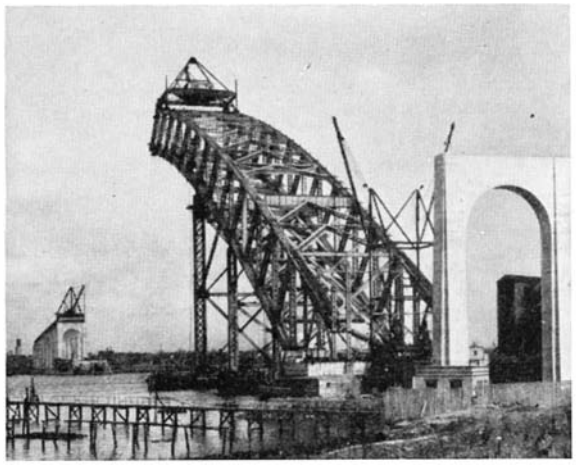
In fixing the exact location of the bridge, the determining factors were the economy of approaches. Topographically, there was little to choose between various available sites. The final plans called for a skew span of greater length than a right-angle crossing. The former fits well into the scheme of highway connections on each side of the river.

The waterborne traffic passing under the bridge was almost as important a consideration as the study of the vehicular traffic that will pass over the bridge. The Kill van Kull is noted for the volume and value of its shipping. It is the main gateway to Newark Bay and the Arthur Kill, and transports an annual tonnage greater than that passing through the Suez Canal.

THE stream is about 1200 feet wide between pierhead lines with a 35-foot channel running close to the Staten Island side; the bridge will have a clear height of 150 feet over the channel with an entirely clear waterway between pierhead lines.

Before selecting the arch design, comprehensive studies were made of other types. The arch design was chosen for both esthetic and economic reasons. It was felt that the arch design was particularly well adapted to the background of the Kill van Kull region. Similarly, the presence of bedrock near the surface, affording a solid foundation to resist the arch thrust, was favorable to the arch design at this location.

The bridge structure is flanked on each side by approaches consisting of steel plate girder spans supported on concrete piers. The Port Richmond approach is approximately 2900 feet in length and the Bayonne approach approximately 3700 feet, making the total length of the structure from plaza to plaza approximately a mile and two thirds. The roadway profile consists principally of straight 4 percent grades, with connecting vertical curves at the ends, and with a hyperbolical curve over the arch structure.



The arch was erected by cantilevering from each side. Above is shown the Staten Island section

The arch abutments are designed to present a massive appearance for architectural reasons, but are of solid masonry only for sufficient height to support the arch shoes. The upper portions are hollow structures of comparatively inexpensive concrete construction with granite facing.

The arch span itself is a parabolic two-hinged steel arch. The bottom chord is the principal arch member, and, at the abutments, supports the entire arch thrust. It is composed entirely of carbon-manganese steel, and has a cross-sectional area of 980 square inches at the abutments, and 580 square inches at the crown.

The hinges are formed by pins 16 inches in diameter, bearing upon heavy steel forgings which insure uniform bearing over the supporting structural steel webs. The arch shoes upon which the lower pin bearings are erected are of riveted structural steel. Each shoe is 10 feet high, 15 by 18 feet at the base, and weighs about 120 tons.

Each of the forged pin bearings weighs about 60 tons. The top chords of the trusses are of silicon steel. The web members of the trusses, and the bracing between the trusses are of carbon steel.

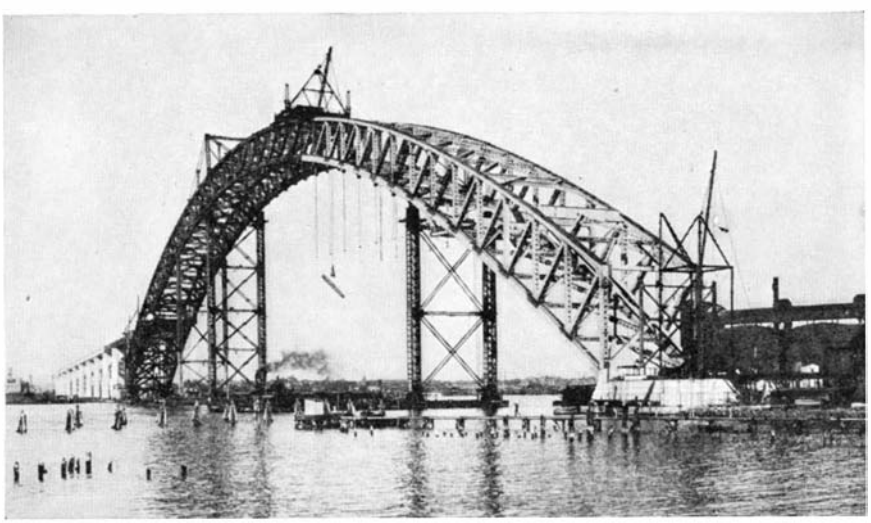
The arch was erected by cantilevering from each side to the connecting point over the channel. Temporary steel piers or bents, made up largely of material which will be used later for the bridge deck and the approaches, supported the arch trusses at certain points as the erection proceeded. Four such bents were used for the south arm and six for the north arm of the arch.

Hydraulic jacks, installed on alternate bents, raised the arch from the preceding bent and then lowered it to full bearing on the succeeding bent, as erection proceeded, each bent being wholly unloaded as soon as erection had advanced to the succeeding bent. Each jack had a capacity of more than 3500 tons. The south arm of the arch was erected to the connecting point over the channel before erection of the north arm was commenced.

THE approach piers are of reinforced concrete, varying in height from 20 to 110 feet above the surface of the ground. The lower piers consist, in general, of two independent hollow shafts. The higher piers consist of two hollow shafts connected at the top by an arch. The principal reinforcement is a structural steel frame, composed of angles with bolted connections, embedded in each pier.

These structural frames furnished means for holding the forms in place as well as forming rigid reinforcement for the concrete. In addition to the frames, "surface reinforcement" by steel rods was used near the exterior surfaces.

Because of the great size of this bridge, and in order to check the theoretical stress investigations, it was considered advisable to construct a test model of the arch span and subject it to loading simulating that which will come upon the completed bridge. The model was constructed with all the arch members made of engravers' brass, a material of very uniform quality. It was built to a scale of 1/16 inch to a foot, making a convenient length of about nine feet for the arch model.



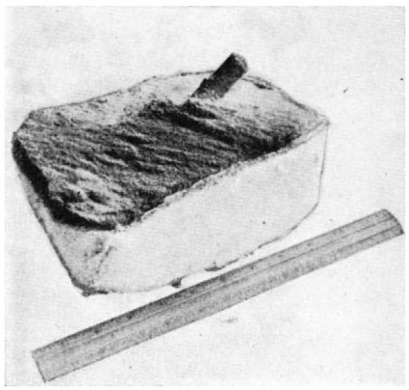
The great steel arch is joined in the center to form the longest arch span in the world. On this side may be seen one of the great girders of the floor support

MORE EVIDENCE OF THE "FOLSOM CULTURE" RACE

By HAROLD J. COOK

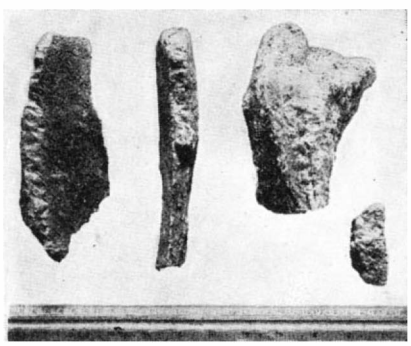
READERS of the SCIENTIFIC AMERICAN may recall an article which appeared in the number for July, 1928, describing an important discovery of skilfully made arrow points of a new type called "Folsom Culture" points, in association with skeletons of a large prehistoric species of bison, near Folsom in the northeastern corner of New Mexico. Since that date much work has been done both in that locality and also in surrounding and adjoining territory, in an attempt to learn more about the remarkable race which was responsible for these evidences, a race which must have antedated the cliff dwellers and pueblo builders and other American Indians, yet was far more skilled than they in the art of flint chipping—skilled to a degree barely equalled by the finest Neolithic flint workers of ancient Egypt and Norway.

Above: **Mr. Perry Anderson, co-discoverer of the site, pointing with his cane to the flint point mentioned in the article.** *Below:* **The point in its original block (note sand-blasted surface) encased in burlap and plaster cinches**



A joint expedition of the Colorado Museum of Natural History (Denver) and the American Museum of Natural History (New York) has completed excavations started two years previously by the Colorado Museum, with the result that 17 of these skilfully made arrow points were recovered in the same layer associated with the skeletons of more than 30 individuals of the extinct *Bison taylori*, an animal one third larger than the existing modern bison. There is some difference of opinion as to whether these peculiarly shaped points, characterized by a long concave flake taken out lengthwise from both sides and a back end with "rabbit ears," in reality were arrow points, dart ("atlatl") points, or spear points, but in any case their general purpose was the same.

SOME time ago Dr. A. E. Jenks, head of the Department of Anthropology at Minnesota University, Minneapolis, examined a new location in Yuma County, northeastern Colorado, which had been found and reported by Messrs. Perry and Harold Anderson of Yuma, Colorado. Professor Jenks reported to the writer evidences of apparent geological antiquity for the occurrence of certain remarkable pieces of flint chipping, apparently found in association with fossil bison and fossil mammoth bone, some of which he turned over to the writer for identification, urging that we examine the place immediately. Press of other matters, however, prevented this until 1929, when the writer, with Mr. Nelson Vaughan of the Museum staff as an assistant, visited the locality.

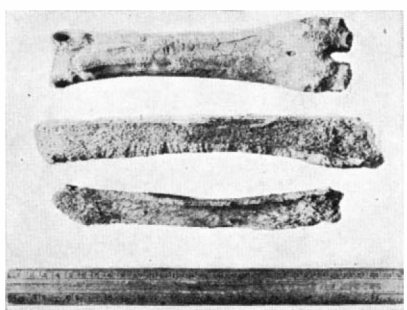


Above: **Broken fossil mammoth bones showing cutting and abrasion marks made when the bones were "green".** *Right:* **Fossil bison bones bearing artificial abrasion marks and cuts along their faces**

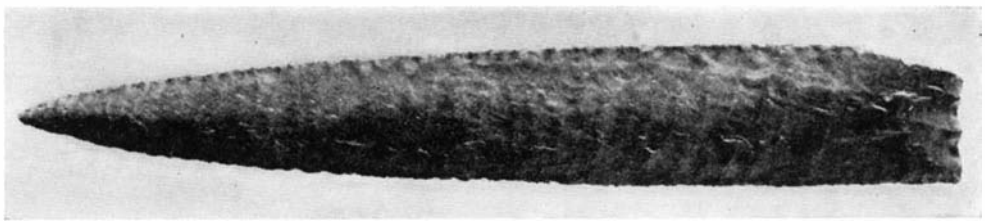
Here the Messrs. Anderson offered us every kindness and all possible aid, taking us to the site of their several discoveries and showing us their large and interesting collections. They deserve great credit for recognizing and bringing to light on their own initiative and at their own expense important new evidence, and working on it at every possible opportunity. The discovery of these artifacts adds another strong link to the chain of accumulating evidence that ancient man lived in America, and throws new light on the antiquity of the "Folsom Culture" described in the former article.

The region is one of the last in which a trained collector would expect to locate such evidence. Situated on the higher part of the watershed between stream valleys of northeastern Colorado, the surface of the area is mostly shifting dune sands, and high, dry, sod-covered grass lands, far from water. No natural exposures of rocks or other old formations are to be seen, a most unpromising combination of conditions. However, a few years ago during a land boom most of the area was homesteaded and many plots of ground were plowed up, varying in size from a few to many acres in extent.

WHERE the plow destroyed the natural grass sod, the prevailing strong winds quickly started the process of removing the light sandy soil, forming "blow-outs" as large as each plowed field. These field-sized pits were deepened by the wind until they reached the deeper formations, exposing these over large areas. Excavation to secure road surfacing materials further deepened a few spots, and exposed a still deeper and more complete section. The deepest beds exposed here are heavy deposits of coarse sands and granitic gravels, evidently old flood plain deposits, and probably of Pleistocene (ice) age, made at a time when the wide plains of



eastern Colorado still were being built up, and before erosion initiated the present drainage system of valleys. Undoubtedly this was coincident with one of the exceedingly wet cycles which occurred intermittently as a result of the melting of the great ice sheets nearby.

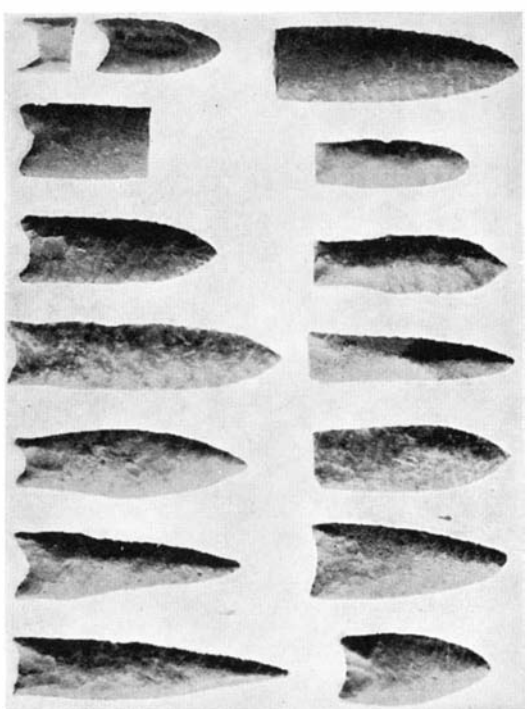


One of the finest pieces of stone chipping found in America. The Andersons found several points of this remarkably refined, delicate type in these old beds. Reproduced at natural size

These gravels are many feet in depth and of unknown thickness. On top of and in contact with them is a greyish colored bed a few feet thick, containing an abundance of silt and lime, fossil bones, shells, and human artifacts. This bed evidently represents the final stages of the flood plain deposits, when the climate turned more dry, and sluggish pools were formed and existed for a time. Then the region dried up, and a prairie soil and sod was formed, a little above the greyish bed. On this were deposited wind-blown sands, and this in turn had been nearly all sodded over in still more recent times, due to a temporarily increased rainfall, previous to the advent of the plow.

From all this it readily will be seen that the grey bed or level containing fossils and artifacts has much antiquity. Not enough study has been done here as yet to date the deposits accurately, but preliminary work indicates a late Pleistocene date, and at the latest, not more recent than immediately post-Pleistocene; that is, in the time immediately following the recession of the last great ice sheet from the north.

In the first blow-out to which the Andersons took us we found scattered fossil bones and flint chippings in the partly eroded surface of the old grey bed. In the second hole, good fortune smiled on us and I had the rare good luck to find, in position and undisturbed, half buried and half exposed by erosion in this grey bed, a large and splendidly wrought flint point. This was first photographed in place just as the wind "sand blasts" had half excavated it. Then it was taken up intact in a block of the matrix, for permanent exhibition in the Colorado Museum of Natural History, in Denver.



Fifteen chalcedony, jasper, flint and quartzite points found by the Andersons at the Colorado site, showing some of the diversity of types in the ancient silt bed. At the upper left are typical Folsom points and the others are modifications of this form. Reproduced at about one third natural size. The Folsom type of workmanship is distinctly finer than the other types found in America. Especially after handling them one derives the impression that they must have been made by "specialists" as skillful as any civilized toolmakers

Further good luck attended us here. A few yards to one side in this bed a fossil bison bone also was found, half buried and half exposed by the cutting of wind-driven sands. This bone shows numerous marks of the type so characteristic of bones used as flaking tools by early races of men. It almost surely was used as such a tool. A short distance away on the other side, a number of broken bones of a mammoth which had previously been located by the Andersons, were found in the same bed. A close examination of these disclosed many cutting and grooving marks, so identical with those found on other bones both in America and in prehistoric sites of Europe that it is apparent they are of similar origin. As far as the writer is aware this appears to be the first mammoth bone found in this country showing evidence of human implements or weapons having left their marks on the green bone. After making a study of the bones and the marks and cuts they bear, Dr. E. B. Renaud, anthropologist of the University of Denver, and the writer are of the opinion that these mammoth bones were used as chipping and flaking tools by the people who were contemporary with them.

Several windblown holes in the same region were visited and mammoth bones were found in place in seven of them. At one spot a good portion of a scattered skeleton of very large size was found in the strata, so placed as to preclude the possibility that it had been intrusively or "secondarily" washed into the grey bed along with human artifacts at some later date. Mammoth bones and fossil bison bones from the grey bed are in the same state of fossilization in several of these blow-outs within an area of a few square miles and show the same type of cutting and tooling marks.

NOW we come to an important point. In nearly all of these sites, very well made Folsom type points are found; also numbers of other equally well worked points. The latter either are modifications of the typical Folsom points, or are made with the same skill and technique, and of the same materials, but in a few other distinctive forms. In many of these a series of very fine chips had been taken off parallel to one another, running from one edge completely over to the other, and often diagonally. These forms lack the usual longitudinal chipped-out groove, or have it only in modified patterns. The Andersons have found well over 100 of such flint points at these sites, and some of them are as deeply patinated as many of the Old Stone Age implements of Europe.

Besides the mammoth, two species of bison have been found. One of these appears to be identical with the *Bison taylori*, found with the original Folsom artifacts in New Mexico, and the second is a smaller species, nearly the size of the modern bison. This evidence appears to tie up the two areas as being nearly contemporaneous, and helps to date the original Folsom discovery.

Technical studies on the fresh water molluscs made by Dr. Junius Henderson of Colorado University at Boulder, Colorado, serve also to indicate Pleistocene or immediately post-Pleistocene antiquity for the beds in which the fossils and artifacts occur.

THE LIFE AND DEATH RATE OF CARS

By R. W. RIIS

MORE than 1600 makes of motor cars have been offered to the public in a little more than 30 years. Fewer than 50 of these have survived. Mortality among them has been great.

Why this surprising death rate? Why this great parade of models and makes and companies to the junk heap? What has been the cause? These questions were put to a motor-car manufacturer who has survived, carried on through good years and lean ones, who has never given up; and this was his reply:

"Some of them no doubt passed out of existence because of poor merchandising methods—but probably not many. The majority of these dead cars have gone to the motor-car graveyard because of a poorly designed product. Every automobile manufacturer can tell stories of millions of dollars lost due to some error of design which, with proper tests, would never have occurred."

What can a manufacturer do to guard against this? How can he keep out of the red ink? What wizardry must be accomplished if a company is to be one of the few survivors rather than one of the many who have died?

There is a very famous law called the law of trial and error. If any product, especially a mechanical product, makes good, stands the gaff, comes through—then with proper business management and wise selling and distribution it has a chance to succeed. On the other hand, if it fails . . . . .

No industry in all the world has proved this more strikingly or graphically than the automobile industry. Simple errors resulting in mechanical weakness have cost millions in a single year. Theories that have looked good on paper but wouldn't work out on the roads have wiped out cars and companies, brought bankruptcy and ruin.

In the beginning all companies built their cars on theory, coupled with the best available known practice. The car was run up a hill or two and down again, and if it worked it went out to the user. The user was the tester. If the car failed, he told his friends and neighbors. If enough cars failed, the maker went defunct.

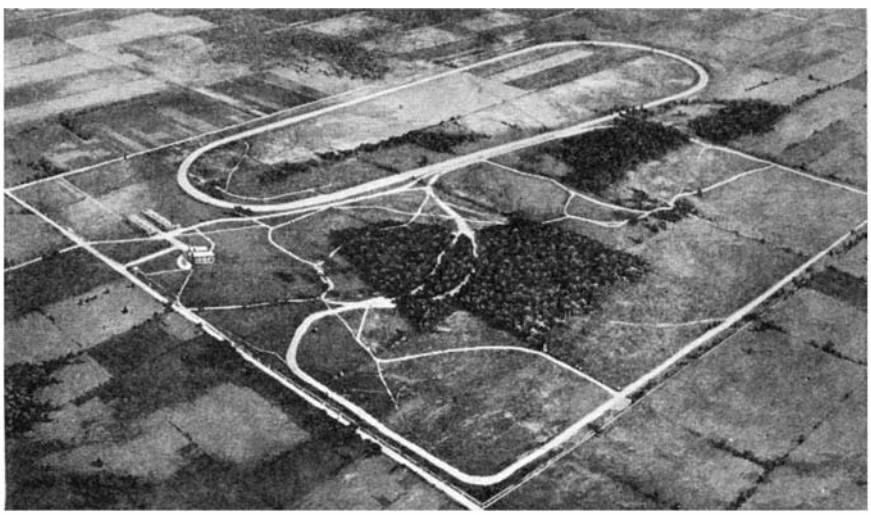
Finally it became evident that there must be a quicker, better way. It dawned in the mind of the manufacturer that he must develop a serum, so to speak, a vaccine. And so, slowly at first, grew up the testing field.

Such a field is the Studebaker proving ground at South Bend, Indiana. It covers 800 acres and represents an investment of 1,000,000 dollars. It has been operating over a period of years, developing a rugged product, has proved its worth, and has paid dividends.

Visit this testing ground and you are likely to find fierce action. It may be your good fortune to witness a "wall test." If you do, this will be the picture:

Their noses against a strong masonry wall, a row of cars stand lined up. You will find many makes of cars, competing lines, selling in the same price class. With clutch out, each engine is started. The operator shoves the accelerator to the floor-board. The engine roars.

Suddenly he lets the clutch in—with a bang. The car surges against the wall. The engine screams, whines, and dies.



Left: **Studebaker's million-dollar proving ground as seen from the air**

Lower left: **The "bath-tub test" to discover any ignition system faults**

Below: **A turn in such ground tests the stamina of the car and its parts**

The operation is repeated again and again. It is a heart-breaking, inhuman test. Nothing could survive it very long.

Fourteen times one car stands the test. Then a grinding and crashing of metal. The clutch gives way. The experiment is repeated with the next car. Twenty-three times and the transmission smashes. Another goes farther. Forty-seven times it has been sent into that wall, wrenching, lurching, groaning, and then!—With a crash, bits of broken steel and iron and a flood of fire and hot oil literally strew the concrete under the car. This ruin is complete. Down the line the engineers go. Some cars collapse quickly. Others battle stubbornly.

Finally a car "takes it" a hundred times. Tires on the drive wheels are sizzling hot, burned and blistered, worn to the cord. But the car stands up and is ready for more.

Trained engineers then gather up the pieces, label them, take the cars to the laboratory—those that have fought bravely and those that failed. They tear them down, examine them minutely with microscopes and micrometer, measure and weigh the parts—and so they learn. They learn lots of things for the good of the balance sheet; they find the weakness and strength of their cars, and all competing cars, that they may not sell failures in Poison Spider, Wyoming, in Rio de Janeiro, or in Calcutta.

"We took six carbureters, of as many makes, under advisement and test," says one of the engineers. "We have built, on this testing ground, roads of concrete, macadam, gravel, and dirt. We drove cars with these carbureters 40,000 miles over all these roads.

"A new type of shackle was needed. We tried a number of types. Two of these types stood up under murderous tests on our testing field for more than 50,000 miles, and then broke down. The ball-bearing spring shackle we adopted stood up for 177,000 miles without failure."

Cars have been driven 1,750,000 miles in a single year in proving grounds. Deep ruts cut diagonally across roads, and a body of water gives the bath-tub test which is primarily to prove ignition parts. Cars are driven into this pool of muddy water at high speed. Besides proving the ignition system, it puts the chassis-lubrication system and the brakes to severe test.

So severe are some of the jolt tests that drivers, with grim humor, have complained of having to pick up loose ribs, digits, and vertebrae off the floor boards and take them home in a bundle for sorting at night. It isn't all fun and companies continuously change test drivers. The cars usually outlast the men.

Then there are other tests less trying on man-power. There are fatigue tests for metal, for example, which may be carried on in inside laboratories where another 1,000,000 dollars is invested. Here springs are bumped and metals pounded and thumped and bent mechanically.

"For example," testifies the laboratory expert, "a fan belt will ordinarily run 3000 revolutions per minute in service. We speed it up to 4000 and get the answer quicker. All the destroying forces of nature are simulated and intensified by our 'weatherometer.' It produces the effect of heat, intense sunlight, and rain. We use it in testing the weathering qualities of lacquers, top materials, and so forth.

"Then there is another thing, called a 'Stroborama,' a rather magical device which has the faculty of 'stopping' swiftly moving parts. It was invented in Belgium and uses a Neon tube. It acts like a slow-motion picture enabling us to watch high-speed machinery as if it were standing still.

"About four years ago, we launched an aggressive program in our engineering department. We decided to build an outstanding type of performance in our cars. To do it we went directly to the laboratory and the proving ground. We ran laboratory tests at 40 degrees below zero and 120 degrees above. And when we were done there, we sent cars into the mountains, into deserts, and tried them out in speed contests on tracks at Culver City, California, and Atlantic City, New Jersey.

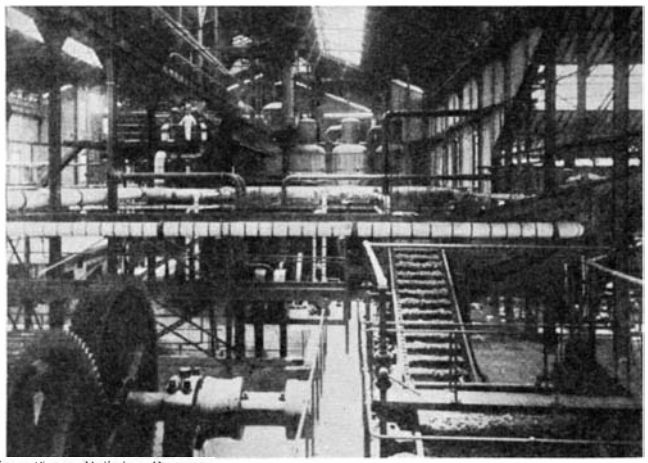
"REPRESENTATIVES of the American Automobile Association came to the plant, picked stock cars out of the assembly line, took them away, inspected them to make sure that they were in no way specially prepared or 'pepped up' mechanically. Then these stock cars were driven 10,000, 20,000, and 30,000 miles, at speeds averaging faster than a mile a minute, to new world's records."

It is difficult to trace the good a proving ground does. It is like a systematic audit every few months because it prevents trouble. It is like an insurance policy in that it protects the stockholders' dividends. It stands on guard against the bugaboo of red ink. And what is perhaps most important of all is:

There's another man's balance sheet that a well-equipped, wisely used proving field protects. That is the balance sheet of the buyer, the user of the car. To the user, the manufacturer's proving ground means lower upkeep and longer and better performance.

The mechanism which determines the turning radius of a car as it is tested

One of the many testing devices: the accelerometer mounted on a seat cushion records on a moving tape the riding qualities of a car on all sorts of roads



All photographs courtesy American Sugar Refining Company

Queer looking locomotives bring the cane to the island factory where the cane is crushed and raw sugar is made

Inside the plantation factory. The crushed sugar cane is carried from one level to another on a conveyor at right

FROM SUGAR CANE TO CRYSTAL CUBE

By ALBERT A. HOPKINS

HARDLY any substance we use has a more interesting life-history than a so-called "lump" of sugar—the word "cube" is perhaps more dignified and descriptive. When you drop the cubes into your coffee the life-history is ended. Sugar is the child of science and care, born in the hot maze of the plantation factory and given an education and a character at the refinery where it is pushed and pulled from building to building and from floor to floor during the cycle of manufacture. Before we start in Cuba and end at the towering buildings on our own waterfront, let us glance at some of the economic phases of the sugar industry.

Cutting cane between December and May. It is then brought to the *centrale* or factory

You will probably be surprised to know that at present we have in the United States an excess of refining capacity of one half over actual requirements or say 2,500,000 tons annually. What is the matter with sugar? Nothing except the war's aftermath and perhaps too much sugar legislation. From 1915 to 1928 there were 94 sugar bills introduced in Congress!

In 1929 the American Sugar Refining Company refined 1,257,842 tons of raw sugar at a profit of $8,166,361.47 or about a quarter of a cent a pound. What is needed is increased consumption and a halt in the growth of production. This will result in a slow recovery of the industry.

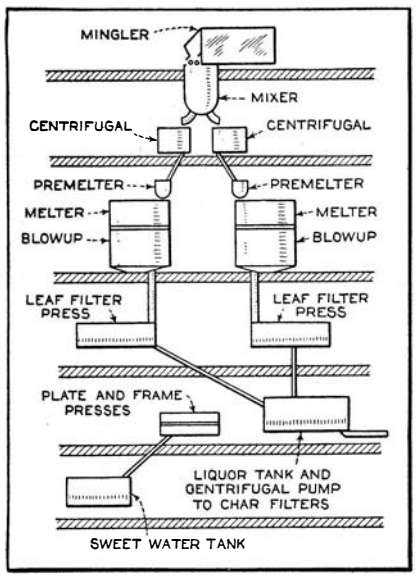
At the outbreak of the World War in 1914 about one third of the normal sugar supply of the world became locked within the battle lines of Europe. England could no longer secure her needs from Germany and Austria and turned to Cuba and Java for replacement. All the allied countries, and the United States later, restricted the consumption of sugar during the war. After its end in 1918, these restrictions were removed and consumers in all countries made a wild dash for sugar. In the United States in 1920, prices went to over 25 cents a pound. Such price levels attracted hidden stocks from all parts of the world and prices collapsed faster than they advanced.

Porto Rican, Hawaiian, and Philippine sugars enter the continental United States free of duty, and together with Louisiana cane sugar and western states beet sugars, now supply over half the yearly needs of the United States. Cuba produces far more than the remaining half. These normally supply all of our requirements. Cuba has found great difficulty in finding a market elsewhere for the surplus sugar that she cannot sell to the United States.

In describing the production and refining of cane sugar let us take Cuba as a source of supply. The cane is cut from January first to May first, and is transported on standard railways from

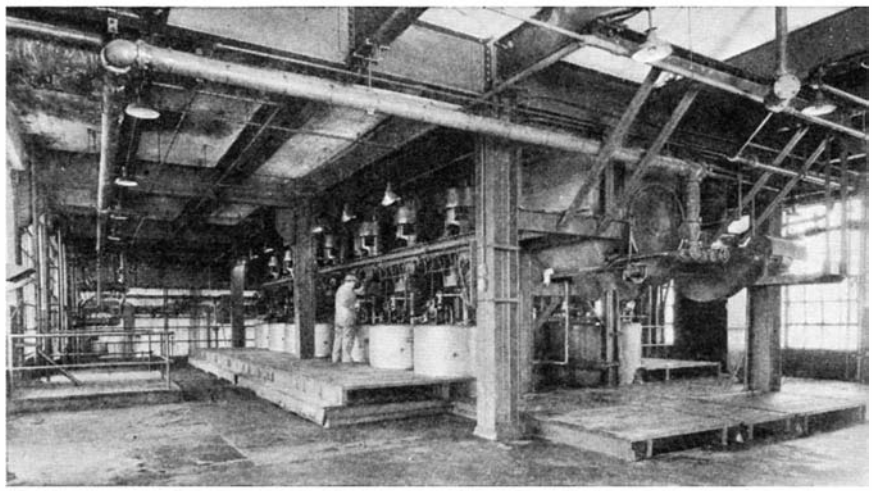
Storing the raw sugar in bags at the warehouse. The many storage bins are of enormous capacity

the cane fields to the *centrale* or plantation mill where it is crushed under many tons of pressure to extract the juice. The cane refuse, *bagasse*, is used as fuel. The thin liquid or juice is treated with lime to neutralize the acids present, and, after being heated and clarified, is thickened in an evaporator and then boiled in a vacuum pan until the sugar crystallizes. Finally, the mother liquor is driven off in a revolving centrifugal machine and the moist raw sugar is bagged and shipped to the refinery in the United States.



Sugar refining, like other major industries, is availing itself of the advances in present-day science. Methods of production have greatly improved. Step by step the laborious methods of the past have been replaced by mechanical processes which have eliminated waste and reduced costs. Even with the greatly increased expense of labor, fuel, and materials following the war, the present cost of production compares favorably with 1914.

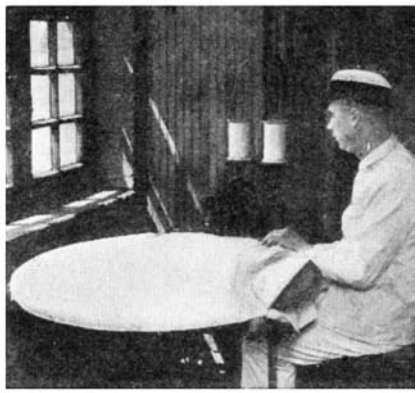
The important steps in the process of cane sugar refining are as follows: Landing, storing, and dumping the raw sugar; washing the raw sugar; dissolving the raw sugar; clarifying the raw sugar solution by filtration through cloth; purifying and decolorizing the raw sugar solution by filtration through boneblack; boiling the char-filtered liquor to produce refined granulated sugar; spinning and washing the refined granulated sugar; drying and screening the refined sugar; packing, warehousing, and shipping the refined sugar.



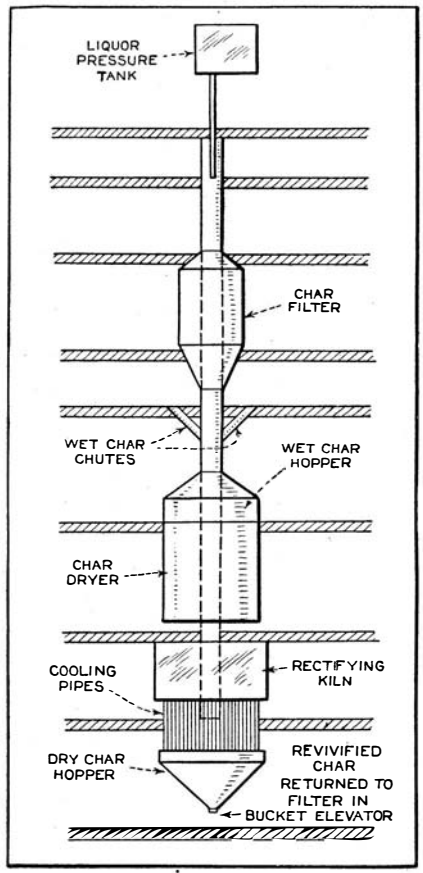
Above: **Raw sugar is mixed with syrup which is removed by a centrifugal. The washed sugar is then melted and the impurities are removed.** *Left:* **Diagram showing "wash house" processes which are carried on in various stories**

The first steps in the operation of a refinery are unloading and storing the bags of raw sugar. The bin capacity is enormous, a refinery using from two to five million pounds of raw sugar per day.

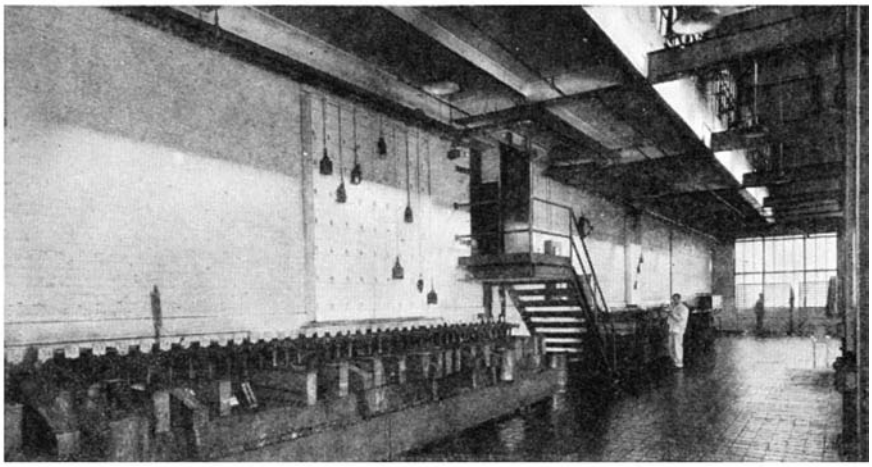
The first refining step is washing the raw sugar to remove the partially dried syrup adhering to the crystals, the process being carried out in what is usually termed the "wash house." Raw sugar from the storage bins is transferred to the top of the wash house by conveyors and elevators. Here a "scroll," or "ming-



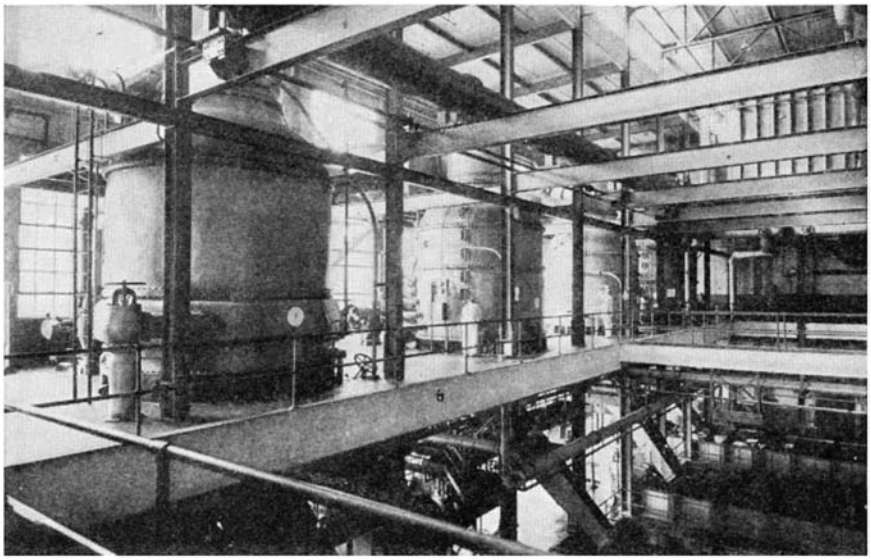
The refinery "seamstress" is sewing cloth on the leaf of a filter press



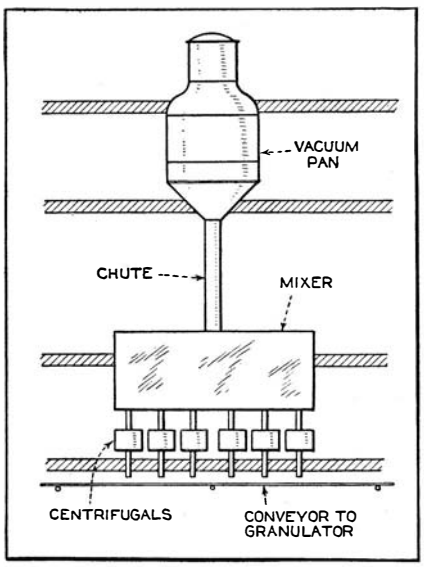
The char filters extend through several stories of the "filter house"



At the central station for clarified sugar liquors the color and strength are tested. The liquor has been passed through the granular boneblack in the char filters



Above: **The vacuum pans boil the sugar liquor to crystallization under vacuum.** *Right:* **"Pan house" showing the relation to the centrifugals**



ler," thoroughly mixes the sugar with a small quantity of syrup obtained from a previous washing to form a pasty mass, termed "magma," which is run into a large tank of special form, called a "mixer." This tank is equipped with a slowly revolving stirrer to keep the sugar crystals in suspension. From the bottom of the mixer the magma is fed to the centrifugal machines through large slice valves.

The "sugar boiler" is taking a test sample without loosing the vacuum

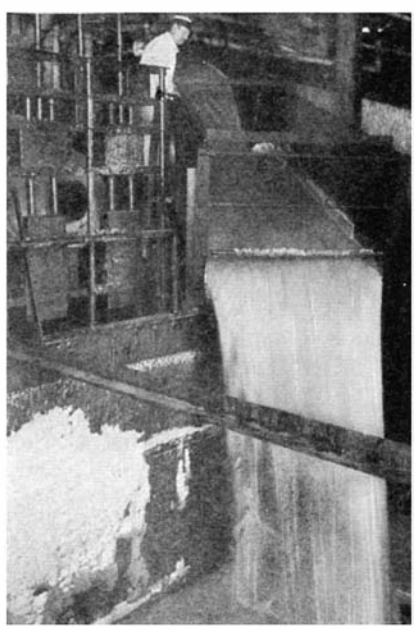
The modern raw sugar centrifugal machine is cylindrical in shape, either 40 or 48 inches in diameter, direct electric drive, self-discharging, and has a perforated vertical side wall. The bottom of the cylindrical basket ends in a funnel, above which is a large disk fastened to the center shaft and revolving with the machine. The centrifugal is charged while running at slow speed, the magma from the slice valve falling onto the disk and being thrown off against the wall of the basket to build up a uniform layer, about six inches in thickness, against the vertical wall. After charging is complete, the machine is run at the full speed of about 1000 revolutions per minute.

When the syrup, which was mixed with the sugar and which acted simply as a carrier, has been spun off through the perforations of the side wall, the sugar is washed with water by means of a special spraying device. Finally the brake is applied and the machine is slowed down to the point where the sugar wall breaks, the loose sugar falling out through the funnel at the bottom and into the scroll which conveys it to the melter. The complete cycle of operations takes about 3½ minutes, and the centrifugal machine discharges from 550 to 750 pounds of washed sugar. The washed sugar, although of 99 percent purity, must go through many refining operations in order to remove this one percent of impurities, and produce the high grade product demanded. After mixing with water to form a solution containing about 64 percent solids, it is ready to continue on through the process.

The next step is the removal of the suspended impurities. The raw liquor is heated in what are called the "blowups" to about 180 degrees Fahrenheit, made neutral or slightly alkaline by the addition of milk of lime, and to it is added an inert filtering medium, known as diatomaceous earth. The liquor is agitated to keep the filtering medium in suspension and is then passed through leaf filters at a pressure as high as 60 pounds per square inch. A cake, composed of a mixture of diatomaceous earth and the suspended matter, such as fiber, gums, and so on from the raw sugar, is built up on the surface of the leaf while the clear filtrate passes through and out of the press.

THE next step in the process is the removal of the soluble impurities, largely organic coloring and mineral matters by passing the clarified liquor through granular boneblack. This material is held in large cylinders, of about 1200 cubic feet capacity, called "char filters." The liquor after being filtered through the boneblack is clear, sparkling and colorless, and is now ready to go to the vacuum pans where crystallization occurs. The char is washed, heated in kilns, and used over and over again.

The vacuum pans are large copper or cast-iron containers, from 12 to 16 feet in diameter, heated by copper steam coils, which boil the liquor under vacuum at a temperature ranging from 120 to 180 degrees Fahrenheit, depend-

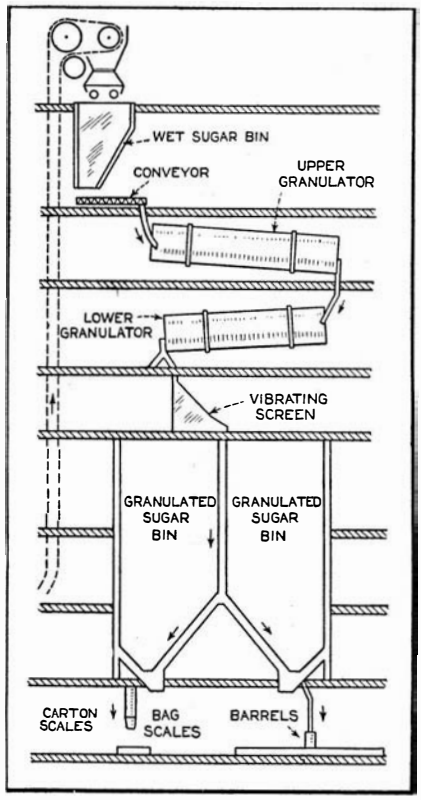


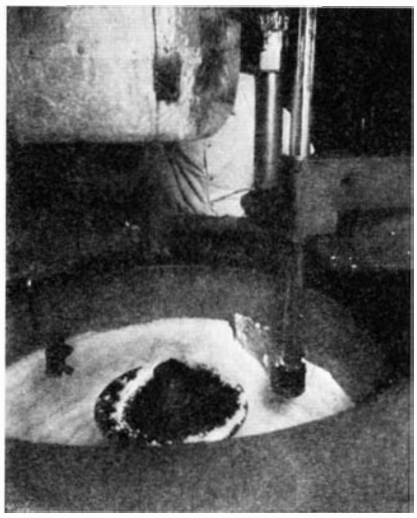
Vacuum pan discharging the sugar into the mixer above centrifugals

ing upon the kind of sugar desired. By this boiling the crystals are formed and the progress of the operation is determined by withdrawing from time to time a small quantity of the contents of the pan without breaking the vacuum, by means of a "proof-stick" or plunger which deposits the sample on a small glass plate to be viewed by transmitted light. When inspection of sample shows crystals to be of the desired size, the steam is turned off, the vacuum broken, and the pan emptied, the contents running into mixers similar to those used in the wash house.

FROM the mixers the warm mass goes to the refined sugar centrifugals which are direct driven, but not self-discharging. After spinning and washing off the mother liquor, the remaining crystals are discharged by means of a mechanical unloader, which is a flat plow fixed to a vertical shaft. While the centrifugal is rotating slowly the plow deflects the sugar from the side wall through an outlet at the bottom. From the centrifugal machines, conveyors carry the moist crystals to the drying apparatus.

Drying is the final step in the refining process, the drying apparatus, called "granulators," being horizontal revolving drums, about 30 feet long and six feet in diameter, set at a slight pitch so that the material introduced at one end will travel slowly to the other. "Baffle plates" or shelves on the inside pick up the sugar and allow it to fall in a shower, a current of heated air being drawn through the drum to carry off the moisture.



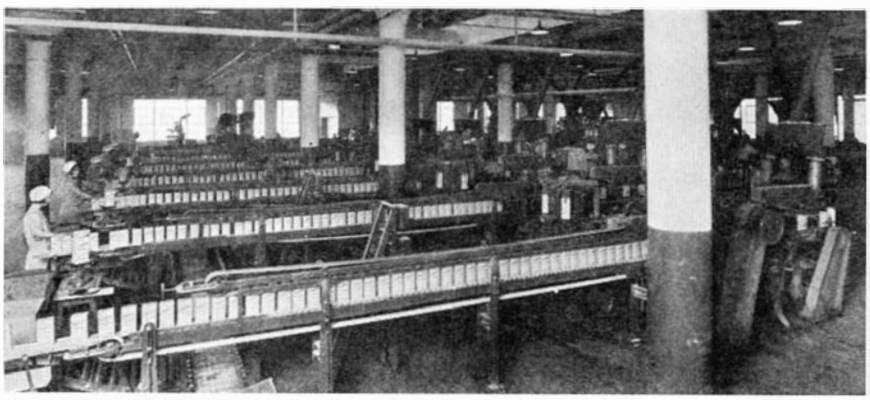


The refined sugar is removed from the centrifugal by means of a plow

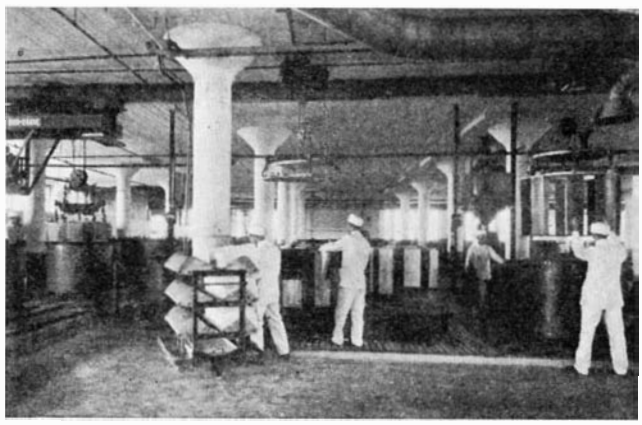
The dried product is then screened and finally conveyed to bins from which it is packed for the market either in bulk bags and barrels, or in small packages for home consumption.

Cube sugars or pressed tablets are made by molding the moist granulated sugar into the desired shape by a special machine. The moist cubes are dried for several hours on plates in steam-heated ovens, after which they are ready for packing. The highest grade tablet sugar is made by a special and costly process. Liquor of the highest possible purity is boiled to grain at high temperature, the mass is run into molds which, when cool, are spun in centrifugals, the sugar being washed by a saturated, high grade, sugar liquor. The sugar is taken from the molds in the form of rectangular plates, 5/8 of an inch thick, which are dried in ovens. These plates are sawed into strips which are clipped by knives to form the brilliant, glittering tablets with the characteristic uneven surfaces. The superior quality and appearance of this sugar justifies the added cost of manufacture.

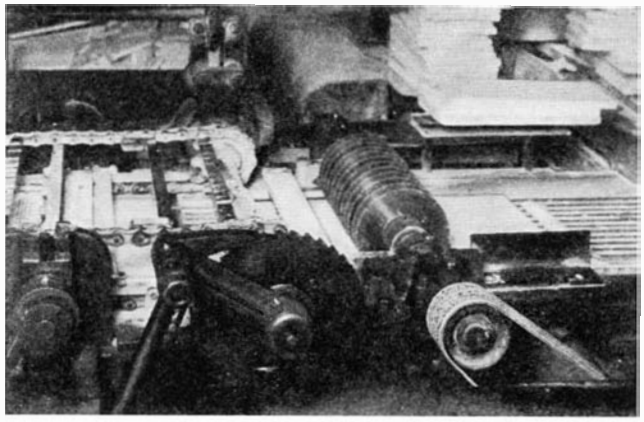
We are indebted to the American Sugar Refining Company for our photographs and for information relative to the technical processes of refining.



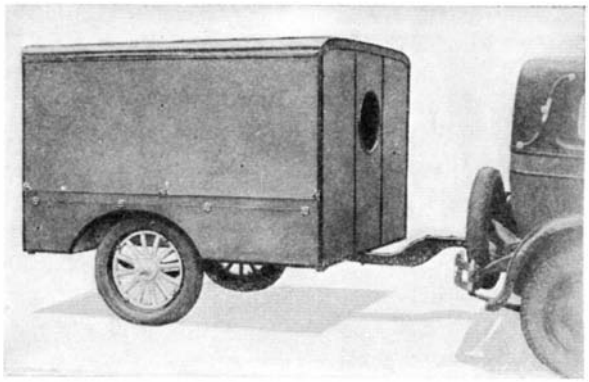
Above: **Packing the refined sugar in cartons by automatic machinery, preserving purity. The drawing shows the "finishing house" where sugar is dried and packed**

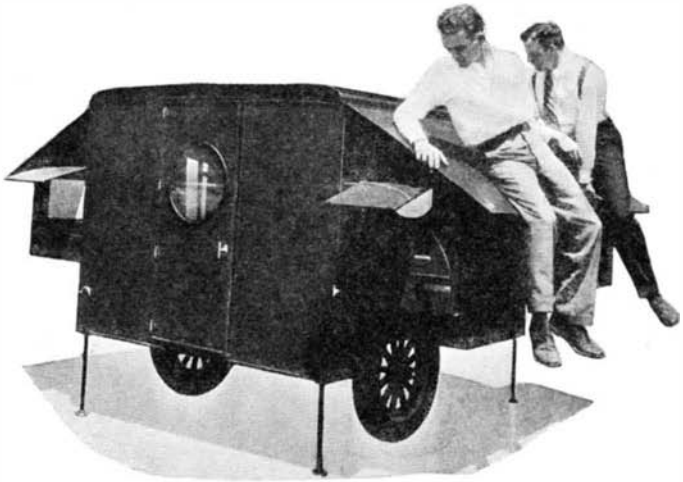


Running tablet sugar liquor into molds to produce rectangular plates which are dried, sawed, chipped, and packed

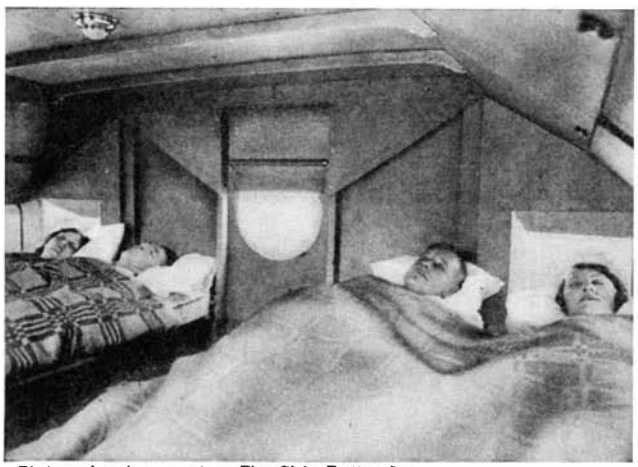


Circular saws cut up the plates of crystallized sugar into strips which are in turn chipped to size by keen knives



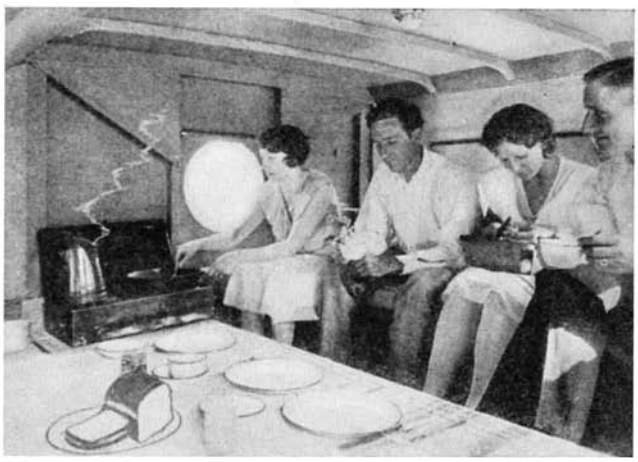


Above: Globe-Trotter ready for the road. *Right:* Same trailer ready for the night, with sides extended and ground supports in place. Men sitting on side show the great strength of this construction



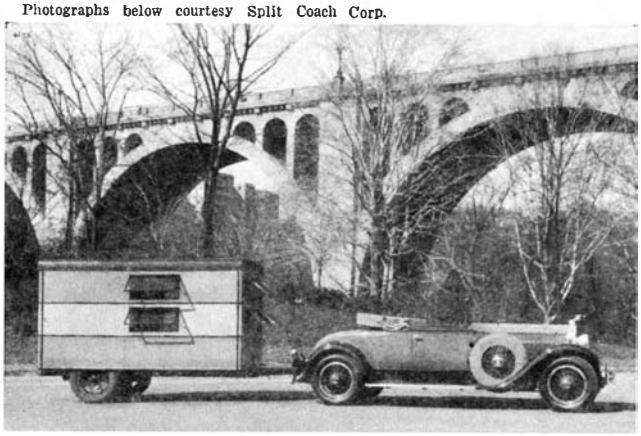
Photographs above courtesy The Globe-Trotter Inc.

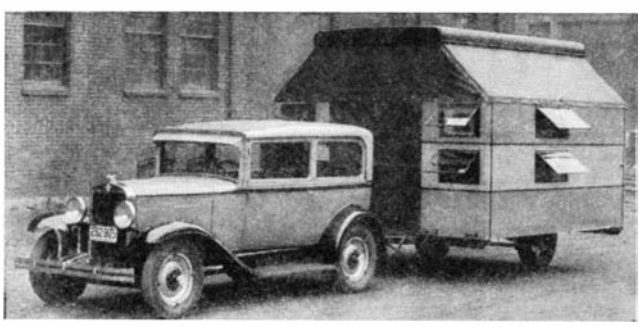
The interior of the above trailer with the two double berths occupied. A curtain may be hung down the center



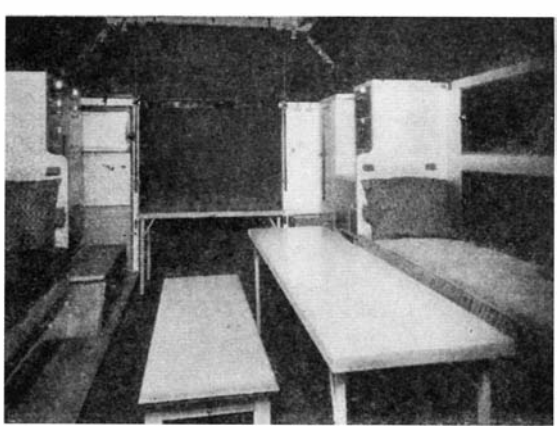
One of the double beds, folded, serves to seat four comfortably, while a meal is cooked and served opposite

Photographs below courtesy Split Coach Corp.



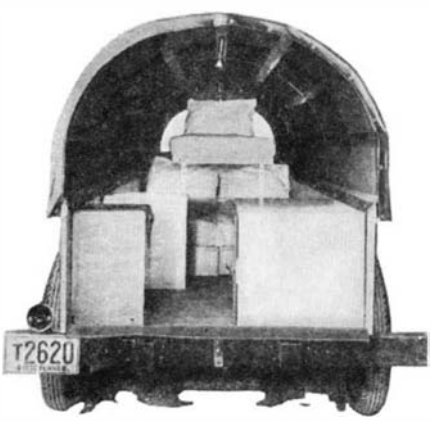


Left: A sport roadster with a Split Coach trailer. *Above:* A trailer of the same type with sides extended and roof raised to afford ample room. When the body is to be extended or the car uncoupled, tripods support the trailer



Left: Interior of the above trailer. When made up for the night, there are upper and lower berths on each side. Ample closet space is one feature of this model

Right: Another type of Split Coach trailer with a "caravan" top. This model, lower in price than others by the same company, may be as fully equipped with personal comforts as is desired



VACATIONING AWHEEL

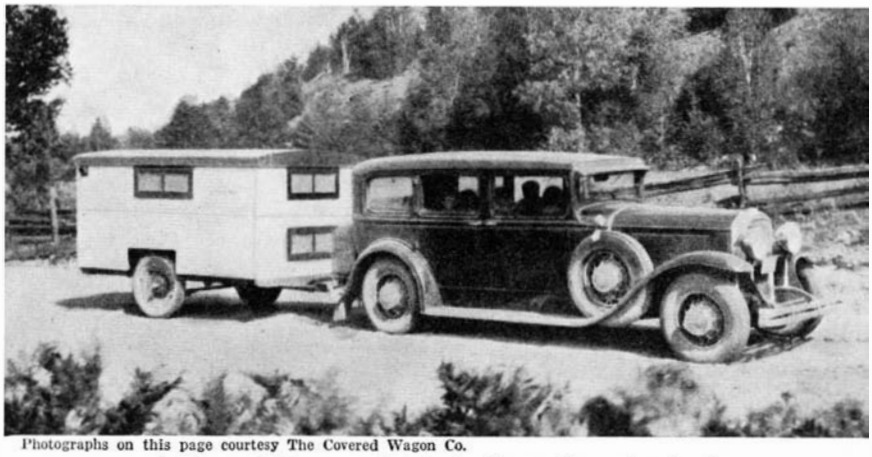
By A. P. PECK

THE coming of the motor car released the city- or town-bound adventurous spirit and enabled him to reach out-of-the-way places heretofore closed to him by the bars of distance. But even then he was bound by certain limitations imposed by the question of food and sleeping quarters unless he was hardy enough to withstand the rigors of a more or less primitive camp. Recently, however, there have appeared on the market, in increasing numbers, camping trailers that can be drawn by any motor car, small or large, and that provide in one unit all the comforts of home.

These trailers have been so designed and constructed that they follow the towing car faithfully and impose but little load on the car chassis. It is said that a properly designed trailer will decrease the top speed of the average car only four miles per hour. In backing and parking, the trailers are not found to present any great difficulty; it is only necessary to allow for the greater effective length of the car, and to remember not to make too sharp a turn. In fact the trailer illustrated at the bottom of the opposite page is equipped with two safety chains that prevent the trailer from assuming too sharp an angle with respect to the car.

From the trailers available we have selected three representative types. The one illustrated on this page has a solid body in which only the floor in the rear section, the kitchen, drops to afford ample head-room while working there. In the one shown at the top of the opposite page, the sides expand as shown to permit the making-up of double berths on each side. In the one at the bottom of the same page, the sides expand and the top rises. Thus more than enough room is had in all dimensions. On all models simple yet positive coupling devices connect trailer and car.

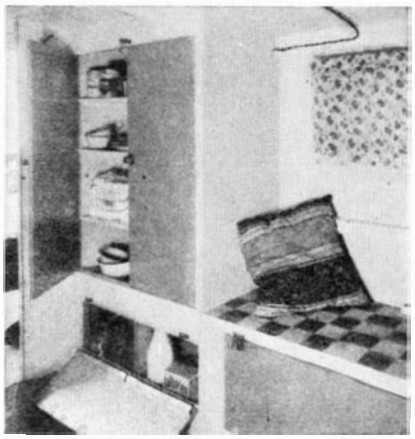
All of these trailers are equipped with electric lights, storage space for clothes, toilets, and facilities for cooking and washing.



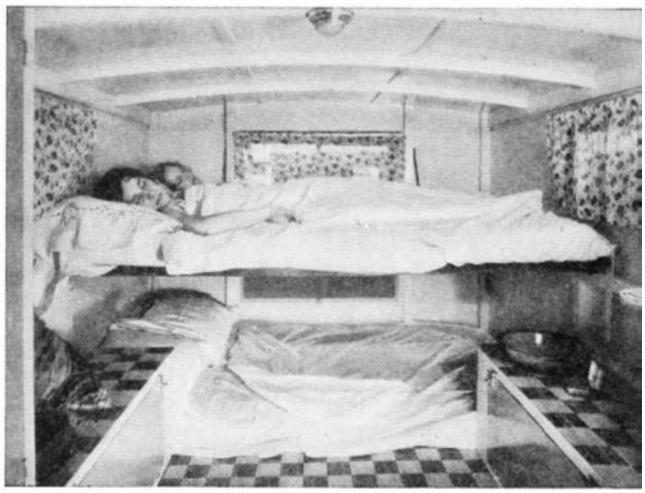
Photographs on this page courtesy The Covered Wagon Co.

A Covered Wagon trailer in the heart of vacation land

The kitchen with built-in gasoline stove. Note water cooler on shelf



Opposite the kitchen is the pantry with 25-pound capacity ice-box



Two double berths in sleeping car fashion can be quickly and easily made up. Storage space is under the side seats

Whiling away an evening or a rainy day is easy in this trailer. There is ample room to play cards or just lounge

The broom plays an important part in the Ford plant all day long in every section

THE BROOM IN INDUSTRY

By EDWIN P. NORWOOD

FOR some vague reason, never satisfactorily explained, there existed for years the belief that a factory could not operate without creating an endless amount of dirt. Moreover, falacious as this premise was, matters did not stop there. On the contrary, bad logic and unthinking management not only accepted the dirt, but to all outward appearances, actually harbored it. The three S's—smoke, soot, and smudge—were as constant as they were typical. Cobwebs consorted in every nook and corner. Litter was everywhere.

This condition fostered innumerable handicaps. To name but a few, the cluttered floors not only hampered the movements of men at their work but often caused mishaps. Space that might have been utilized for better purposes was tied up by piles of odds and ends seldom drawn upon and of scant value. Because of too few and rarely washed windows, shop interiors preserved a twilight gloom even on days when the sun shone brightest. Considering industry as a whole, there was incalculable waste—a waste of material, a waste of time, a waste of efficiency, a waste of light, and a waste of men. Furthermore, there was an inequality of product. Consistency of workmanship was not apt to be found in so haphazard a setting.

BUT, happily, the factory world moves. If there is truth in the old saying that one may judge a farmer's products merely by having a look at his fences, then one may now, and with equal assurance, estimate the quality of a factory's output by observing its windows.

For it has been amply demonstrated by those who have had the wisdom to make the try, that a clean shop produces better articles, more articles, and these at a much lower cost than one that is dirty, badly lighted, and littered with leavings. The rule works both ways. That is, the more attention given to orderliness and cleanliness, the greater the return. The less attention, the less return. Indeed, the expense of this phase of upkeep is insignificant when compared with the results directly traceable to it.

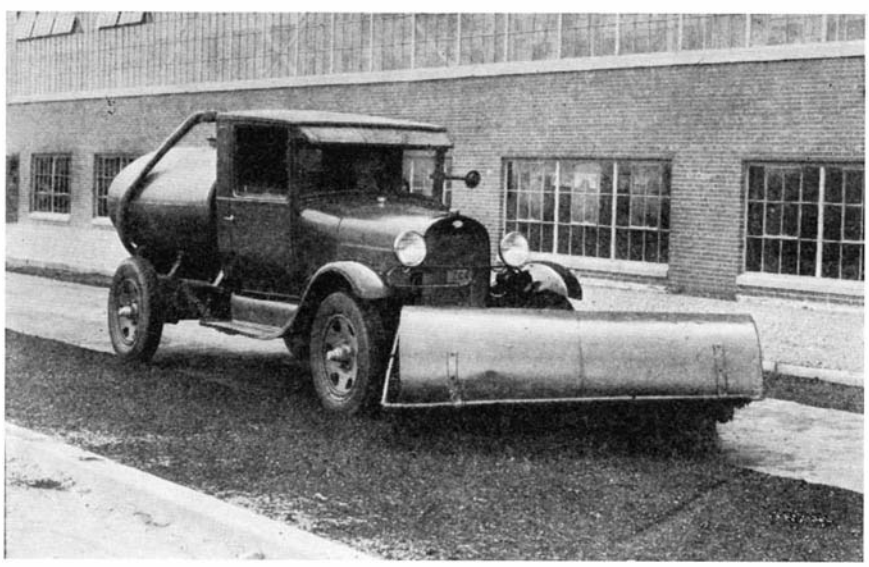
There is no one now engaged in the business of manufacturing who is more positive on this point than Henry Ford. He has the right to his convictions because he has proved the correctness of them. Several years ago he made this assertion:

"No shop can have morale without cleanliness. We tolerate makeshift cleanliness no more than makeshift methods."

At the time that statement was made something less than a thousand men were engaged in making this cleanliness apparent. Now more than 4900 are employed in what is called the "clean up department" at the Ford Motor Company's Rouge Plant, in Dearborn, Michigan. This force is engaged solely and continuously in the work of preserving buildings and accessories in a condition of cleanliness. It would appear that keeping things clean shows returns.

For the sake of designation, these men, according to the nature of their work, are called sweepers, window washers, painters, pick-up men, and so forth. None receives less than the Ford minimum wage of seven dollars for an eight-hour day, and they are given steady employment. Does that seem fairly high pay for, say, a man who does nothing but handle a broom? Assuming for a moment that it does, this is to be remembered: Though called by the names just listed, these men, as viewed from the Ford idea, are far more than mere cleaners. They are those who, by their constant attention to the job given them, increase the efficiency of those other men who work at machines. The work of the two is, to use a shop term, cast integral. They are of a piece. Otherwise we have a return to the old factory of uncertain output.

ASK any Ford shop foreman why his department benefits from cleanliness and he will not fumble the answer. In all probability he will enumerate some points that are entirely new to you. To begin with there is the importance of sunlight. Frequently washed windows admit the maximum. Good light serves many ends. It raises the visibility of all things in the shop, cuts down eye strain, reduces the chance of work being spoiled through insufficient lighting, and, to a large extent, prevents accidents. Also, it costs nothing to produce, excepting, of course, the means of giving it freedom of entrance. The



The plant's highways are never as littered as this; cinders were scattered here to show most effectively the operation of the special combination sprinkler-sweepers

shop that takes advantage of all the natural light that is available keeps down its electric light charges. Furthermore, sunlight shows up dirt.

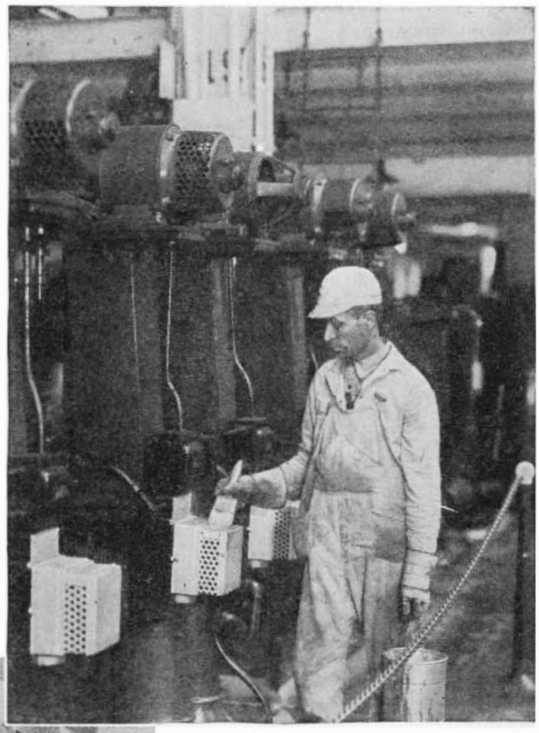
"It's the best inspector on the whole staff," one of the foremen declared. "Anybody knows that if there's one thing that a dirty wall or a dingy pocket can't stand, it's a straight shot of sunshine. What may pass as pretty fair in a dim light often looks mighty bad when you flood it with light through good clean windows."

There are plenty of windows in the Rouge Plant buildings to effect this flooding. If joined together they would total an area covering something like 330 acres. A great many of these transparent acres are washed as often as once a week. To give greater efficiency of penetration and to avoid splashing, the interior panes are cleaned with whitening. That was once the method employed on the outside. But the work was slow and took too many men from jobs equally important. So one day a long handled brush was rigged out and a small hose run to it up the side of the handle. The thing worked splendidly. Now a hollow handle of light weight metal has displaced the hose. A hose is still used but this is screwed on at the bottom. The window cleaners connect their implements to convenient taps and go to work.

AS sunlight in huge quantities is thus admitted, it is turned to proper account when it reaches the inside of the shops. Much thought has been given to that extremely important detail. To send the light downward, where it is most needed, the upper part of the walls, girders, and that portion of the ceiling not taken up by skylights, are painted in egg-shell white. Experiments demonstrated that this slightly glossy finish made an excellent reflector.

Other experiments decided that a dark blue, tinged with gray, was easiest upon the eyes of workers. Therefore all machine frames, housings, safety covers, and sheathings are painted what is termed "machine blue." For similar reasons, the walls to a point a little above what is ordinarily thought of as wainscoting height, are finished in a rather deep gray. Everywhere there is consistency in the colors used. Stock-bins, racks, and timekeepers' desks are always olive green. Railings are usually black. Stacks, and furnace and oven exteriors are coated with aluminum paint which resists discoloration from heat. But all fire appurtenances, such as alarm boxes and hydrants, are in red. This color likewise designates the location of first aid stations. Things needed quickly can be seen quickly.

Painting, like window washing, goes on continuously. The exterior parts of machinery are painted perhaps most frequently. This is not done by the cleaning squad men but by those within the respective departments. Every foreman is responsible not only for the condition but for the appearance of the machinery under his supervision. At any hour of the day he is privileged to send to a supply crib for paint. And he is instructed to make use of it whenever the slightest opportunity affords. In consequence the amount of "machine blue" applied at the Rouge Plant each month will exceed 5000 gallons. That is enough paint to give a single coat to a fifth that many medium-sized cottages. And while on the subject of quantities, almost 11,000 gallons of egg-shell white are used on interior walls and ceilings every month. That which this paint covers reflects a large amount of sunlight and so makes working conditions easier, work more efficient, the output greater, and the costs lower. Making every day paint-up day is sound economy.



One man may paint switch boxes; another, motors; still another, machine frames—paint is always being used somewhere in the plant

Windows are kept clean. The brushes have hollow handles to convey the water

Cement floors and concrete exteriors of buildings are treated with a paint specially prepared for this type of surface. Acid-resisting coats are used on all battery room floors, and fume-proof enamel is applied to the walls and ceilings. This type of paint extends to use in the laboratories.

So the washers of acres of windows let in the sunlight and the painters see that all which this sunlight examines is good to look upon. Between the coming and going of the painters the washing squad keeps the walls free of dirt and splatterings. However, there is little dirt. The scrubbers, and the sweepers that precede them, are too active to allow much of it to gather. First the floors are treated with a cleaning soda, then flushed with hot water, next scrubbed, then rinsed, and lastly, squeegeed. Two hundred mops and brooms are worn out in the Motors Building alone, every five days—from which it will be gathered that much "elbow-grease" is used in cleaning.

THAT the floors may be kept in a condition free for mopping, two other sets of men have particular jobs to perform. The pick-up crew keeps all floors clear of scrap material too large to be easily handled with brooms. They go about with small, light carts. That which they gather travels to the Rouge Plant salvaging department to be turned to various uses. Smaller bits—metal leavings, stray chips, or steel shavings that have eluded the conveyors provided to receive them—are placed in rubbish cans, of which there are thousands throughout the plant. This work goes on hour after hour so that at no time are men who are engaged at machines, at furnaces, or in any other line of work ever obliged to walk across or stand upon anything but an absolutely clean floor. Yet the sweepers never interfere with operations. It is interesting to watch how they contrive to introduce them-

selves and their brooms without, apparently, interposing either.

Much more goes into the rubbish cans just mentioned. At the end of meal periods, boxes or bags that have contained lunches, newspapers that are to be thrown away, all things that would otherwise litter the shops, are deposited in these receptacles by the entire factory force. No one need take more than a half dozen steps to find such a container. Making use of them keeps the surroundings a more pleasant place in which to work. The rubbish cans are emptied every two hours. In reclamation yards situated outside the various buildings, the contents are immediately sorted and all things, including the smallest pieces of metal, wood, and clean paper, sent to the division of salvage. The comparatively little that remains following this process is scooped into dump tractors and used for filling uneven ground at various points in the plant property.

It is hard to believe that in this spotless area 10 open hearth furnaces are operating continuously

TO facilitate the work of the scrubbers, every shop has its system of pipes and faucets. Boiling water seething with steam comes through mains that are laid in tunnels which lead from the power houses. From these larger conduits, a net-work of smaller pipes travels to points convenient for use. They sprout from almost every supporting post.

Between many of these columns are hundreds of large pipes of quite a different character that disappear through the roofs. These are part of the air suction systems. Leading upward to them are smaller pipes with nozzles set close to work done by such machines as the grinders. As quickly as emery, fiber, or the dust of metal drops from the wheels that produce it, that dust is drawn into these nozzles to be shot into collector bins stationed on the various roofs, there to be placed in bags and disposed of according to kind. And while this operation is apart from a story which deals with the cleaning squad, it nevertheless has much to do with the cleanliness of the surroundings in which men work. It furnishes scores upon scores of invisible brooms that not only keep air and lungs clean, but greatly reduce the task delegated to those of corn-straw and fiber.

All floors in every department and in every factory office at the Rouge Plant are scrubbed every eight hours, and many areas immediately adjacent to machines, every two hours. The wider aisles and interior driveways, less subject to oil or litterings from machines or furnaces, are mopped once a day. That represents quite a job. There are almost 7,000,000 square feet of floor space in this huge galaxy of buildings. True, a portion of it is occupied by machinery. Yet perhaps a half is accessible to mop and broom. Moreover, that which is accessible is nothing less than that. There are no unreachable holes or unsavory pockets.

Whatever the exact free floor area may be, these figures are positive: Each month the cleaning department uses more than 1700 barrels of general cleaner, almost 800 barrels of soda ash, 70 barrels of soap powder, and calls upon the salvaging department to supply it with mop pails at the rate of 150 a day.

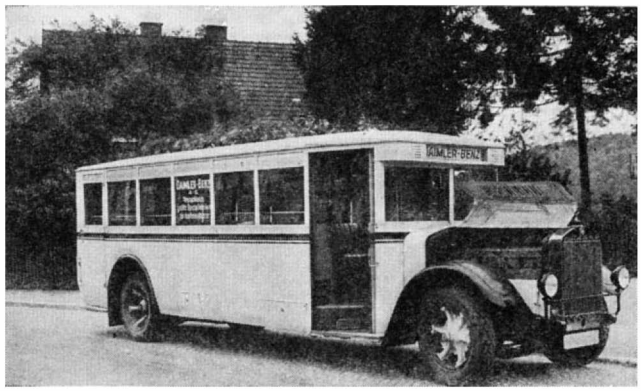
No matter where you go, whether to the carpenter shop hidden away at one edge of the 1100 acres that form the plant property; to the locomotive repair shop situated in an equally remote corner; or to the general assembly building which stands in the heart of it—everywhere are to be found men keeping things clean. And in all places you will see an abundance of sunlight. Consider the motors building. It is almost a third of a mile long by half that in width. Down its length runs a covered street, easily wide enough to allow two trucks to pass. Walk along it, stop when and where you will and look in as many directions as you like. Always, about you and as far as the eye can reach beyond, you will see things bathed in sunlight.

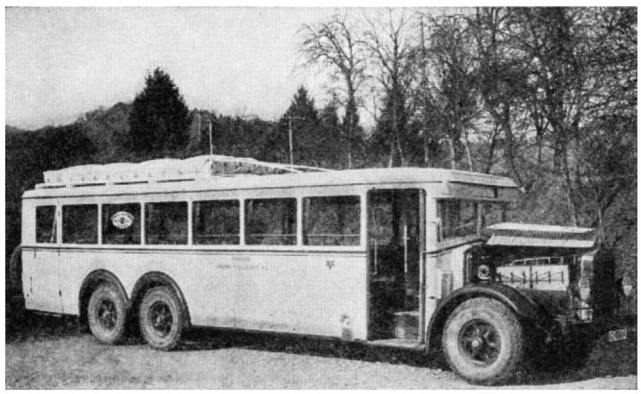
OR go to the open hearth building where furnaces are making steel and this steel is being cast into ingots. Adjacent to it is the steel mill where the ingots are being converted into blooms and the blooms turned into billets and bars. Sunlight. Tons of it!

Can a steel mill and an open hearth furnace building be kept clean? There was a time when such an idea would have been laughed out of industry. Yet here the visitor may spend an entire day and depart with his linen less soiled than it would be in an equal number of hours spent in a metropolitan business district. Such, at any rate, has been this writer's experience, not once but upon a dozen occasions.

Considering the whole subject, a pure fundamental asserts itself: Excellence of material and workmanship to one side; measurements that limit some motor parts in the making to ten-thousandths of an inch, ignored for the moment; rigidity of inspection in manufacture likewise dismissed; how, you ask yourself, could anything save that which is fine come from shops kept so scrupulously clean? And you depart carrying a pretty fair notion as to why Henry Ford finds it good business to employ almost a twentieth of the Rouge Plant force of more than 100,000 men, solely to give battle to litter and dirt.

White uniformed "stokers" work in this "ball room" which is, in reality, a furnace and boiler room. The popular idea is that this is a place of ashes and coal





Two examples of Diesel-powered buses that are made in regular standard models

THE DIESEL ON THE HIGHWAY

THE present-day gasoline engine for commercial vehicles has reached a stage of development at which revolutionary alterations in design with a view to increased working economy appear unlikely in the near future. This gives a stimulus to the idea of obtaining a further decrease in running costs of commercial vehicles by the use of a much cheaper fuel; and already for many years the foremost engine designers of the world have been occupied with the problem of applying the principle of the Diesel engine to a power unit for motor trucks, buses, and so on.

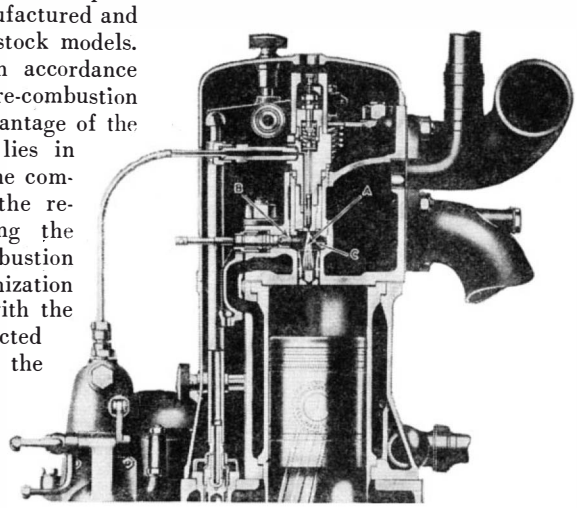
In this attempt to develop the Diesel for highway use the designers were confronted with several serious problems. The most important of these was the excessive weight of the Diesel and the necessity of getting a speed with it comparable to that of the ordinary gasoline engine. These two problems were inseparably connected, since it is well known that high-speed machines can be constructed much lighter in all their parts than slow running machines for equal power output. In addition to this, there was the necessity, in connection with the high speed, to inject very small quantities of fuel in a finely atomized state and with sufficient speed into the combustion chamber, and to adjust this to the extremely variable load of the commercial vehicle.

Some months ago there was introduced to this country a motor bus powered by a Mercedes-Benz crude-oil, or Diesel, engine. Representing the result of years of thorough research, this Diesel is in everyday use in hundreds of commercial vehicles in Europe; and even though its introduction to this country is of comparatively recent date, American companies are already operating a large number of buses with this power unit. To our knowledge this is the first and only complete Diesel-powered motor bus to be manufactured and sold in regular standard stock models.

The motor functions in accordance with the Mercedes-Benz pre-combustion system. The principal advantage of the pre-combustion chamber lies in the fact that it replaces the compressor, since it fulfills the requirements of introducing the fuel into the actual combustion chamber with perfect atomization and intimate admixture with the air. The fuel is not injected directly into the part of the cylinder swept by the piston but into a pre-combustion chamber where it undergoes partial combustion. The extra pressure thus generated in this small chamber drives the fuel-air mixture through a special inserted burner into the combustion chamber proper.

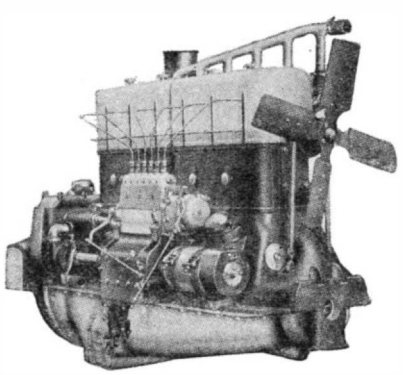
This new bus crude-oil engine has six cylinders of 105 millimeter bore by 165 millimeter stroke. At 1300 revolutions per minute, the engine delivers 70 horsepower. The fuel pumps—one for each cylinder—are collected in one block housing.

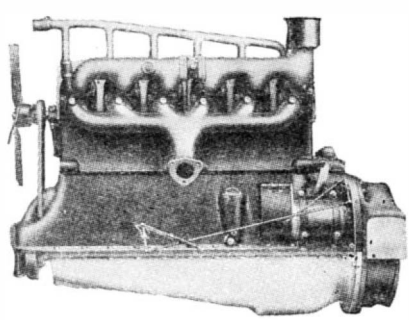
The atomizers, which are also called injection valves, are spring-loaded needles which close up the atomizer opening with a conical seating. The section of the needle projecting upon the seating gives the fuel an opportunity to elevate the needle against the pressure of the spring. The fuel is, of course, supplied from the pump in a measured quantity for each cylinder.



Section through a cylinder showing: A, the fuel spray; B, glow plug; and C, pre-combustion chamber

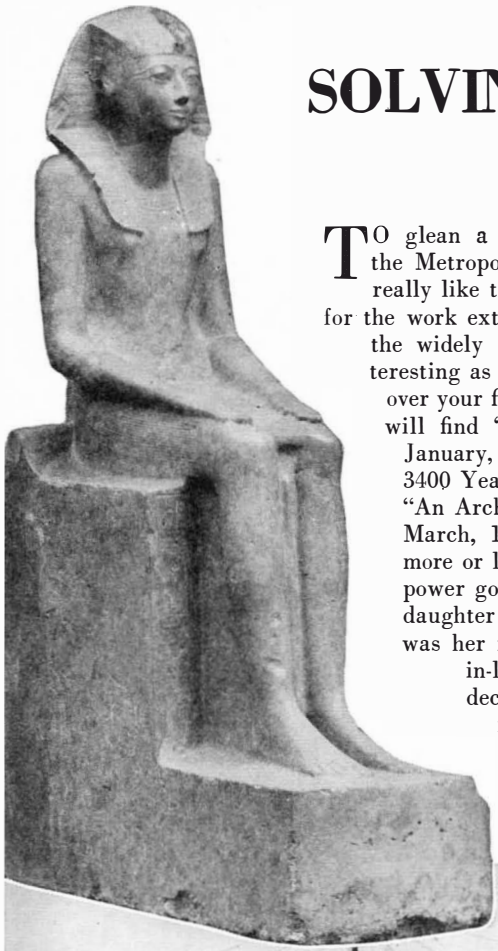
This Diesel is started with an electric starter, exactly the same as any gasoline engine. To facilitate the starting of the cold engine, Bosch incandescent heaters, commonly called "glow plugs," which project into the pre-combustion chamber, are heated by the current from the battery and are then dispensed with.





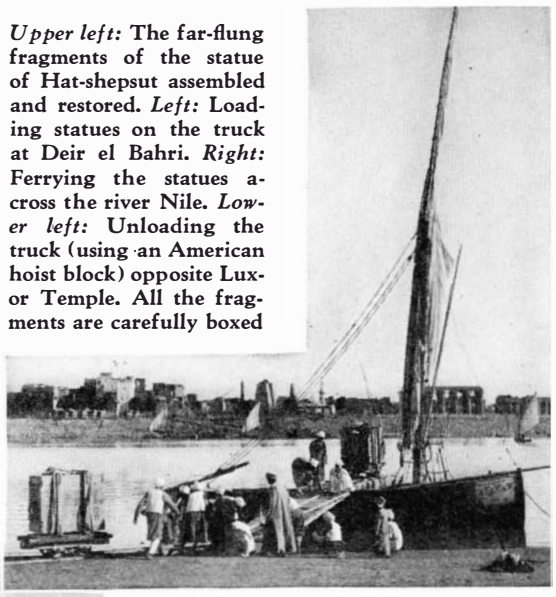
The new bus Diesel engine is a clean design. The fuel pump is shown on the side in the left-hand picture

SOLVING A 3400 YEAR OLD EGYPTIAN ENIGMA

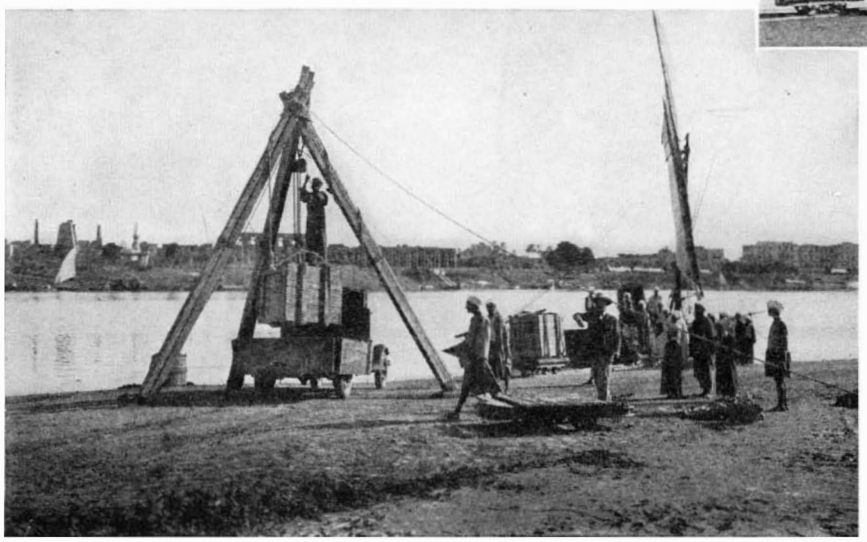


TO glean a knowledge of the excavations of the Metropolitan Museum of Art at Thebes is really like trying to follow a three year serial, for the work extends over that period of time and the widely spaced chapters become more interesting as we progress. If you will look back over your file of the SCIENTIFIC AMERICAN you will find "Adventurous Archeology" in the January, 1929 issue; "Egyptian Vandalism 3400 Years Ago" in June, 1929, and finally "An Archeologist-Detective at Work" in the March, 1930 issue. All these articles refer more or less to Hat-shepsut whose desire for power got her into posthumous trouble. Her daughter married young Thutmose III, who was her nephew and stepson! The mother-in-law kindly acted as regent but she declined to quit when he reached his majority. She was the antique prototype of Catherine of Russia and other female tyrants. For 12 years this indomitable mother-in-law, et cetera, kept the throne of Egypt. She was very vain and built the temple of Deir el Bahri to justify her assumption of the rule and depicted herself as a man. The irate son-in-law after her death extirpated all memorials to her and it is in the quarries and dumps that we must look for the fragments. This having been done and the world combed for missing pieces, we can at least have the satisfaction of seeing how this wilful woman really looked.

Mr. Herbert E. Winlock, who is one of the best writers on archeology we have, describes the later developments in his last report. It will be remembered that in previous years parts of a marble-like limestone head and other portions of the body had been found. The material suggested a headless seated statue of Hat-shepsut in Berlin. Surmise led to certainty when Mr. Winlock went to



Upper left: **The far-flung fragments of the statue of Hat-shepsut assembled and restored.** *Left:* **Loading statues on the truck at Deir el Bahri.** *Right:* **Ferrying the statues across the river Nile.** *Lower left:* **Unloading the truck (using an American hoist block) opposite Luxor Temple. All the fragments are carefully boxed**



Berlin with photographs of the fragments. He says: "Once face to face with the statue then I felt perfectly certain that we were dealing with one and the same monument. In the division of finds with the Egyptian Antiquities Service at the end of our 1928-1929 season the head and other fragments fell to the share of the Metropolitan Museum." In our March, 1930 article we stated that negotiations were afoot for the reuniting of these statues. The negotiations were successful and the Director and Trustees of the Metropolitan Museum and the Prussian Minister of Education ratified the proposed exchanges which were made. As a result the Berlin mu-

seum obtained a most imposing granite sphinx and the Metropolitan Museum acquired a complete seated statue which will always be one of the prizes of the Egyptian Department. The account of the attitude of the Berlin authorities is most refreshing and shows the real unselfishness of science.

Mr. Winlock refers most interestingly to such curious archeological finds. "Such accidents—and some of them far less excusable—have separated scores of mutilated works of art in the past, but for it to be admitted that such separations are final and forever hardly fits the modern way of looking at things. It smacks too much of the old-fashioned amateur—and just a bit of the collector of curios, to whom a meaningless scrap of rock becomes a treasure if it has been chipped off the corner of the Great Pyramid or fetched from the Great Wall of China. At least, to our intense mutual pleasure, Dr. Schäfer (of the State Museums, Berlin) and I found each other feeling that way."

The work of putting together the fragments was done in New York with extreme care. Mr. Winlock says: "After all, it was only guesswork whether the fragments would fit, but when even the last sliver from the tip of the nose clicked into place, something louder than the proverbial sigh of relief escaped me."

A spare wig found in a coffin is stiff with sticky antique pomade

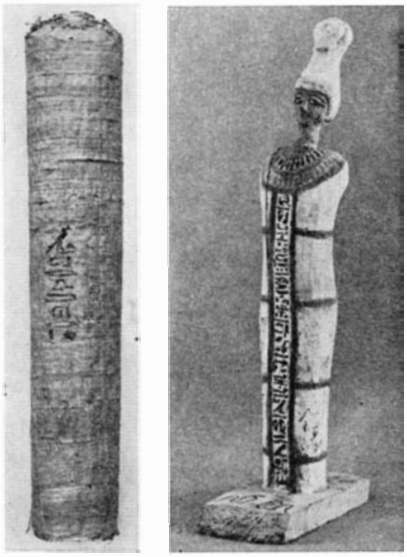
The rest of the report is extremely interesting, detailing some of the routine work necessitated by the previous explorations. The methodically plundered tomb of Meryet-amun which we have previously described gave up many objects of interest. A large amphora or jar contained a yeasty sediment of beer which was analyzed by Dr. Grüss of Berlin who found that the yeast could be called "pure." About 3400 B.C., the yeast was a wild organism full of impurities, but "after 2000 years the Egyptian brewer had developed a culture" says Mr. Winlock, "almost comparable to the modern, without the aid of the paraphernalia of microscopes and filters."

With the mummy of the King's daughter Entiu-ny the explorers found in the coffin a spare wig remarkably preserved but almost solidified with the still sticky pomade in which it had been soaked. An examination of the mummy showed that she was a very short woman, 4 feet 10 inches tall, but extraordinarily fat. She was about 70 years old, but the hairdressers and undertakers made her look weirdly and grotesquely young. The burial furniture even of one of Entiu-ny's rank was, in her day, never as elaborate as it had been in early, more primitive times.

All photos courtesy Metropolitan Museum of Art

In the vast, cavernous shops of the Metropolitan Museum the statues are being repaired

The shattered head of a sphinx of Hat-shepsut is a portrait statue



The Osiris figure 25 inches high concealed a roll of papyrus *(left)*

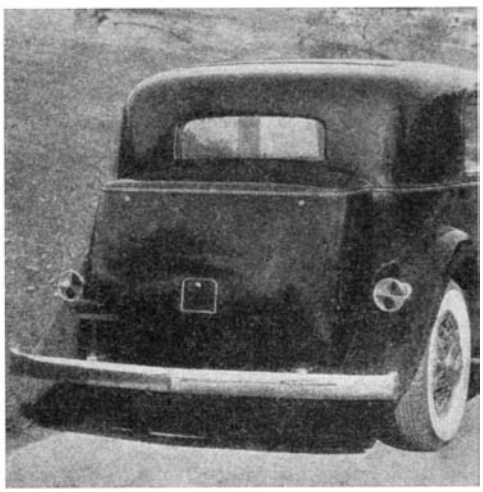
Scandals had been very prevalent in ancient Thebes and the Thebans began to realize that their dead could hardly keep their treasures because of the dishonest actions of the living. Therefore they turned rather to questions of conduct for the departed to observe before the strange collection of gods, genii, and demons who formed such an important place in the uncanny universe to which they were bound. So it was not surprising to find a "Book of the Dead" as a *vade mecum*. In the one found with Entiu-ny it was an 18½-foot papyrus enclosed in an Osiris figure 25⅜ inches high. There was a circular patch of wood in the bottom held in place with plaster. When this was pried loose, the papyrus easily slipped out, almost as fresh as when it was enclosed. The papyrus is now on exhibition at the Museum.

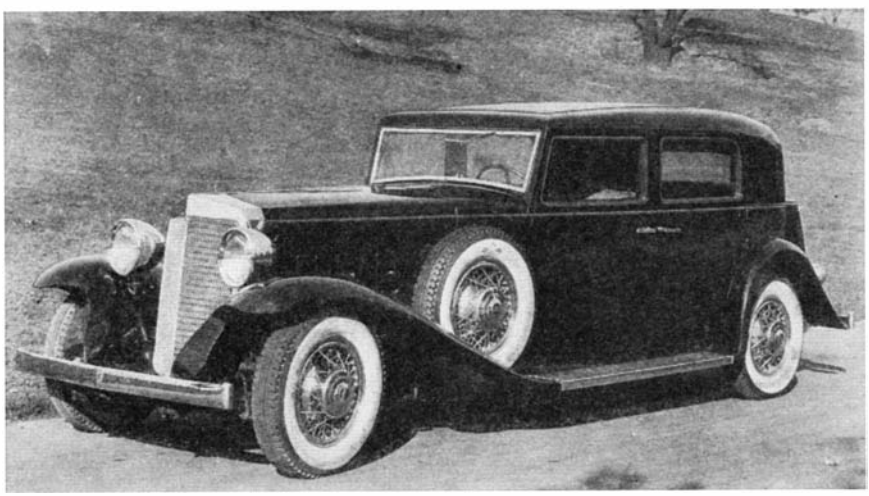
THE ARISTOCRATS OF MOTORDOM

THE 26th annual Automobile Salon was held at the Hotel Commodore, New York City, recently and presented a notable collection of cars of the highest type ranging in price up to 25,000 dollars. The 90 models exhibited had an aggregate value of over 1,000,000 dollars. Most of the bodies shown were the handiwork of individual coach builders who specialize in designing cars to suit the individual tastes of particular customers. Certainly the showing indicates that the art of the coach builder has developed very radically along artistic lines. The product of "Brewster & Co., Inc." is a far cry from "Brewster of Broome Street" which was synonymous with the highest grade of coach work a generation and a half ago. The modern coach builder knows no geographical bounds and some of the best bodies shown came from Pasadena, California. Practically all the chassis were of standard make. The cars represent a great variety of styles and the newest ideas are introduced. Garish colors were generally absent and the tendency was towards subdued colors in exterior finish. The interior finishing, on the other hand, showed much individual development. The selection of woods was very carefully made and the cabinet work was of a very high order. The bodies were generally lower than last year and the passenger accommodation was comfortable as to seats. There were many convertible models shown and it is evident that people who can afford such expensive cars want an all-weather body.

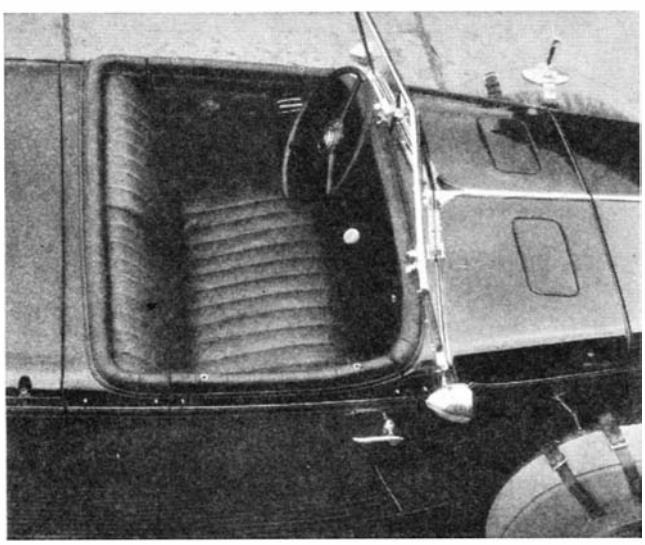
It is not true, as has been reported, that all the cars were arranged to match shades in milady's Paris gowns. While we may have hats, shoes, gloves, and bags to match the costume, we have not yet put the car into the color scheme although some fashion editors would like to make us think so. Some of the cars, more particularly of the sports type, are very rakish in appearance with "laid-back ear" effects.

The metal parts do not hide their light under a bushel and stainless steel and chromium plate are very much in evidence. Polished radiator screens were quite a feature of the show. On some of the models the metal tire cover harmonizes with the rest of the body. Longer wheel bases are made necessary by the longer hoods required by the great

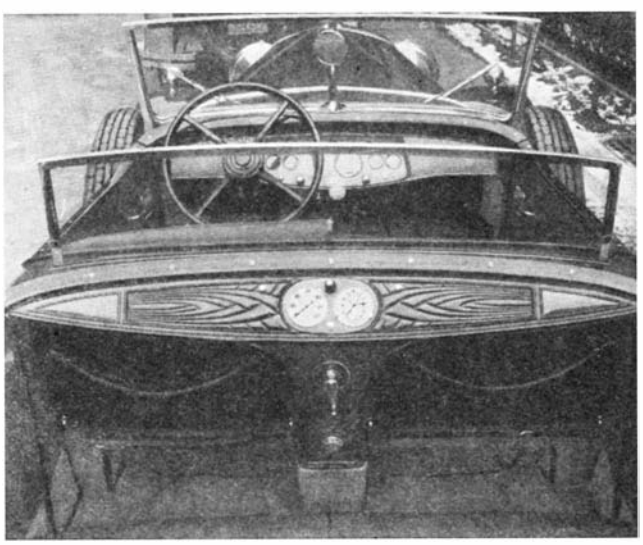




Right: **Marmon sixteen has been unified and there is no appearance of a body set on a chassis.** ***Above:*** **The built-in trunk encloses the gas tank**



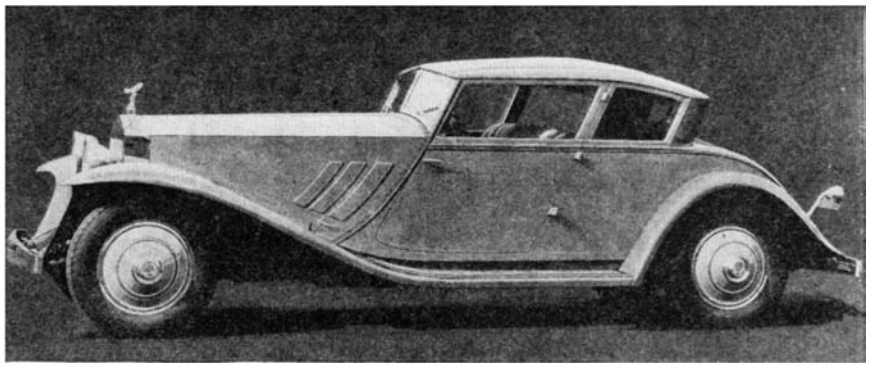
Chrysler Imperial 8 phaeton has an airplane cockpit effect in a long and swanky model. The body is by LeBaron



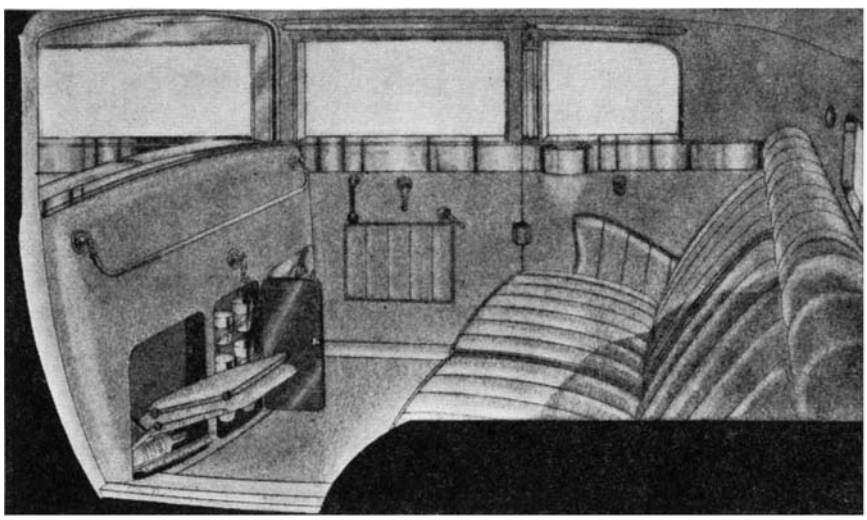
Cadillac sixteen-cylinder phaeton has a disappearing rear windshield. Clock and speedometer are both duplicated

power plants. The size of the doors is very noteworthy. In one Italian car one door, over five feet long, took the place of the usual two. On this car the running board was pontoon-shaped. In some of the new designs the body sides are carried down over the side of the frame, covering the running boards. Many of the cars displayed very large bumpers of the single-bar type; others are characterized by large head lamps of entirely new design streamlined to harmonize with the car and to cut down the wind resistance.

Some of the woods employed are so rare that it would take a professor from the Forest Products Laboratory to name



Rolls-Royce four-passenger sport car looked 21,750 dollars worth and made a sensation. The lines are ultra-modern with dashing curves and sloping windows



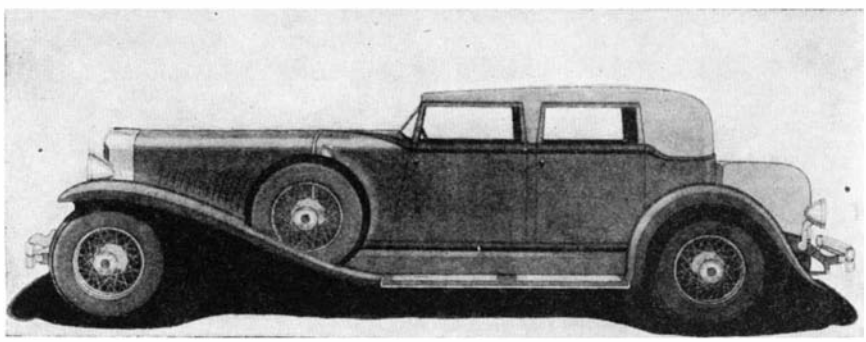
In this Duesenberg car, with body by Judkins, are some of the unhallowed delights of home, for "passengers only", in the cellarette. It is all there but the rail

them. Some of the inlays are in silver and one even had Wedgwood medallions.

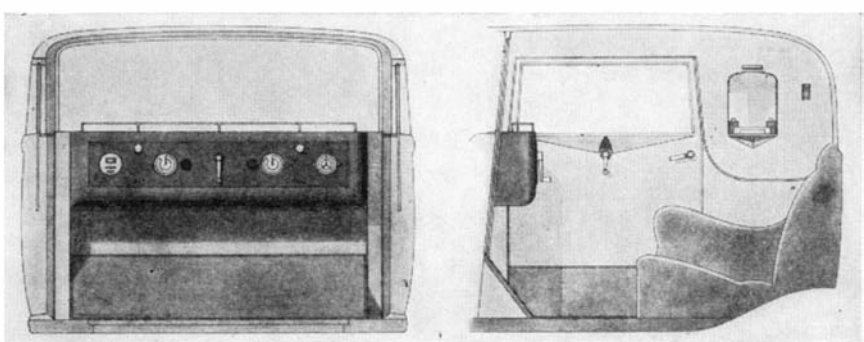
Several of the cars had a duplicate instrument board, usually somewhat abbreviated. The opinion as to the merits and disadvantages of such an arrangement varies. Some contend that it conduces to "rear seat driving" which is dangerous, as we all concede, and others think that if you cannot trust your chauffeur with a high-priced car and your lives that another speedometer will not better matters.

One of the cars shown had a fine radio with concealed loud speaker. While of course we have had radios in cars for some time, they have rarely been so cleverly concealed. There was another car scheduled for the Salon which was kidnapped at St. Louis and never got to New York at all. We show the reason diagrammatically. Perhaps the new owner wanted to enjoy his new car immediately. Well, it had a bar, if the truth must come out and there was ice "and everything." The maker of the chassis exhibited another car which in addition to the radio had a cute little boudoir powdering alcove about six by nine inches which can be lighted independently.

We will not attempt to catalogue the bewildering displays. We have selected a few of what we might call the high spots of the show and we present these in pictorial form, some of the photographs being specially taken for this



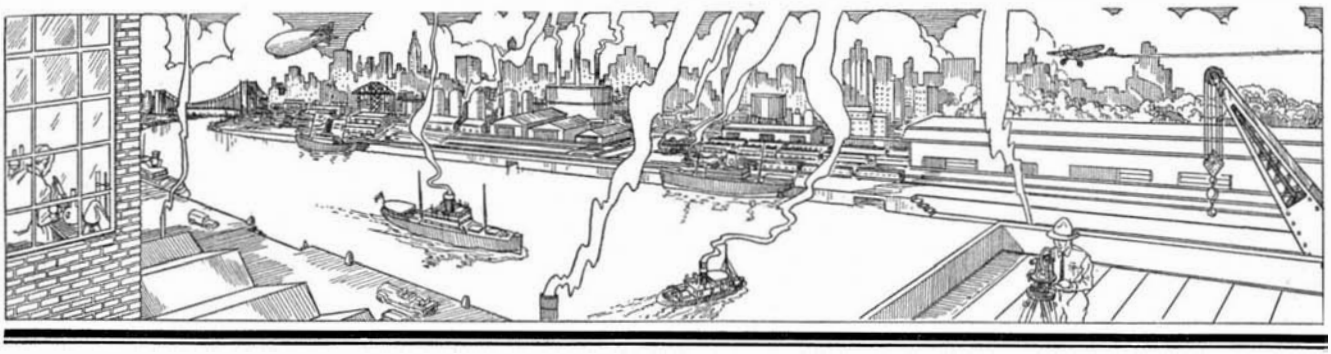
Duesenberg special sport sedan limousine with body by Murphy has 153½ inch wheel base with doors cleverly arranged. Interior views are shown below



The interior of this luxurious car, shown above, possesses many novel features. There is a radio with loud speaker, a duplicate speedometer, and a clock. At the side is a mirror and cabinet independently lighted for the use of the ladies

purpose. There is one feature of the Salon which is especially noteworthy and that is the brilliancy of the patronage. The leaders in social life and in the business and professional world lend their endorsement to this super-show by their presence. Society reporters are on hand and the list of distinguished visitors sounded very much like a list of box holders in the golden circle at the opera.

The sales at the Salon were very large, 341,000 dollars worth being disposed of in the first two days, the volume of business being much greater than last year. One company alone received orders for 22 of its specially built cars.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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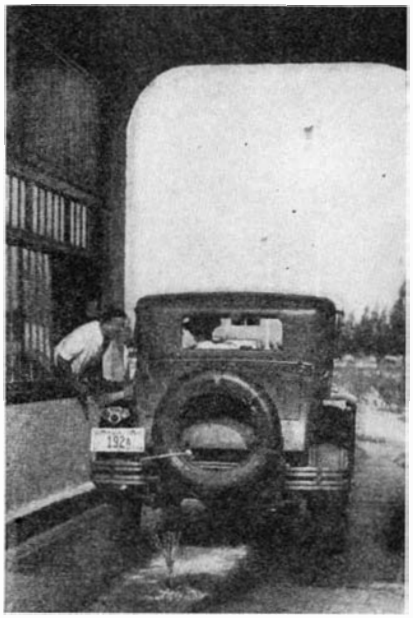
Teach Deaf and Dumb Children with Gas

DEAF and dumb youngsters are finding gas an ally in their struggle for an education, according to a report from London.

They watch the flickers of a gas flame as an instructor pronounces the letters of the alphabet, and then attempt to imitate the teacher, visualizing their effort by the vibrations of the flame. The average student learns the alphabet in three months by this method, educators report.



A piece of cable imbedded in concrete "grounds" the static of a car

Wire Cable Static Absorber

WHAT is perhaps an unusual use of steel cable recently came to light when a photograph was received by the Broderick and Bascom Rope Company from one of their Florida distributors.

The photograph, which is reproduced on this page, shows a small section of steel cable imbedded in the roadway just outside the toll station at one end of the bridge spanning Old Tampa Bay between Tampa and St. Petersburg, Florida. The end of this cable, which projects possibly a foot from the surface, is frazzled out into a brush so that as an automobile passes over it, the cable makes a ground contact with the frame of the car. This contact discharges the static electricity which may have been developed in the car due to its rapid motion, and thus obviates the unpleasant shock the driver and toll gate keeper would otherwise receive when exchanging money and ticket.

The cable company humorously refers to this user of their product as probably the "smallest consumer of the shortest commercial lengths" of their cable in the world.

Wood Alcohol as an Anti-freeze

A RECENT report published by the United States Bureau of Mines relative to the use of methanol as an anti-freeze for automobile radiators adds a strong note to the argument that a reasonable use of this chemical is not dangerous. This report represents work done under a co-operative agreement between the United States Bureau of Mines and the Carbide and Carbon Chemicals Corporation, the DuPont Ammonia Company, and the Commercial Solvents Corporation. The conclusions and recommendations contained in this report are as follows:

"1. Observations made by the Bureau of Mines have indicated that there is no danger of poisoning from the reasonable use of methanol as an anti-freeze for automobile radiators.

"2. The evidence that methanol poisoning has been caused by absorption through the skin is rare and inconclusive.

"3. Practically continuous exposure to low concentrations and short intermittent exposure to high concentrations of methanol cause no apparent harm; but, on the other hand, continued exposure to high concentrations will cause serious poisoning.

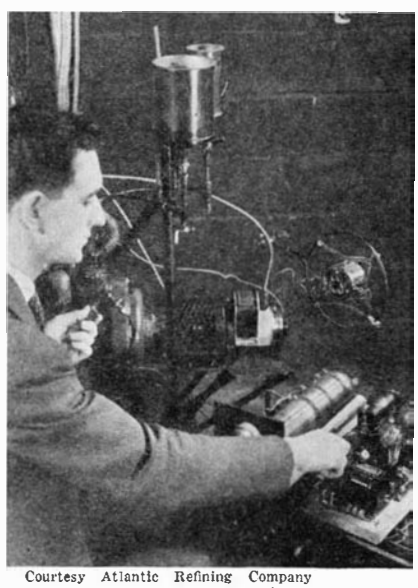
"4. All methanol, whether made by wood distillation methods or synthetic methods, or whether it is crude, refined, or highly purified, is poisonous when taken internally. It will cause serious poisoning, blindness, and possibly death when as little as 2 ounces is taken into the stomach.

"5. To avoid misuse it is recommended that in the future all anti-freeze methanol be brightly colored to enable garage attendants and the public to identify it as methanol; and to warn against misuse, particularly for beverage purposes.

"6. The largest producers of methanol anti-freeze label their containers so as to call attention to the hazards of misuse of methanol and also issue information and instructions to garage attendants and the consuming public warning against its misuse. It is recommended that these precautionary measures be adopted by all producers."

"Electric Eye" Measures Internal Stresses of Glass

A DEVICE which detects and measures internal strains in glass was described by Dr. A. L. Duval D'Adrian at a recent meeting of the American Chemical Society. Dr. Duval is an expert in glass manufacture and was formerly consulting ceramic



Courtesy Atlantic Refining Company

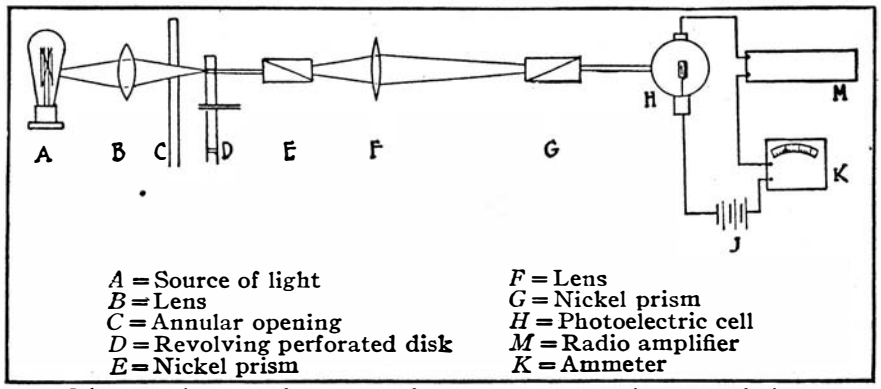
An "electrical ear" used in anti-knock research. The "mike" near the testing engine picks up the faintest whisper of a knock which, after a hundredfold amplification through high-pass filters and tubes, is then registered on a meter dial

engineer for the Illinois Glass Company.

In the apparatus invented by Dr. Duval, the magnitude of strain in a piece of glass is measured by the degree of deflection of the needle of an ammeter.

Referring to the diagram, "A" is a source of light, the rays of which are gathered in the lens "B," and pass through the orifice "C." These rays are interrupted by the revolving perforated disk "D," and then passed through the polarizing prism "E." The parallel rays are gathered by the lens "F," impinging upon the prism "G." Any rays passing through this second prism excite the photo-electric cell "H" and current set up in this cell is amplified by the radio amplifier "M" and registered in ammeter "K."

To operate, the prisms are rotated to the point where the ammeter registers a slight positive reading. If a glass without strain is inserted in the stream of rays between "F" and "G," the ammeter will register a negative reading on account of the reduction in the volume of light caused by the glass. On the other hand, a glass which shows strain will give a positive reading depending upon the magnitude of the strain, as strained glass rotates the polarized light. A high-frequency current is generated in the photo-electric cell which is amplified by the radio amplifier. The instrument should have considerable use in the glass industry.—*A. E. B.*



Schematic diagram of apparatus for measuring internal stresses of glass

Corn Harvesting by Machinery

IMAGINE if you can the modern wheat belt farmer attempting to harvest a huge wheat crop with the old-fashioned cradle. In this modern age such a thing would be unbelievable. Yet, until recently no relief from old methods of corn harvesting has been afforded the corn raiser. The corn grower has been forced, through no fault of his own, to harvest his crop largely with tools no less antiquated than the wood cradle which was formerly used in harvesting wheat.

With the development of the Gleaner Baldwin Corn Combine, the corn grower will get a new deal. This new machine will cut, shell, clean, and bin the corn, and at the same time clear the field for the plow. The farmer completes the job in one operation and rides while he is doing it. The cost of doing this, according to tests before unbiased judges, is said to be a fraction over three cents per bushel contrasted to about 12 cents per bushel by hand methods.

As the machine is drawn through the corn field the rotary notched cutters shown in an accompanying photograph cut two rows of stalks at a time. As the stalks are cut they fall, or are carried, into the steel harvester pan. The rapidly revolving steel conveyor feeder conveys them directly into the cylinder. This cylinder shells the corn which is then transported to a cleaner. The stalks are kept in constant agitation as they pass through the separator to the ground.

The shelled corn is given the first cleaning by a blast of air from the separator fan. Final cleaning is a simple sifting process, and refuse that reaches the shoe is sifted and blown from the corn. The corn passes through the chaffers and an auxiliary screen and is then conveyed to a bin. Although no large amount of corn is cracked by the cylinder, provision is made for saving that which passes through the auxiliary screen. Power is supplied by a model-A Ford engine which is regular equipment on all Gleaner Baldwin Combines.

This Combine is convertible so that it will harvest wheat, oats, flax, barley, or other field seed crop.

Treatment of Burns

THERE is no injury so immediately painful and annoying as a superficial burn and no other injury so dangerous to life as a serious burn. Clinicians are likely to classify burns in three groups according to their severity, representing what are called first, second, or third degree burns. The classification has to do with the depth of the burn and the amount of surface destroyed.

There has been for many years an attempt to control the incidence of burns through proper care in industry and in the home, and the number of deaths from them is unquestionably decreasing. In Great Britain there were 251 deaths in the period from 1899 to 1903 in one large London hospital, as contrasted with 19 deaths in the period from 1924 to 1928. In the former period, there were 990 cases in the hospital, whereas in the latter there were only 286.

Among the reasons for the decline, according to Dr. Charles Donald, are the replacement of oil lamps and other liquid lights by the electric bulb, discontinuation of the use of flannelette as clothing, factory regulations, and better attention to the child in the home. In Great Britain there is a law making it a punishable offense to leave a child under seven years of age in a room with an unprotected fire!

The reason for the diminished mortality from burns is believed by Doctor Donald to be a better method of treatment of these conditions by the medical profession in recent years. It has been recognized from the first that one of the most important methods of control of the burn is to cover it up in order to prevent irritation of the portion from pain due to stimulation of the exposed nerve endings.

During the war, the paraffin treatment of burns had great vogue. This involved painting the area with paraffin, which hardened and formed a protective coating. Before the use of paraffin, it was a common custom in the home to cover the burn with oil or with a mixture of equal parts of olive oil and lime water or with any other good covering. While this represents good first-aid treatment, it is not the safe method of treatment for promoting cleanliness and healing. Burn ointments usually consist of a mixture of zinc oxide, boric acid, eucalyptus, vaseline, lanolin, and castor oil.

It has been recognized that the burned

A tractor pulls the corn combine which harvests corn, shucks and shells it, and dumps the shelled corn into bins

Pointed deflectors turn the corn stalks in toward the rotating disks with sharp serrated edges which cut it easily

tissue may be absorbed by the blood and produce toxic changes in the body. Investigators have shown that a severe burn also produces anhydremia or drying out of the body, with thickness of the blood, and that it is important to get considerable quantities of fluid into the patient if he is to survive.

The most recently accepted treatment of burns is the tannic acid treatment. In this method, the first-aid treatment, which is usually a greasy substance, is removed by washing with benzene. Blisters and devitalized skin are removed with sterile instruments and the burned area is then sprayed with a 5 percent watery solution of tannic acid. This must be made up fresh, since it breaks down, on standing, to the less astringent gallic acid. It is customary where there is much emergency work involving the treatment of burns to put up the tannic acid in waxed envelopes, 1.5 grams or 23 grains of the tannic acid to be dissolved in one ounce or 30 cubic centimeters of boiled water in order to make a 5 percent solution. When there is a serious burn about the face, care must be taken to protect the eyes from the tannic acid spray. It is customary to spray the burns with the tannic acid solution every hour until a heavy brown or black crust is produced. The production of this crust makes it unnecessary to put on dressings and to remove them frequently, which is a painful procedure.

If the burn is extensive, the person can lie on a bed. The bed clothing should not be permitted to touch the burned area. It is customary to cover the patient with a tent containing electric lights which will keep the patient warm and aid the drying of the secretions.

Obviously one of the chief dangers of burns is the infection of the wound and the intoxication from the burned area. This must be taken care of promptly by a physician who can take care of the indications as they arise. The treatment of burns can be resolved into prompt cleansing by antiseptic methods of all burns; the covering of superficial burns with some protective ointment, oil, or melted wax; and the use of the tannic acid spray for more serious burns.—*M. F.*

In mining copper, large masses of practically pure metal are often discovered. One of the largest on record is the "nugget" that was encountered on the 86th level of a Quincy Mining Company mine last year, and shown in the illustration. It weighed about 35 tons, was 30 feet long, 8 feet wide, and was 3 feet thick

"Tracks" for Motorists on Bridge

THE motorist's practice of weaving in and out of a traffic line is never entirely safe; on a bridge it not only is dangerous but serves to retard traffic. For that reason the upper deck roadway of the Queensboro bridge connecting Brooklyn and Manhattan, New York City, will have three distinct tracks divided by safety guards 13 inches wide. This fact was recently announced by Commissioner Albert Goldman and Edward A. Byrne, Chief Engineer of the Department of Plant and Structures.

The tracks will actually take the form of gutters, each slightly over five feet seven inches wide, depressed two inches below the safety guards which separate the three lanes. At the end of the bridge the motorist is routed into these lanes in such a way as to eliminate as nearly as possible any crowding in any particular lane. Having once entered a lane the motorist cannot weave in and out of the various lines without bumping over the safety guards.

It is expected that this system will expedite traffic over the new upper deck roadway which will be completed and opened for traffic early next summer. It will accommodate 40,000 automobiles in 24 hours. The main deck of the bridge handles 90,000 cars a day.

The "R-100" Motor Car

SIR DENIS BURNEY, the designer of the British airship *R-100*, has built a remarkable motor car which made its appearance on the streets of London recently. Its streamlines are based on those of the airship, in order to counteract wind resistance, and it is claimed that the car will cut gasoline consumption by 50 percent. Due to the aerodynamic principles involved in its body design, at high speeds it scarcely touches the ground, with a consequent saving in tire wear. If a speed of 180 miles per hour could be attained the car would actually rise in the air. Another feature of the remarkable car is that the engine is situated at the rear as shown in the illustration below.

Castor Oil Increasing as Motor Lubricant Abroad

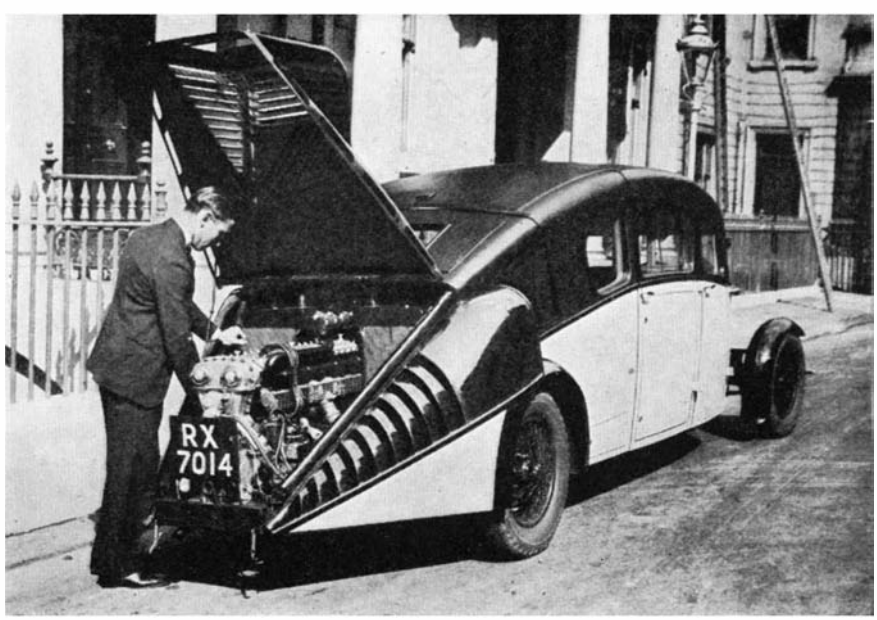
THE use of castor oil as a lubricant for automobile and airplane motors becomes more and more general in France. The cultivation of castor-oil plants has increased in Morocco and Algeria in the last three or four years. The results obtained have been very satisfactory and castor oil is used to an ever increasing extent.

The acidity of castor oil has been one of its chief disadvantages. Now, castor oil neutralized by triethylamine prepared for this purpose is used. The triethylamine is a viscous liquid formed by mixing primary, secondary, and tertiary amines and it can be used to counteract exactly the free acid in castor oil. The oil thus neutralized is washed with water, filtered, and dried. It has lost none of its lubricating properties and is indefinitely stable.—*A. E. B.*

Clothing and the Child

A BRITISH psychologist recently undertook an inquiry among 122 girls and 183 boys between the ages of 6 and 15, with a view to finding out their attitude toward clothing. A result of the study indicated that children up to about the age of nine look on clothing simply as being decorative and would probably, if free to choose, wear anything as long as the color is sufficiently brilliant. From the tenth to the twelfth year the desire for decoration increases and some attention is given to design and cut as well as to color. At this age, the child begins to be disturbed by convention which demands care for and consideration of clothing. As the girl grows older, she begins to sublimate her interest in her body on to the clothing.

The author finds that the motive of modesty is strongly considered in connec-



The engine in the tail of the so-called "R-100" motor car

tion with clothes, so far as the girls in lower classes of society are concerned. Apparently the lower classes have not yet accepted the widely held opinion among higher classes that a lightly dressed body is not necessarily and deliberately immodest.

Children are particularly intolerant of tight or rough clothing, and complain particularly of too much heat. Evidently the unconscious impulse, up to at least the age of ten years, is in favor of nakedness.—*M. F.*

Power from Salt of Ocean?

REFERENCE has been made in these columns to the spectacular efforts of Georges Claude, French scientist, to produce power by utilizing the difference in temperature which exists between surface water and the water from the depths of the sea. Claude's pioneering experiments at Matanzas, Cuba, have been recounted at length in the daily press. The preliminary experiments have been adjudged very promising, and the inventor is convinced that he has led the way to a new and unlimited source of the world's power requirements.

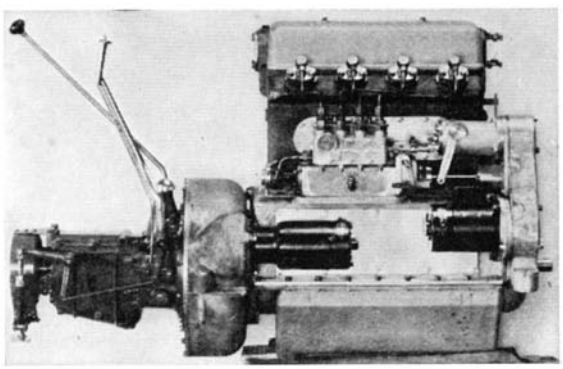
Now comes a new suggestion along analogous lines. Following the same general principles, it has been proposed in a recent report to the Academy of Sciences of France to use the differences of vapor pressure, not of warm and cold water, but of waters of different salt content. At the mouths of rivers, a large volume of fresh water is found immediately in contact with a large volume of salt water, and it seems possible, by means of a suitable apparatus built on principles similar to those demonstrated by Georges Claude, to utilize the difference in vapor pressures. No experimental work has yet been done to test out this proposal.—*A. E. B.*

An American Diesel-Engined Truck

A DEMONSTRATION of the possibilities of the Diesel engine in highway transportation was recently made when the Hill Diesel Engine Company installed one of their four-cylinder Diesel engines in a Reo Speed Wagon and transported a Diesel-electric generator set from their factory at Lansing to New York and established a record for low cost transportation that will probably stand for some time.

While the engine design follows closely recent automotive practice, it was developed mainly to meet the need for a light-weight, high-speed Diesel engine for auxiliary power on motorships, yachts, and other Diesel-powered craft, and for propulsion of smaller boats than have heretofore had the advantage of that safe and economical prime mover.

Finding it necessary to deliver to a yacht at New York one of the little generator sets in the shortest possible time, it was decided to power a truck with one of the engines and give it a reliability test and at the same time determine the adaptability of the Diesel engine to highway transportation. Accordingly, the gasoline power plant was removed from a one-ton Reo Speed Wagon and the Diesel installed in its place, using the same transmission and rear axle gear ratio of 5¼ to 1. The engine alone weighs 700 pounds, and the truck complete without load, 4300 pounds. The load weighed 2300 pounds, so the gross weight was 6600 pounds.



The four-cylinder Diesel engine manufactured by the Hill Diesel Engine Company with automotive transmission with which it was equipped before mounting in the truck. The run of the truck to New York provided a practical test of the Diesel engine in road service

After installation of the engine, the truck was given a few minutes' trial, loaded, and started on the long trip to New York. The fuel tank which had a capacity of 18 gallons was filled with Michigan oil, known as Zilwaukee fuel oil, having a gravity of 26 degrees Baumé.

The route taken was via Detroit, Toledo, Norwalk, Elyria, Barea, Bedford, Ravenna, and Warren, Ohio, then Sharon, Meadville, Waterford, thence through Scranton and Carbondale, Pennsylvania, to Middletown, New York, then down to Nyack, New York, where the load was delivered and installed on the yacht at Peterson's shipyard.

At Barea, Ohio, room for 10 gallons of fuel oil was found in the tank and this quantity was obtained at an ice plant at five cents per gallon. The engineer did not know the gravity of this fuel, but it was fairly heavy black oil purchased for use in a large stationary engine. The run was continued to Sharon, Pennsylvania, where a stop was made for the night, the distance for the day being 287 miles. The next day's run was to Youngsville, Pennsylvania, where 15 gallons of fuel oil were obtained at a flour mill at ten cents per gallon. The short run of 131 miles for this day is accounted for by a late start, several detours, and a considerable mileage of high crowned narrow roads which made slow going necessary with the rather top-heavy overload.

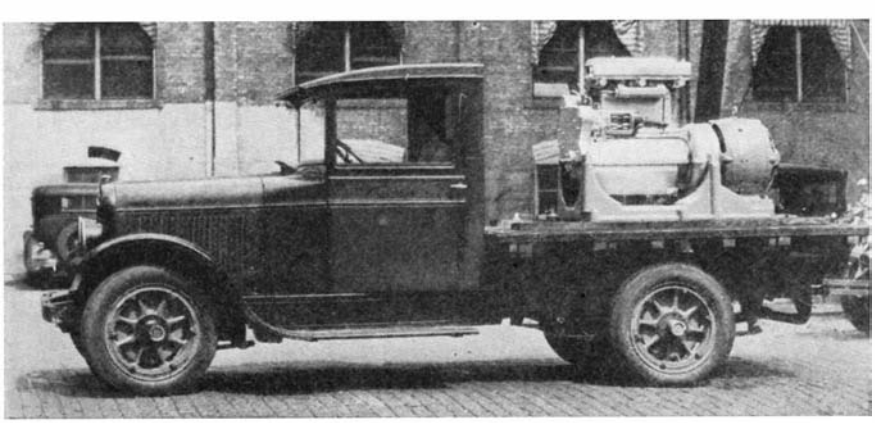
At Scranton it was thought best to replenish the fuel supply, but as it was Sunday, fuel oil was not obtainable, and three gallons of kerosene which had been used to wash out an engine base were obtained from a garage and five gallons of clean kerosene were obtained from a filling station. This filling carried the truck through to its destination with three gallons to spare.

This last day's run was 252 miles.

Total distance traveled	959 miles
Total fuel consumed	48 gal.
Miles per gallon of fuel	20
Weight of pay load	2300 lbs.
Ton-miles pay load	1102 miles
Ton-miles per gallon	23
Total cost of fuel	$3.72
Cost of fuel per ton-mile pay load	$0.003375

The return trip was made with 1200-pound load via Middletown, Binghamton, Elmira, Dansville, Hamburg, and Buffalo and thence, by boat, to Detroit, and by highway to Lansing. This return trip was shorter, and the cost of fuel per ton-mile pay-load was $0.00418.

It is believed that these results constitute a low cost record for highway freight transport, and further, that it is the first American Diesel engine powered truck to make a long distance service run.



The Diesel-engined Reo truck ready for the run to New York

Testing Vision of Future Drivers

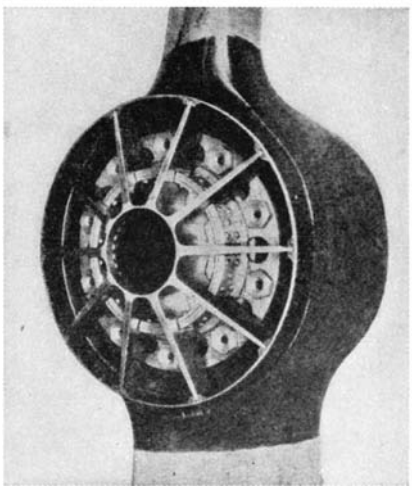
RECENT examinations given to applicants for motor vehicle operators' licenses in Connecticut show that about 15 percent of all those applying wear or need eyeglasses. Only about 52 percent of all appear to have perfect eyesight. About 1 percent are refused licenses because of poor vision. Eight percent are given restricted licenses, which permit them to drive only when wearing spectacles. Many applicants have been made aware of minor defects of vision. In a majority of cases these defects are corrected by the use of eyeglasses or some other means, and after re-examination the applicant is licensed to drive.

There is always a question as to how much a physical defect will interfere with proper driving. It is an interesting question, and one which comes before an administrator many times.

The answer seems to be, as applied in modern practice, that a person may be defective in almost any sense except sight

and yet drive a car successfully. The theory or law of compensation applies. It appears that when one sense or faculty is deficient the others become more acute or more efficient.

It remains true, however, that good eyesight is essential in the operation of an automobile. All states which have examinations for prospective drivers carefully consider this qualification. Eyesight tests are



Flexible propeller hub which was designed to avoid torsional vibration

common. Usually they are so adjusted that they will detect lack of vision which would make a person unsafe as an operator. Most of the tests will determine whether the person examined can distinguish a moving object within 200 feet. Few are discovered with such poor vision as that, but such persons do exist. In most cases the eyesight troubles can be corrected.—Robbins B. Stoeckel, Commissioner of Motor Vehicles, State of Connecticut, in the *United States Daily*.

Itching Skin

IT has been said again and again that the skin is the mirror of the body. Recently John H. Stokes has been giving special attention to the effect on the skin of emotional and nervous states. He points out that itching of an apparently normal skin may arise from a submerged or repressed anxiety or desire. It is also recognized that such itching may have an underlying sexual stress or craving. Quite frequently the person derives pleasure from scratching, and this substitutes for some unsatisfied desire.—*M. F.*

A Flexible Propeller Hub

SOLDIERS crossing a strong bridge may cause it to break down if the rhythm of their step happens to coincide with the natural vibration of the bridge. In the same manner, when the firing impulses of an aircraft engine happen to coincide with the period of vibration or rate at which the crankshaft twists back and forth when put in torsion, the twist of the shaft may become dangerously great. A shaft may be enormously strong and yet give rise to this dangerous phenomenon known as "resonance." Very often the resonance occurs at a low engine speed, say about 1000 or 1100 revolutions per minute, and once this speed is passed all traces of resonance disappear.

To cure resonance completely the period of vibration of the shaft should be very long, so that the oscillations of the shaft are always too slow to "get in step" with the firing impulses of the engine. The shaft should be less stiff to achieve this end. But to make a shaft less stiff may mean weakening it dangerously. The Royal Aircraft Factory in England claims to have found a solution of the problem. Whenever "resonance" is present, the shaft is left just as it is, but a flexible hub is employed.

A normal airscrew hub is employed, but it is free to float on the shaft. The propeller is driven by means of radial spring arms, the central boss of the arms being keyed to the shaft in the usual way. This reduces the stiffness of the system, slows down the period of oscillation, yet at the same time affects the strength not at all. —*A. K.*

An Italian Helicopter

IN a recent thriller, entitled the "Jury of Death" we read of the city of Cayuga, dominated by gangsters who use helicopters, or "copters," as a method of transportation. The "copters" land on roofs and serve gangsters and police alike. It is a strange thing that imaginative writers, whether novelists or newspaper men, seem convinced of the coming of the helicopter, while the technicians are very doubtful. In the D'Ascanio helicopter, described somewhat sketchily in the foreign technical press, all existing helicopter records for endurance, distance, and altitude have been broken, and the hopes of the helicopter exponents raised afresh.

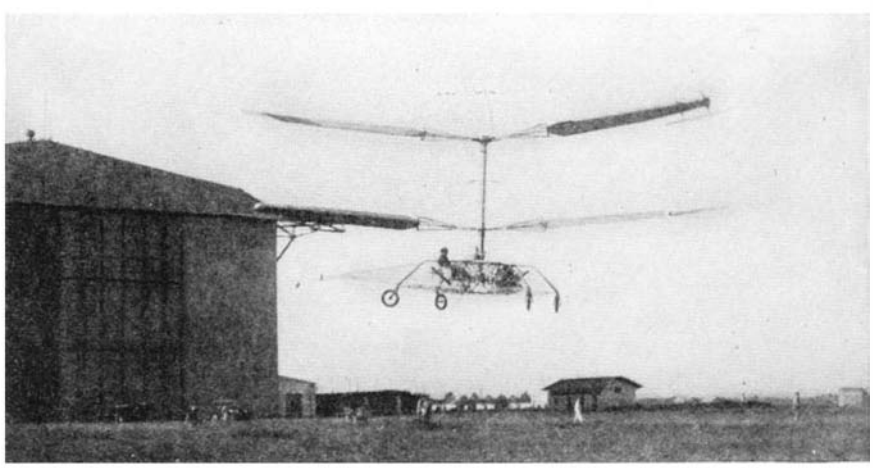
The D'Ascanio helicopter has been flown at the Ciampino Nord Aerodrome in Italy, both in the open and inside an airship hangar.

It consists of a cruciform framework fuselage, surmounted at the centre by two large horizontal propellers, rotating in opposite directions. The propellers are really large wings, jointed at the roots, with elevators at the tips. By changing the angle of the elevators, the pilot can change the angle of incidence of the main blades. When the wings are set at a positive angle the craft ascends; when set at a negative angle, the craft descends. When the engine quits, the rotating airfoils act as a windmill and give the helicopter parachutal qualities.

At each end of the fuselage cross there are small propellers, also rotating in a horizontal plane. By driving one or other of these small propellers the craft can be tilted and caused to proceed along any direction. Therefore extreme flexibility of movement is achieved.

The machine is a single seater weighing only 1750 pounds and powered with an 85 horsepower Fiat engine. During its tests, the D'Ascanio helicopter took off and landed in a circle 49 feet in diameter, and maintained steady flight at an altitude of 13 feet. The record for altitude was secured by a climb to a height of 59 feet, and the endurance record was broken by a flight of 8 minutes, 45½ seconds. During some tests, the machine flew "hands off" with perfect steadiness.

While these are only preliminary trials, they give great promise.—*A. K.*



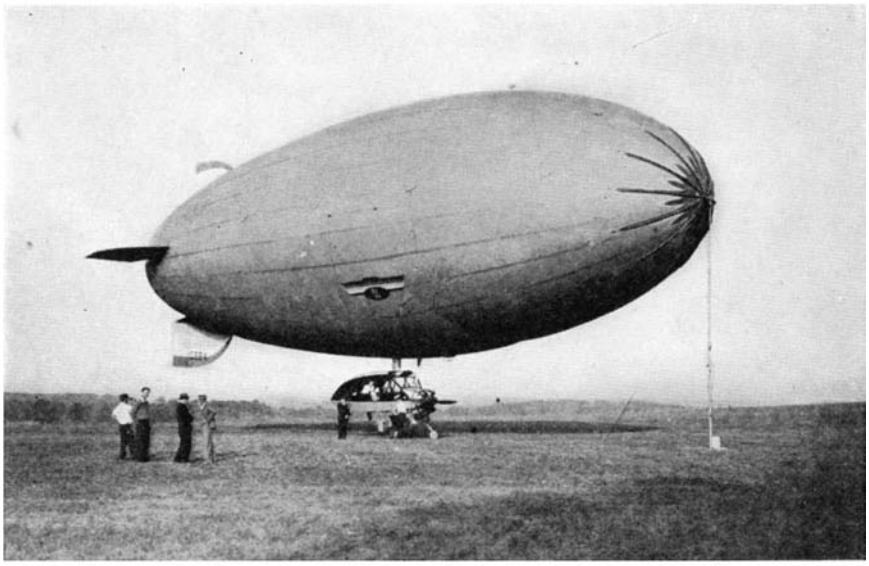
The record-breaking D'Ascanio helicopter in flight

Barnaby on Gliding

LIEUTENANT RALPH S. BARNABY of the Navy Bureau of Aeronautics is a distinguished technician who took up gliding as long ago as 1911 in self-instructed gliding flights. In August 1929 he soared for 15 minutes and 6 seconds at South Wellfleet, Massachusetts, qualifying as the first "first-class glider pilot" in this country. It was Lieutenant Barnaby who in January of last year launched his glider from the airship *Los Angeles* in flight over Lakehurst and reached the landing field, 3000 feet below in 12 minutes. He has now written a book "Gliders and Gliding" which is thoroughly in keeping with his knowledge and experience.

To glance through this book is to learn what a rich and complex art gliders and glider construction have become. There are now primary gliders, secondary training gliders, and soaring planes of wonderful delicacy and efficiency. There is a whole theory of gliding in being. Gliders can be launched off a hill, by towing behind an automobile, by use of a ground crew, and by means of an automatic shock cord. The phenomenon of soaring in an up current, when the air strikes a suitable hill or ridge, is well understood.

Now students of the art are delving into soaring in "thermic currents." These are vertical currents caused by heated air rising and cold air descending. Variations in radiation from the sun and the nature of the ground cause certain bodies of air to become heated and ascend. For example, the sun shining on a plowed field will heat



The Heinen airship moored to a light collapsible mast

the air above it very rapidly. Cool air blowing in from the water will be warmed by the land and will rise. Soft, smooth, cumulus clouds, with their towers and valleys, are the tops of such rising currents of air. The warm air rising bears moisture with it. As the air reaches higher altitudes it cools. Cool air will not hold as much moisture as warm air. It condenses in the form of the cumulus clouds. It was by soaring under one of these clouds, whose origin is so simply explained by the author, that Robert Kronfield, at the Wasserkuppe (Germany) Meet in 1929, was able to soar to a height of 7000 feet, and by gliding from cloud to cloud continued his flight for nearly 100 miles, an achievement which appears almost miraculous to us.

While Barnaby is an enthusiastic glider pilot, he strikes a conservative note in a chapter on "The Future." "Gliding on level ground or even from a moderate hill, launched by shock-cord, palls after a few flights. It is all very well for beginners but even the wildest enthusiast will tire of it before long. Automobile towing to higher altitudes from which one may enjoy a prolonged glide with easy turns back to the ground will carry things along a bit further. The real fact remains that the ultimate goal of gliding is soaring and unless soaring terrain is available, gliding as a sport is bound to wane."

There are many good soaring sites to be found. Cape Cod, Massachusetts, Point Loma, California, Uniontown, Pennsylvania, and Elmira, New York, have already shown their possibilities. But enthusiastic promoters of glider clubs and schools must take all the facts of the situation into account, and that is one of the real services rendered by this splendid book.—*A. K.*

A Sportsman's Airship

WE are accustomed to think of airships as craft of huge size, with millions of cubic feet of gas capacity, a number of powerful engines, and a range adequate for transoceanic travel. Captain Anton Heinen, former Zeppelin pilot and employed as a practical expert by the United States Navy during the construction of the *Shenandoah*, is of the opinion that there is also scope for the small airship, that the small airship has a number of industrial possibilities, and that it is an excellent craft for the sportsman owner.

He is courageously endeavoring to prove his case by building and flying the *Heinen Air Yacht*, one of the smallest airships on record.

The specifications of the *Air Yacht* are interesting. The overall length is 104 feet, maximum diameter 27 feet, length of car 22 feet. Inflated, the ship has a height of 39 feet; deflated, it is only nine feet high. The gas capacity is 39,700 cubic feet. The total weight empty is 1700 pounds. The total lifting capacity is given as 2700 pounds, which postulates rather more than 60 pounds lift per 1000 cubic feet of gas. The airship is powered with a Brownback-Tiger radial, air-cooled, six-cylinder engine of between 90 and 100 horsepower. The maximum speed of the airship is estimated at 65 miles per hour with the engine working at 1700 revolutions per minute.

When inflated with hydrogen, the useful load is about 860 pounds, including one pilot, three passengers, and enough gas for 250 miles flying. With helium the useful load is only 700 pounds because of the higher specific weight of the gas and hence its reduced lift.

A pamphlet describing the airship gives some interesting figures on expenditures for fuel and gas.

The consumption of lifting gas is estimated at 1 percent of the gross volume per every 24 hours of operation; in other words a loss of some 400 cubic feet a day. The gasoline consumption is given as six gallons an hour. The cost of hydrogen, furnished in 200 cubic feet containers by commercial plants, is $1.15 per 100 cubic feet. Helium is much more expensive, six to eight dollars per 100 cubic feet, but of course this gas can be purified and used over and over again. (See page 56, January 1931, SCIENTIFIC AMERICAN.)

These figures certainly do not look terrifying, although the maintenance of even a small airship is an expensive matter.

Airships are classified generally in three types—rigids, semi-rigids, and non-rigids. In the rigid there is a complete internal structure of duralumin girders and steel wires, one of the most complicated and refined structures known to the engineer. In the semi-rigid, there is a combination of a rigid keel with tension forces taken by the fabric covering. In the non-rigid airship such as Heinen's, there is no internal structure whatsoever; reliance is placed entirely on internal pressure for maintaining the form of the airship.

That internal pressure alone, with nothing but flexible fabric, can constitute a structure, may seem puzzling at first. The airship has its lift distributed, its loads concentrated. Therefore it has the character of a beam. How can a flexible material provide the characteristics of a beam, which we associate with steel girders? If a beam will bend, surely the flexible fabric will buckle either at the top or the bottom, depending on how the loads are distributed? The answer is that the internal pressure, a little higher than the surrounding atmospheric pressure, puts the whole of the airship fabric in tension. Therefore any compression forces which come on to the upper part of the fabric are neutralized by the tension and the airship not only preserves its form but is capable of supporting considerable bending moments.

The reader may ask how this internal pressure is maintained, particularly when gas has to be let out for descent.

Captain Heinen in the car of his small airship

The answer lies in the conventional, but thoroughly effective ballonet and scoop system. At the lower part of the bag is a collapsible air compartment known as the ballonet. As the airship rises when ballast is thrown overboard, the helium or hydrogen gas in the main compartments expands, and the airbag collapses. When the pilot wishes to descend he releases a little gas, and as the helium or hydrogen contracts, a scoop above the pilot's head is filled with air under pressure by the slipstream of the propeller. From the scoop the air passes through a pipe to the ballonet, and thus with the aid of two automatic valves, one in the main gas compartment and one in the ballonet, a certain excess pressure is always maintained.

At the bow, where the maximum aerodynamic pressure of the air is exercised when the ship is in flight, special curved nose-battens also help to maintain the form of the ship.

The weight of the airship car must be carefully transmitted to the fabric and the load should not be too localized in its application. A number of cables are carefully arranged to carry the weight of the car, with the pull in each cable subdivided into the finger patches so that nowhere are excessive pulls applied to the fabric itself. The system of support can be seen in one of our photographs.

The construction of the airship is novel in that it resembles an airplane fuselage with undercarriage. The wheels are castorable, which is as it should be, since the airship may be required to move sideways on the ground. Another photograph illustrates the car, with the genial Captain Heinen himself in the front compartment. Incidentally this photograph shows very clearly the air scoop at the front of the car, and the air pipe leading up to the ballonet. At the front is the pilot's compartment with windows in all directions. In rear is the passenger cabin, and aft is the gas tank.

We are informed that the collapsible mooring mast to which the airship is shown attached is surprisingly light and effective. It is claimed that with the aid of this mooring mast a ground crew of two men is all that is necessary to handle the airship.

Experience alone will show whether a small airship of this type will prove useful as a vehicle of either pleasure or business. The Heinen company makes out at least a plausible case for its use as a pleasure craft, and also points out likely possibilities for passenger carrying, sightseeing, advertising, poison spraying in agricultural work, and for transportation purposes in rough and inaccessible country, where even the airplane may fail.—*A. K.*

Flight in the Stratosphere

SOMEWHAT to the disgust of the Junkers Aircraft Corporation, of Dessau, Germany, there have appeared newspaper accounts of a novel craft to fly at a mean altitude of 35,000 feet, and to cover the distance between Berlin and New York in a few hours, with a flight speed of between 500 and 800 miles an hour.

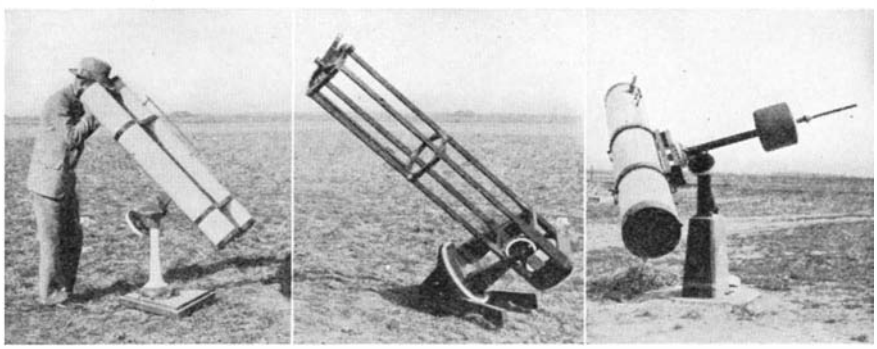
Very little authentic information is available on this plan of the Junkers Company; therefore we can give our imagination full scope in considering this new airplane.

(*Please turn to page* 131)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

HARD times do not seem to have depressed the amateur telescope making "industry." There never before have been so much interest in it, so much demand for the instruction book "Amateur Telescope Making," and so many telescopes made. We are 'way behind on publication of descriptions sent in by workers and find we have 28 on hand as we begin this month's make-up of the department. It looks almost as though people who were temporarily out of work at last had found an opportunity to tackle a job which previous busy-ness had prevented them from doing. At such a time telescope making provides a good way to keep from going



Mr. Hanson with his binocular; also his 10-inch and 12-inch reflectors

crazy, at any rate; though our office cynic says it is a special form of insanity in itself. However, "the other fellow's" pet hobbies always have been just a little bit crazy. It's all a matter of point of view. Anyway, with some 7000 of us addicts all gone crazy together, why should we worry about cynics? Let our wives, relatives, and friends rave about our disease and go play bridge if they wish; we shall head for the cellar workshop, crawling out of our hole at midnight or only when the coast is entirely clear. Many a worker has pleaded an imaginary job "that would suffer if put off," in lieu of a dreaded social obligation. Telescope making is a fine alibi.

WELL, here are some of the descriptions mentioned above.

Something original if not unique, a reflecting binocular, is the product of Hilmer Hanson, R. F. D. 5, Holdrege, Nebraska. Let Mr. Hanson describe it, noting the photograph and sketch (as drawn by him) on this page.

"The mirrors of the binocular have a focal length of 54 inches. Estimated magnifying power with the pair of eyepieces used is about 65 diameters. One advantage of this telescope over a monocular is, of course, that it enables one to view objects with both eyes. It gives an admirable view of an object such as the full moon. The stereoscopic effect on terrestrial objects up to a mile or so is a great deal exaggerated. It gives one a sense of position of the objects viewed, though these objects are reversed and inverted.

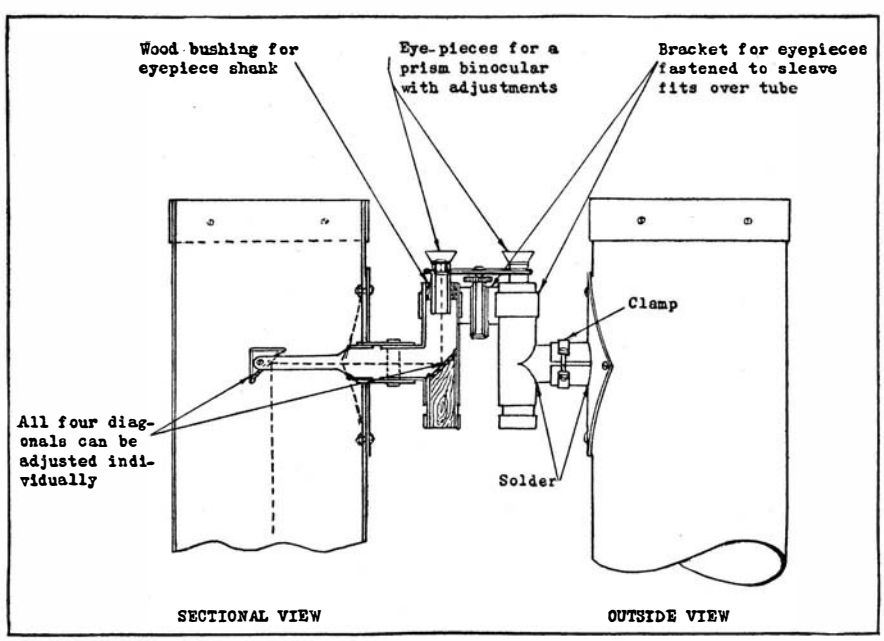
"The method of grinding and polishing two six-inch mirrors to the same focal length was as follows: Both mirrors were ground alternately on one tool. In rough grinding the mirrors were changed on the tool once on each wet, and in the finer stages they were changed several times in a wet. The polishing was done somewhat in the same manner as in the grinding. Only one pitch lap was used.

"The mirrors were tested and figured individually with the knife-edge, but simultaneously with binocular eyepieces. This test was not difficult to set up, and should prove quite valuable in determining the focal length of binocular mirrors. Although the test was not made before the mirrors had been brought to approximately the same figure, it showed them to have the same focal length on the first trial. The test was very interesting, as the image could be viewed with both eyes, and by manipulating the eyepieces in certain ways it was possible to examine the images of the pinhole individually, and compare them with one another. When viewed as one image with both eyes the pinhole has the appearance of solidity. The performance of this telescope is good and gives a wonderful binocular view of the heavenly bodies. It was not much more difficult to make than an average reflector.

"The pedestal is a half of a rear axle housing. A brake drum is used for R. A. circle and a protractor for declination. A slender tube without lens, mounted on the telescope, is used for sighting."

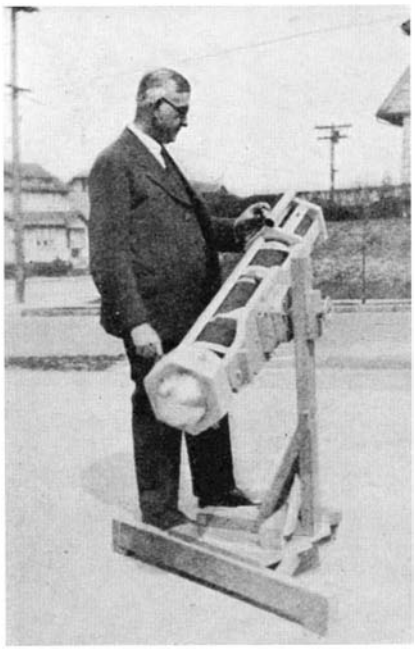
Mr. Hanson also made two single-tubed reflectors, of which photographs are reproduced. He writes concerning one of them: "The open tube telescope is a 10-inch with a focal length of 79 inches. The polar axis is a heavy spindle with bearings and hub, from the front wheel of an automobile. The fork of the telescope is fastened to a plate welded to the spindle body. The tube of the telescope has a counter-weight at the bottom end, and there is also enough clearance between the bottom of the tube and the fork to permit one to view the Pole Star, or to reach any part of the sky. The adapter tube, diagonal, and eyepiece are all in one unit which can be revolved in the support, so that no neck craning is necessary. The whole telescope can be moved about on its casters. This open tube telescope was made with the one purpose in view—to improve on seeing, and as compared with the same mirror used before in a metal tube, a marked improvement, with steadier seeing, is noticeable."

JAMES A. McCARROLL, 521 Palisade Avenue, Teaneck, New Jersey, an archi-



Mr. Hanson's self-explanatory drawing of the eye end of his binocular

tect, has turned his natural inclination into a structure of unique design for supporting his six-inch mirror. He writes: "After grinding, polishing, and figuring the mirror twice I obtained very satisfactory results. The tube is made of thin galvanized leader pipe and the hexagonal pieces around it and the lengthwise slats are of wood, the latter being for protection. The



Mr. McCarroll and reflector

convex attachment to the bottom of the wooden cell is a ten cent aluminum bowl partly filled with plaster of Paris, and is mainly for making the tube balance at the desired point.

"The diagonal is a glass mirror and the eyepiece a single lens from an old telescope, having a focal length of about an inch and a quarter. All the optical parts are completely adjustable and easily removable, which would seem to be a necessity. The finder is a 1¼-inch metal tube with a 5/16-inch hole in a stop at the eye end and a half inch stop opening at the other. Having no place to set an equatorial mounting permanently I made the 'revolving post' altazimuth type shown in the photograph and this has proved satisfactory. By attaching wooden rings and slats to the light sheet metal tube most of the subsequent operations were simple woodworking ones. The instrument weighs 53 pounds and the total cost was less than 30 dollars. I consider my small outlay in 'Amateur Telescope Making' one of the best investments I ever have made, as it has provided me with a hobby which from all indications will furnish me with a fascinating indoor and outdoor sport for the rest of my life—at very little expense."

WE learn of some very definite signs of life in Pittsburgh where the enterprising amateurs are organized as "The Astronomical Section of the Academy of Science and Art of Pittsburgh," Leo J. Scanlon, Secretary-treasurer, 1405 East Street, N. S. Pittsburgh, Pennsylvania. They have worked out an aluminum observatory having original features. The story is too long for our available space but later we may find place for a part of it.

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

DIRECTORY OF OFFICIALS AND ORGANIZATIONS CONCERNED WITH THE PROTECTION OF BIRDS AND GAME, 1930 (Miscellaneous Publication No. 92, United States Department of Agriculture) was compiled by Talbott Denmead and Frank G. Grimes. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

THE ATTEMPT TO DEFINE AGGRESSION (International Conciliation No. 264, November 1930) by Clyde Eagleton is an attempt to clarify ideas on this important subject and to bring together the various proposals. *Carnegie Foundation for International Peace, 44 Portland St., Worcester, Mass. —5 cents.*

BROWN ELECTRIC INDICATING AND RECORDING TACHOMETERS (Catalogue No. 46) fully describes a well known method of recording and automatic control. *The Brown Instrument Company, Philadelphia, Pa.—Gratis.*

INSPECTION OF WELDED STEEL FRAMING IN BUILDINGS gives valuable information on a new problem in construction. *Robert W. Hunt Co., 2200 Insurance Exchange, Chicago, Ill.—Gratis.*

BIOLOGY OF THE VOLES OF NEW YORK (Roosevelt Wild Life Bulletin, Volume 5, No. 4) by Robert T. Hatt is a scientific study of meadow mice and related species, detailing their value, the damage they do, and how to control them. There are a number of illustrations including a colored plate. *The Roosevelt Wild Life Forest Experiment Station, Syracuse, N. Y.—$1.00.*

THE MARITIME PROVINCES, CANADA, gives a short description of the developments in New Brunswick, Nova Scotia, and Prince Edward Island. The wealth of these provinces has been overlooked during the growth of western Canada and the industrial expansion in Ontario and Quebec, and it is only now that they are receiving the recognition which their resources deserve.—*Natural Development Bureau, Ottawa, Canada.—Gratis.*

CIVIL ENGINEERING (October 1930, Vol. 1, No. 1) is a new monthly magazine published by the American Society of Civil Engineers and is a great forward step as it deals with those interests of civil engineering which could not be covered in the more technical *Proceedings* which will, of course, be continued. The style is more facile than was heretofore possible. It is beautifully produced with adequate illustrations.—*American Society of Mechanical Engineers, 33 W. 39th St., New York City.—$5.00 a year, single copies 50 cents.*

SINCE the inception of this survey service of current bulletins two years ago, readers and publishers of bulletins alike have expressed their thanks. When letters of appreciation are received in ever-increasing numbers from such distant lands as New Zealand, Japan, and South America, naturally we feel that our pride in this section of the *Scientific American* is justified. To make this page of greater value to our readers, the editor shall be glad to consider for review papers and bulletins on any phase of science, engineering, or industry. However, we do not wish ordinary catalogs, and we will not mention what is obviously propaganda.

Material submitted should give full information as to where obtainable and the price, if any, so that the reader may obtain copies directly without unnecessary correspondence. — *The Editor.*

GROWING TREES FOR FOREST PLANTING IN MONTANA AND IDAHO (Circular No. 120, U. S. Department of Agriculture) by D. S. Olson is a fully illustrated monograph on the subject. *Superintendent of Documents, Washington, D. C. — 25 cents (Money Order).*

WHY SOME WOOD SURFACES HOLD PAINT LONGER THAN OTHERS (Leaflet No. 62, U. S. Department of Agriculture) by F. L. Browne gives the fundamentals of painting characteristics, when to repaint, and so on. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

THE TORSIONAL EFFECT OF TRANSVERSE BENDING LOADS ON CHANNEL BEAMS (Bulletin No. 211, Engineering Experiment Station, University of Illinois) by Fred B. Seely, William J. Putnam and William L. Schwalbe gives the result of many experiments. *Engineering Experiment Station, University of Illinois, Urbana, Ill.—35 cents.*

MUSICAL CAPACITY OF ADULTS REPEATED AFTER MUSICAL EDUCATION by Hazel M. Stanton and Wilhelmina Koerth is a study of retest scores and ratings in the Seashore Measures of Musical Talent after three years of musical education in the Eastman School of Music, The University of Rochester. Valuable for all music teachers—*Department of Publications, State University of Iowa, Iowa City.—35 cents.*

PRECISION WIRE WOUND RESISTORS is a useful piece of literature dealing with such units and how they may be applied to measuring instruments. *International Resistance Co., 2006 Chestnut St., Philadelphia, Pa.—Gratis.*

NICKEL ALLOY STEEL PRODUCTS. A directory of manufacturers, fabricators, and distributors of nickel-alloy steel products. The carefully annotated list is very imposing for a comparatively new industry.—*The International Nickel Co., Inc., 67 Wall Street, New York.—Gratis.*

THE FINAL SETTLEMENT OF THE REPARATIONS PROBLEMS GROWING OUT OF THE WORLD WAR (International Conciliation, September, 1930, No. 262) gives the Protocol with Annexes approved at the Plenary session of the Hague Conference, August 31, 1929, and agreements concluded at the Hague Conference, January, 1930. There are 197 pages of text.—*Carnegie Endowment for International Peace, 44 Portland St., Worcester, Mass.—5 cents.*

PHOTO-ELECTRIC CELLS AND THEIR APPLICATIONS. A 235-page unbound book containing 31 scientific papers delivered before the Physical and Optical Societies. *The Physical and Optical Societies, 1 Lowther Gardens, Exhibition Road, London, S. W. 1, England—$3.12.*

WASHING, CLEANING, AND POLISHING MATERIALS (Circular of the Bureau of Standards, No. 383). The information conveyed here is out of all proportion to the nominal charge. The definitions are authoritative and the bibliographical references are excellent.—*Superintendent of Documents, Washington, D. C.—10 cents (coin).*

AVIATION TRAINING (Aeronautics Bulletin No. 19, U. S. Department of Commerce, Aeronautics Branch) is a pamphlet intended to acquaint those who are contemplating entering the field of aeronautics with the methods of acquiring training and also some of the opportunities for employment. It is filled with valuable hints. *Aeronautics Branch, Department of Commerce, Washington, D. C.—Gratis.*

A STUDY OF SLIP LINES, STRAIN LINES, AND CRACKS IN METALS UNDER REPEATED STRESS (University of Illinois Bulletin, Vol. XXVII., No. 40, June 3, 1930, Bulletin No. 208) by Herbert F. Moore and Tibor Ver gives much valuable information on the fracture of metals under stress. Profusely illustrated.—*Engineering Experiment Station, University of Illinois, Urbana, Ill.—35 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 127)

First of all, there is the question of a power plant. The ordinary plane loses speed as it goes up to high altitude, because, as the altitude increases, the density of the air decreases also, and a smaller amount of fuel only can be burned in the cylinders of the engine. This difficulty is obviated by applying a supercharger to the aircraft engine. This supercharger is generally a centrifugal compressor, or a Roots blower driven either by gearing from the main engine, or by a gas turbine which is itself propelled by the exhaust of the engine. The supercharger supplies the engine with air of atmospheric density; therefore the power of the engine is maintained up to heights exceeding 30,000 feet.

Granted that the power of the engine can be thus maintained at altitude, what is the effect on the speed of the airplane? As the plane rises to altitude it must fly at a higher angle of incidence. Owing to the lesser density of the air, the higher angle of incidence is needed to provide more intrinsic lifting capacity. At ground level and at top speed the wing flies at very low incidence, zero degrees, or even at small negative incidence to the wind. With this altitude-plane it would be possible to fly at 35,000 feet at four degrees incidence, provided the power is maintained by the supercharger. Now, it so happens that an airplane wing is much more efficient at four degrees than it is at very small angles; therefore, the altitude-plane, when flying in rarefied air of great heights, will be functioning much more efficiently than in high speed condition at ground level. It follows from this that with power maintained constant the plane can fly some 30 or 40 percent faster at a great height than at sea level.

Granted that the Junkers Company, taking advantage of all of the aerodynamic refinements now at our disposal, can design a plane which will be as efficient and have as powerful an engine as a Schneider Cup racer, which can attain 400 miles an hour at ground level (unofficial reports have it that certain British seaplanes have already attained this figure) and if we add between 30 or 40 percent to the 400 miles an hour by altitude flight, then a speed of 600 miles an hour at 35,000 feet is not beyond the realm of possibility.

There is still another device besides the superchargers which has to be embodied in our altitude-ship, namely, the variable pitch propeller. Since the propeller at altitude has to work in a rarer medium, and at the same time has to propel the airplane at a greater speed than at ground level, the ordinary fixed blade propeller will work very inefficiently at height. We must have a variable pitch propeller whose pitch can be considerably increased for the journey at 35,000 feet height.

Even this does not end the list of engineering innovations which have to be provided. At very high speeds parasite resistance becomes extremely important, far more important than increase in weight.

The modern airplane with its beautiful streamline fuselage and finely tapered wing has one remaining item the resistance of which can be eliminated—the landing gear. There is little doubt that in the Junkers altitude plane the landing gear will be retracted and hidden away, either in the fuselage or in the wings, just as a bird withdraws its feet when flying at great speed.

This finishes the engineering difficulties, which have to do mainly with the construction of the airplane, but there is still to be considered what happens to the passengers and pilots at great altitudes. The passenger cabin will undoubtedly have to be made in the form of a completely enclosed metal shell, capable of resisting a difference in pressure between the outside and the inside of the cabin. The interior of the cabin will have to be supplied with air, compressed so as to bring it back to the pressure and density that we are accustomed to in our every-day life. Further, neither the pilot nor the passenger can be expected to be entirely comfortable if he is to be bundled up in electrically heated clothing during the comparatively long flight. The exhaust of the engine will therefore have to be utilized carefully so as to maintain an equable temperature inside the cabin.

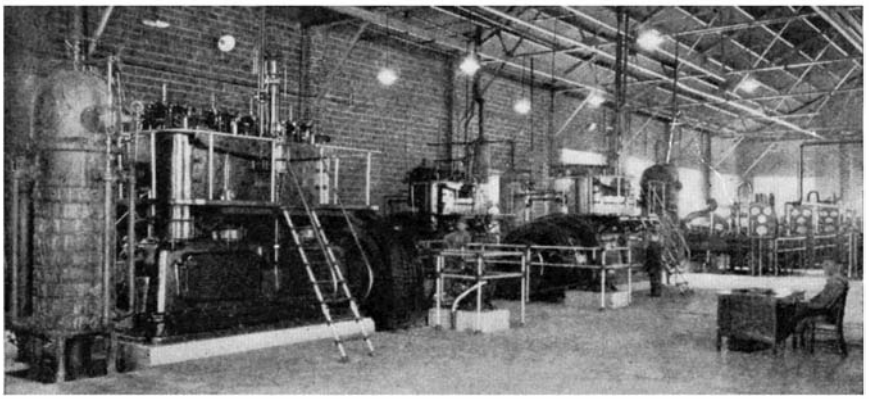
There is one very helpful feature in the German constructor's plan. At high altitudes, owing to the fact that the earth rotates from west to east there is a constant high wind blowing from east to west. Scientists calculate that this wind may have a magnitude of 100 miles an hour, or even more. In that case, in flying from Berlin to New York, the adventurers of the upper air would have a powerful aid to speed.

We have seen the Germans build successfully large rigid airships, the largest flying boat in the world, and rocket-propelled airplanes. Many people of all countries have thought of the altitude plane. It is not impossible that the Germans may in this field also lead the world by their boldness of conception and execution.—*A. K.*

Cause of the Common Cold

FOR at least 20 years there has been intensive research into the question of the cause of the common cold. Among the most recent reports is one emanating from investigators in New York City, including Doctors G. S. Shibley, K. C. Mills, and A. R. Dochez, who have carried out research on young chimpanzees. They first determined the bacteria usually found in the upper respiratory tract of the chimpanzee, and concluded that chimpanzees are susceptible to the human type of infection and that the symptoms suffered by these apes resemble those suffered by human beings who catch cold. The animals were placed in strict quarantine, everything used by them was sterilized and strict surgical sterility was observed among the workers who came in contact with the animals.

Washings were made from the noses of persons suffering with colds. After each filtration this material was injected into the nostrils of the chimpanzees. Twenty-eight chimpanzees were inoculated, 20 with material obtained from patients in acute stages of the common cold and eight with material obtained from normal individuals at a season of the year when colds were at their lowest incidence. Four animals were excluded because they had recently suffered



Power house in the government's helium plant in Amarillo, Texas, showing the gas engine units in the foreground and the compressor units in the background

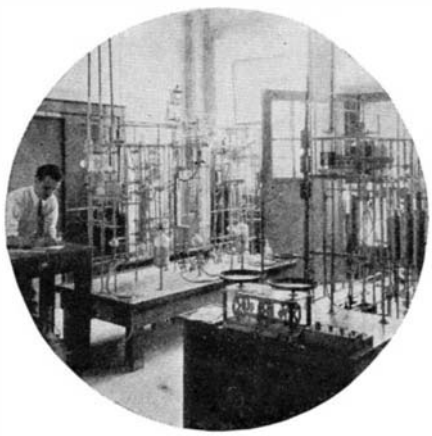
from respiratory infection. Of the remaining 16, seven contracted experimental colds, usually within from 36 to 48 hours after inoculation. The animals developed lassitude, loss of appetite, and a mucous nasal discharge followed by nasal obstruction, sneezing, coughing, and sometimes sore throat.

Following these experiments on apes, the authors attempted transmission of colds from man to man. Volunteers were secured and inoculated exactly as were the apes. Nine experiments were completed and in four instances colds were successfully transmitted.

As a result of their investigations, the authors conclude that the contagious cold in human beings is caused by an invisible uncultivable, filtrable agent which probably belongs to the group of so-called filtrable viruses.—*M. F.*

Helium Plant Celebrates First Birthday

HELIUM, the non-inflammable gas used for floating lighter-than-air craft, is produced commercially only within the United States. The government's newest helium plant, located on an 18-acre site, some seven miles from the town of Amarillo, Texas, has just completed its first fiscal year's operation and a very interesting description of the unique operations appeared recently in *Chemical and Metallurgical Engineering*, written by C. W. Seibel, supervising engineer of the United States Bureau of Mines. The Bureau of Mines obtained control of the gas rights of a virgin gas field comprising some 50,000 acres. The gas reserves of this area are adequate to supply the Army and Navy with helium for many years. Not only does this field produce gas containing nearly 2 percent helium but the pressure is such that there is no need to compress further the gas in the process of helium extraction. The field is connected to the plant with a six-inch welded steel pipe line about 12 miles in length.



Cryogenic laboratory in the helium plant showing gas analysis apparatus. Here is housed the equipment used in gas research problems which usually involve low temperatures

The natural gas which the plant processes has a rather high carbon-dioxide content for fuel gas—about one half of one percent—and it is necessary to remove this constituent before the helium can be separated. Failure to do so would result in solidifying the carbon dioxide in some of the tubing and thus putting the plant out of operation.

The removal is accomplished by scrubbing the gas under pressure with a 6 percent solution of caustic soda. This scrubbing is effected inside a four-inch pipe having a total length of about 1000 feet, and through which all of the incoming gas to the plant must pass. The caustic soda solution is forced into the gas stream with the aid of a plunger-type pump. After the gas and liquid have traveled the length of the pipe they are separated by a special trap.

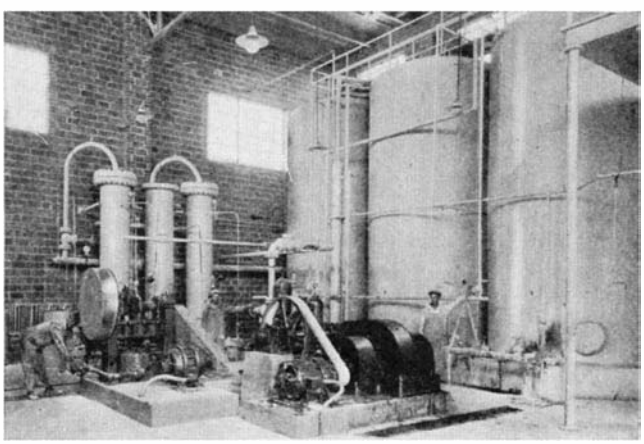
The gas, still under pressure, is then conveyed to the building in which the helium is actually removed. The gas coming to the separation building consists chiefly of methane, ethane, nitrogen, and somewhat less than 2 percent of helium. In order to separate the helium and get it in a nearly pure state, it is necessary to cool the mixture to an exceedingly low temperature. The fact that the gas reaches the plant from the field at a pressure of something more than 650 pounds obviates the necessity of further compression. Practically all of the gas which enters the plant at ordinary room temperature is cooled to about 300 degrees below zero, at which temperature the helium is separated from the resulting liquid-gas mixture.

The helium finally produced has a purity of from 40 to 80 percent, depending on the method of operation. It is sent to a gas holder and from there re-compressed, carefully dried over lump caustic soda, and sent through another similar cycle, by which its purity is stepped up to about 98 percent.

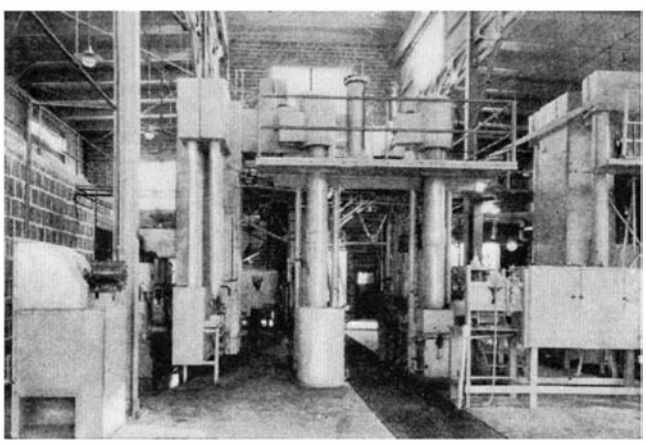
The helium is shipped from the plant to the Army and Navy flying fields either in tank cars or small cylinders. Each of the helium tank cars consists of three or more large heavy-walled, seamless steel tanks mounted on railroad trucks. These tank cars, filled to a pressure of 2000 pounds per square inch, hold about 200,000 cubic feet of free gas.—*A. E. B.*

Odorless Varnish

REFRIGERATOR manufacturers have been working for the last three or four years to obtain a synthetic paneling material for the construction of their "boxes" because of the desirable qualities of laminated board. The use of synthetic materials of the bakelite type, however, was limited as they were not satisfactory when



Carbon dioxide must be removed from the natural gas before the helium can be separated. The pumps shown handle the caustic soda solution used to absorb carbon dioxide



In the helium separation building, the gas which is used in the airships of the United States is separated from the natural gas by freezing out all the other constituents

brought into close proximity to foodstuffs, because of the slight residual traces of phenol odor which were readily absorbed by almost any type of fatty produce, such as butter. A new odorless varnish has contributed to the solution of this problem and the use of laminated board is now possible for manufacturers of refrigerators and in work of a similar nature. During the past year the use of laminated stock for hotel paneling, desk tops, radio panels, window decoration, and so on has been quite common and on the increase.—*A. E. B.*

Hupmobile Has Free-wheeling

FREE-WHEELING will be included as standard equipment on every new model produced this year by Hupmobile, according to information received by us from the Hupp Motor Car Corporation too late to be included in our review of 1931 cars on page 860. In making this announcement, Hupmobile is in the unique position of having free-wheeling not only in all its new eight-cylinder cars, but in its new six-cylinder models as well.

As adopted by Hupmobile, free-wheeling is simplicity itself. In free-wheeling, the clutch may be used to shift into all speeds. It must be used as in ordinary driving when shifting into reverse and low speeds and from low into second speed. However, under certain operating conditions, it is easily possible to shift from second to high or back from high to second speed in free-wheeling without using the clutch. When free-wheeling is not used, the clutch must be used to shift into all gears.

Hupmobile's free-wheeling consists of an over-running or one-way clutch. This clutch permits the gears to remain engaged in either second or high speed while the car is rolling forward under its own momentum and the engine is idling at a speed equivalent to from six to eight miles an hour. In operation, this clutch operates in a manner similar to the well-known bicycle coaster feature, the stem-winding watch, and the winding key of a portable moving picture camera, in that it turns freely in one direction and engages when the power is applied for an increase in speed.

Geographical Localization of Diseases

SINCE the time of Noah Webster's famous epidemiology, it has been recognized that death rates from some diseases are frequently higher in some sections of the world than others. Thus, the death rate from diabetes diminishes as one approaches the equator, and, in general, increases in the opposite directions. Dr. C. A. Mills has suggested that this increase in the cooler and more stimulating regions probably results from an exhaustion effect of overstimulation by the highly changeable climate. He did not find a sufficient correlation between the rate of the consumption of sugar and the death rate from diabetes to indicate a cause and effect relationship.

Doctor Mills has also given special attention to the geographical distribution of pernicious anemia, goiter, Addison's disease, and angina pectoris. He finds that the same countries that have such a high and increasing death rate from diabetes are also the ones afflicted with pernicious anemia. Near the equator, both diseases are much less fatal. The distribution does not appear to be racial, since Italy, Uruguay, and Iceland are mainly populated by the white race, Ceylon by Indians, and the Philippines and the Straits Settlements by the yellow and brown races. Nevertheless, the distribution of the diseases follows the geographical rather than the racial distribution.

It has been pointed out again and again that simple goiter occurs more frequently in regions in which iodine is not prevalent in the soil, in the drinking water, or in the food used by the people. Exophthalmic goiter represents possibly the effect of overstimulation of the metabolic rate. In the United States there is a lower death rate from this cause in the southern states as compared with the northern. There is a low rate in all states having a comparatively extensive contact with the Atlantic Ocean, while the Pacific Coast states show a high rate.

Doctor Mills also points out that during almost two years' hospital experience in China, he saw little advanced hardening of the arteries or its complications in the Chinese people. Blood pressure in the Chinese ranges considerably below the level common in the northern United States, and the basal metabolism and general scale of physical activity are correspondingly low.

The death rate from angina pectoris in the southern states is about half that of the northern states. The rate among the Negroes is lower than in the white population in the south, whereas the rate of the white population in the south is only two thirds of that of the north. So far as the Negroes are concerned, their death rates from pernicious anemia and angina pectoris are lower than that of the white population; for the acute infectious diseases and for tuberculosis, they are higher.—*M. F.*

Gas Helps Railroads Fight Snow and Ice

THE Chicago & Northwestern Railroad recently completed the installation of gas burners in the intricate track approaches to its passenger station in Chicago as a weapon against the snow and ice of winter blizzards.

The gas burners are placed underneath switches and other track work that must be kept free from obstruction. When the storms come, the burners are lighted. They warm the steel just enough to melt the snow and ice.

Gas heat to keep railroad switches clear in winter was first proved practicable in Chicago last winter when, during the worst blizzard in ten years, the Union passenger station track approaches were kept free from obstruction by the burners. Several hundred men were required to sweep and shovel snow at the Northwestern station, according to J. A. Peabody, the railroad's engineer of maintenance, and it was decided to profit by the Union station's example.

Tank Lining Material Resists Acids

A NEW acid-resistant material for application in fluid or plastic form has recently been developed and placed upon the market for use as a jointing compound in bell and spigot cast-iron water mains and for lining tanks made of concrete. The new

material may also be used for pointing joints in acid-proof masonry.

This material, known as Mineralead, is marketed in the form of 10-pound ingots. The material has a melting point of 113 degrees Centigrade, and in use it is only necessary to melt a sufficient number of ingots and apply the melted product, either in the fused or plastic state, to the work. The base of this material is sulfur, which gives it, according to the claim of the manufacturers, almost complete resistance to most acids. Its shrinkage upon cooling is negligible, so that joints or linings made with the material are free from shrinkage cracks and pinholes.

In the tests which have been made with Mineralead thus far, excellent resistance to certain strengths of all acids except hydrofluoric has been indicated. Hydrochloric and phosphoric acids of any strength, most organic acids of any strength, and dilute sulfuric and nitric acids are among the acids which have been successfully handled in this material. Temperature, however, is a limiting factor, as Mineralead is not recommended for temperatures above 100 degrees Centigrade.

A considerable quantity of Mineralead is already in use as a jointing material for water-supply piping. Tests conducted by one of the largest water-supply systems in the country showed a decided superiority for the new material over lead caulking. Strength was considerably higher. No industrial applications have as yet been made with the material as a tank lining, but preliminary tests indicate that a strong and very resistant surface is produced.

In the use of Mineralead for lining concrete tanks, the material is heated to the liquid state and flowed onto the natural concrete surface with a fiber brush. Three coatings suffice to give a thickness of ⅛ to ¼ inch. This is believed to be sufficient for most purposes. As a lining for concrete, Mineralead is easier to apply than lead and is said to be considerably cheaper. Among the uses which have been suggested for large-scale trial of the material are: electrolytic cells, tanks for phosphoric acid, storage and process tanks for chamber sulfuric acid, and similar applications.—*A. E. B.*

Ideals in Physical Education

IT is now generally recognized that big muscles are not necessarily synonymous with perfect health; in fact, the man who builds himself extraordinary muscular apparatus in order that he may compete successfully in sports may find this excess tissue a hazard rather than an asset after middle age when he is unable to continue his excessive exercise. Physical education should be planned for the vast majority of boys and girls primarily as a means to normal exercise of the body and not in an attempt to build small models of Hercules.

The tremendous crowds attending football, basket ball, and hockey games have gradually caused these sports to be placed on a pedestal. Young men make them major interests during their educational careers, and find themselves immediately after graduation with no means of livelihood, except professionalism in sports and capitalization of publicity through association with bond houses. Physical education should be planned primarily for health. When it goes beyond this objective, it becomes a menace not only to the individual but to the curriculum of the educational institution.—*M. F.*

New Fumigant for Grain Eliminates Fire Hazard

DEVELOPMENT of a new method of fumigating grain in storage without incurring a fire hazard is an outstanding achievement of government scientists during the past year, Dr. C. L. Marlatt, chief of the Bureau of Entomology of the Department of Agriculture, reveals in his annual report.

The new fumigant is a mixture of solid carbon dioxide, or "dry ice," and ethylene oxide. Tests by commercial handlers of grains have proved the value of the method, which is economical and superior to the more familiar carbon disulfide treatment of grain, due to its non-inflammability.—*Science Service.*

Stopping Cracks in Sheet Metal

EXCESSIVE vibration is the principal cause of cracks in sheet-metal products and components. The continuous bending to and fro of the fibers causes them to crystallize and finally fracture. An effective method of preventing cracks in sheet metal from enlarging or extending is to drill a small hole through the metal at the extreme end of the crack. The hole should be so located that about three fourths of the drill will cut beyond the end of the crack in the sound metal. This method should be followed even when a sheet-metal patch is riveted over the crack, as otherwise the crack will ultimately creep or extend beyond the patched area. Oxy-acetylene welding, however, provides an ideal method of stopping cracks in sheet-metal products, as the metal is annealed by the torch flame which welds the fibers together.—*Machinery.*

Cause of "Jake" Paralysis

THE United States Public Health Service has proof that technical triorthocresyl phosphate was the cause of thousands of cases of paralysis attributed to drinking Jamaica ginger. Ginger itself is completely exonerated. The Jamaica ginger drink responsible for the paralysis was adulterated with the tricresyl phosphate. Ginger snaps, ginger bread, and other ginger delicacies need not be shunned for fear of the disease. The United States Public Health Service has no record of a single case of paralysis caused by ginger put out by a reputable pharmaceutical manufacturer.

The adulterant that caused the paralysis is a relative of carbolic acid. It is widely used in the manufacture of varnishes, shellacs, et cetera. It is cheap and easily obtainable, and was probably used because its physical characteristics make it hard to distinguish from normal ginger constituents. —*A. E. B.*

The Progress of Medicine

IN his address delivered at the opening of the Banting Research Institute of the University of Toronto, named in honor of Frederick Banting, who is credited with

the major portion of the discovery of insulin, Lord Moynihan, perhaps one of the most noted among living British surgeons, emphasized the changing point of view of medicine and surgery today. He contrasted the method of Hippocrates, which involved the observation of various symptoms and signs with the Galenic method, which concerned modifications occurring in disease and a study of these modifications by the investigator.

Doctor Moynihan emphasized particularly the importance of physiology in the medicine of today. Many a hospital has physiologists attached now to its staff. The physiologist formerly was concerned entirely with the normal individual. Today he is concerned with detecting as early as possible the first departure from the normal.

Furthermore, surgery which formerly was concerned primarily with removing from the diseased body as soon as possible the portion which was the center of disease is now concerned primarily with restoring that body as nearly as possible to normal state. In other words, surgery instead of being primarily a mutilating branch of medicine has become a reconstructive branch of medicine.—*M. F.*

Electricity to Make "Trolleys" of Steam Lines

"THAT most tantalizing of modern mysteries—the time-table" will be banished with the electrification of steam railroads, according to J. A. Droege, vice president of the New York, New Haven & Hartford Railroad.

Addressing a meeting of the electrical engineers of the American Railway Association in Chicago recently, Mr. Droege saw in electrification the hope of providing passengers the constant service similar to that now received from the street car.

Although a railroad official for more than 25 years, Mr. Droege said he could not read a time-table and make connections. However, with shorter, faster, and more frequent trains which will come with electrification, passengers will be able to wait for the next train without instructions from a time-table.

In discussing the progress of railroad electrification, R. F. Schuchardt, chief electrical engineer of the Commonwealth Edison Company, announced that last year the electric light and power companies supplied 1,000,000,000 kilowatt-hours of electricity for railway operation.

Water and Ice Damage Roads

OUTSTANDING factors causing road damage are water and ice, according to W. I. Watkins of the United States Bureau of Chemistry and Soils, who addressed the eleventh annual meeting of the American Soil Survey Association on the subject, "The Utilization of Soil Surveying in Road Construction."

Mr. Watkins based the conclusions of his paper on 16 years of soil surveying and road construction experience, including four years of co-operative studies with the Bureau of Public Roads. With reference to the importance of soil survey Mr. Watkins said: "A knowledge of soil and soil characteristics enables one to determine in what form and layers the water and ice occur. This knowledge furnishes a basis for determining the character of non-drainable soils and the intelligent designing of drains."

According to Mr. Watkins the detrimental effects and movement of water are greatest during the spring thaw and rains and are most damaging to non-rigid road surfaces. During the winter, ice accumulates in some of the subgrade soils in sufficient amounts to cause them to become supersaturated upon thawing and with the flexing of the road surface the subgrade loses its stability. The road surface breaks if traffic loads are sufficient to exceed the road surface flexibility and subgrade stability.

Mr. Watkins pointed out that in the colder regions of the United States frost and ice accumulation associated with certain types of soil cause a heaving of two inches to a foot in concrete roads. Continuing, he said:

"This produces a decidedly bumpy surface, often causing a concrete road surface to break. Low type road surfaces become soft and impassable during the spring thaw. Such spots are known as 'frost boils.' Frost accumulation is most extensively developed in very fine sandy loams, silt loams, and silty clay loams but seldom occurs in the granular structured, more porous portion of the soil in sufficient amounts to cause damage, unless in a poorly drained position, which causes the soil to become puddled. Puddling destroys structure, increases density and water-holding capacity. This condition is common in roads traversing poorly drained land."—*The United States Daily.*

OUR POINT OF VIEW

(*Continued from page* 85)

1 cruiser, 7500 tons, six-inch guns, to carry six planes.
11 destroyers, including one destroyer leader.
4 submarines of 1100 tons each.

In addition, the President has recommended that two battleships be modernized, and that 130 airplanes be built for use on the eight-inch gun cruisers, built or building.

These 18 ships are the beginning, and if we continue in accordance with the well-planned program of the Navy Department, by 1936 we will have, built or building, the ships allowed us under the London Conference. In his testimony before the House Committee, Admiral Pratt stated that we will not be able to reach our assigned treaty tonnage before 1937; this statement emphasizes the condition of naval inferiority that resulted from our failure to build during the years 1921-29 when we sought to lead the world to naval disarmament by example.

This naval program will be a direct boon to our ship-building industry and will indirectly benefit many others. Most of the cost of a ship is in the labor, and practically every dollar expended is spent within the United States; the disbursements for our new navy will recruit the ranks of the gainfully employed and add to our national security.

Mr. Stimson Kills Some Rumors

MR. STIMSON recently paused long enough from reading reports, mainly troublesome, reaching him from all parts of the world, to deny

officially the following rumors concerning the current foreign policies of the United States:—

First: that any agreement exists between France and the United States to withhold credits to any nation that is contemplating an increase in armaments.

Second: that there was any intention on the part of the United States to co-operate with other powers in the "implementation" of the Kellogg-Briand Pact, or to participate more directly in the affairs of Europe.

Third: that Ambassador Gibson had committed the United States to any revision of the Versailles Treaty.

Fourth: that Great Britain and the United States had come to an agreement concerning the "Freedom of the Seas."

This authoritative statement will assure the American people that their government is not unduly involving itself in the affairs of Europe. We cannot isolate ourselves from European developments, nor could Washington, John Adams, Jefferson, Lincoln, McKinley, Roosevelt, or Wilson. Our people originated in Europe, our past development has been largely affected by European events, and our future will inevitably be profoundly influenced by Europe; but we should avoid entangling ourselves unnecessarily in Europe's local issues. The statement of Mr. Stimson will meet general public approval.

Great Britain and the United States should be able to find a common meeting ground in the matter of the "Freedom of the Seas." If we but realized it, the real interests of both states are identical. Both have depended for protection upon navies rather than armies, and both should uphold the belligerent rights of men-of-war. The vigorous employment of sea-power enabled Britain to support unaided her long war against Napoleon, and sustained Lincoln in his efforts to preserve the Union. When we are neutrals, our trade is vexed by belligerent war vessels, but we should endure this comparatively small inconvenience rather than discard (and try to force Great Britain to discard) the weapon that has preserved both countries in the past and will probably stand them in good stead in the future. It is significant that France and Russia, whose strength abode in their armies, and the small nations unable to support fleets, have always advocated whittling away the advantages naturally adhering to sea-power; we should beware how we wantonly kick away in the tranquil days of peace the prop that supported us during the fateful days of war.

Mussolini—Stalin —Mustapha Kemal —Venizelos

EUROPE was startled by the recent open rapprochement between Soviet Russia and Fascist Italy. Maxim Litvinoff, Soviet representative at the Limitation of Arms Conference, voiced his disgust at the alleged hypocrisy of the conferees and ostentatiously proceeded from Geneva to Milan, where a trade agreement was rapidly concluded between Italy and Russia. The official accounts of these meetings would not disturb nervous Europe, but there are rumors of accompanying secret military agreements that bind Russia and Italy with Germany, Austria, Hungary, Turkey, and Greece into a bloc opposed to France, Jugoslavia, Poland, Czechoslovakia, and Rumania.

In addition to the visit of Litvinoff to Milan, the following significant visits have recently been noted: Premier Venizelos to Mustapha Kemal at Angora; the Hungarian Prime Minister, Bethlen, to Hindenburg at Berlin; and the Turkish Foreign Minister to Mussolini at Rome. This round of visits aroused particular interest and some alarm in France, where the hand of Mussolini is seen pulling the hidden strings. Official England, undisturbed, professes to see Italy acting as mediator between Germany and Russia. England has rarely been nervous when the European continent was fairly evenly divided.

In the new alignment, Russia and Italy pass to the side of the nations that lost the World War, while France still heads the continental nations that won. The French group wishes a strict enforcement of the Versailles Treaty; the opposing group desires to revise the treaty. The instinct of Europe to arrange itself into two nearly equal groups is an old one, and if France succeeds in creating a French bloc on the continent her success will almost automatically result in the creation of an opposition bloc.

One visible result of the re-grouping is an increased boldness in Germany, who demands that her late enemies disarm or permit her to re-arm. Her very able representative at the Disarmament Conference, Count von Bernstorff, former ambassador at Washington, advanced the artless supposition that Germany disarmed in 1919 because the Allies promised to disarm later. Our memories are short but we can still recall that Foch, Haig, Pershing, Beatty, Sims, and other allied leaders gave Hindenburg and Ludendorf more pressing reasons for disarming than the possible future disarmament of Europe. Even Viscount Cecil, devout believer in disarmament, took umbrage at the challenging German tone, and indicated that Great Britain would take her place on the side of the French group if Germany were unduly provocative.

AUTOMOBILES FOR 1931

(*Continued from page* 89)

a gear pump.

The principal change in the De Soto six is manifest in outward appearance. A pronounced lowness, afforded by a newly designed double-drop frame, and certain improvements in body contours coupled with numerous refinements in detail and a longer hood, add a fleet, close-to-the-road appearance. The power output of the engine has been increased by making the cylinders ⅛-inch larger in diameter and by increasing the compression ratio. Longer pistons, a nine-inch single-plate clutch, and a slightly altered carbureter throat design all contribute to the enhanced power, speed, and stamina. Virtually all of the mechanical features which have characterized De Soto production in the past have been retained.

Greater power, acceleration ability, and speed constitute the major changes in the De Soto eight. The engine now develops 75 horsepower, the increase being afforded by an increase of ¼-inch in piston stroke and a slight decrease in gear ratio. The compression ratio is slightly higher; the crankshaft is heavier; and a larger single-plate

clutch is used. Mechanical features used in former production are retained. The most marked improvement in appearance is made in the adoption of a slender-profile radiator and a longer hood.

The new Dodge Brothers eight is four inches longer and four inches lower. Displacement of engine has been increased to 240.33 cubic inches; and the engine actually develops 84 horsepower at 3200 revolutions per minute. Road shocks and vibrations are eliminated from the frame and body by a more liberal use of rubber insulation. As to body design and trim, no effort has been spared to make this car a peer in its class.

While no radical changes have been made in the Hudson Great Eight, this car presents a new appearance of smoothness in its swinging streamlines. This new and greater Hudson will be available in 14 body types on two chassis lengths—119 inches and 126 inches—hung low over the wheels on a double-drop frame. Steel replaces wood throughout, even in the roof rails, and improved welding makes the body virtually a single, seamless piece of steel.

The new high compression engine of the Hudson is of the L-head type, the bore being increased to 2⅞ inches and the stroke being 4½ inches. A noteworthy feature of the engine is a full by-pass furnishing a correctly compounded, high-velocity fuel mixture at idling and low speeds. The pistons have cam-ground, flexible skirts, the upper portion being perfectly round while the skirt is ground out to resemble a double cam. Hudson engineers claim that this piston insures better and quicker transfer of heat from the piston head to the skirt, thereby minimizing any tendency to detonation. Another engine detail of interest is a system of cooling the engine oil by causing it to travel around a series of cooling baffles arranged throughout the length of the crankcase reservoir.

Six body types are available on the 113-inch chassis of the Essex Super-Six. Like the Hudson, this car is lower, has cam-ground pistons, and the Hudson-patented oil-cooling system. The motor has added horsepower at all speeds within the usual driving range. The bore has been increased from 2¾ to 2⅞ inches, and improved carburetion now develops 60 horsepower at 3300 revolutions per minute compared to 58 horsepower at a speed of 3400 in last year's motor.

New President and Commander eights by Studebaker offer many improvements such as more powerful engines, longer wheelbase, roomier bodies, as well as many important engineering features; but the free-wheeling mechanism is perhaps the most important. This mechanism was first introduced in America by Studebaker several months ago on President and Commander eights and now becomes available to the modest purse in the Dictator eight.

With the free-wheeling mechanism which is an integral part of the transmission, full use is made of car momentum. The instant the foot is lifted off the accelerator, the engine slows to idling speed. The clutch is employed only to start the car and back up, gears being shifted back and forth between second and high at any speed without the slightest clash. Free wheeling eliminates the reversional strains thrown on tires, rear axle, universal joints, clutch and transmission when the foot is suddenly lifted from the accelerator. Carbon is also reduced because the engine is never forced by car momentum to pump excess oil and gasoline when decelerating. When, however, it is desired to use the engine as a braking medium on hills, a slight touch on the gear lever places the car into conventional second gear and suspends the free wheeling for as long as the driver pleases.

The new Cadillac and La Salle V-8 models in 10 body styles, are more powerful, faster, and more flexible than ever before, and the wheelbase on both is 134 inches. Among other things both cars have springs enclosed in dust-tight metal covers, rear spring shackles of compression type, and bodies mounted on the frame with 14 blocks of thick, live rubber. A new intake muffler eliminates carbureter roar; oil dilution is prevented by a new system of crankcase ventilation; and all bearings are pressure lubricated. Easy starting is provided by double reduction gears. A thermostatic switch automatically increases the charging rate of the generator in winter and decreases it in summer. The cars are equipped with synchro-mesh transmission. Mechanical four-wheel brakes are said to be of exclusive design. Brake shoes are of aluminum alloy and therefore no braking effort is lost by drum expansion since the shoes tend to expand, while working, at a more rapid rate than the drums.

An especially notable development in motor cars is the Cadillac V-16, the first sixteen-cylinder car to be produced in this country and which was announced early in 1930. It has a wheelbase of 148 inches and an engine which develops 165 horsepower. The cylinders are cast eight *en bloc* and set at a 45-degree angle. Besides many other important features which lack of space prohibits detailing, the V-16 has two entirely separate fuel systems consisting of gasoline line, carbureter, and vacuum tank for each block of eight cylinders.

In general the exterior lines of the Cadillac V-12 follow the style motif of the V-8; and the engine is in many ways identical with the V-16, the difference being mainly in that six cylinders are in each block instead of eight. In fact, it is so characteristically Cadillac in design and operation that a great deal of attention will be focused on it.

Employing the first all-aluminum engine, the new Marmon sixteen made its début at the New York Automobile Show. However, there is nothing radical or bizarre in this new car which will be produced in eight body styles. It is built on a wheelbase of 145 inches, is powered by a 16-cylinder engine of 490 cubic inches displacement, and will sell below 5000 dollars.

The engine of the Marmon sixteen was originally designed by Colonel Howard Marmon in 1926, but more than three years were spent in improving it before it was declared ready for production. From a mechanical point of view, this 200-horsepower engine is the most interesting part of the new car. Its light weight gives it the extraordinary ratio of one horsepower to 4.65 pounds engine weight. Carburetion and manifolding have been perfected and simplified by an adaptation of the principle of equi-distant down-draft manifolding originated several years ago by Marmon. There is but one carbureter but this is of the duplex down-draft type. The crankcase is ventilated by the up-draft system. Full

pressure lubrication is provided for every rotating bearing. Other equipment on the engine includes an oil filter, an air cleaner, and a gasoline filter. A three-speed transmission is used, second and third speeds being of the silent type. The Marmon sixteen represents, in many details too numerous to be mentioned, complete coordination of effort between designer and engineer.

Coincident with the presentation of the sixteen, Marmon also announces two new straight eights to round out its line in the more popular priced fields. The first of these is the Marmon 88, of 125 horsepower on two wheelbases, to sell in the 2000-dollar class. The other is the Marmon 70, of 84 horsepower, in the 1000-dollar field.

The new Pierce-Arrow line for 1931 is presented in one custom group by LeBaron and three standard groups. All of these are longer, larger, have many structural improvements, and are the most powerful in Pierce-Arrow history. Of the new major mechanical changes that have been made the most important is the adoption of the Pierce-Arrow designed free-wheeling principle, already regarded by engineers as ranking in importance with the self-starter, four-wheel brakes, and balloon tires.

Oakland's most important change is found in the new synchro-mesh transmission which, combined with the 85 horsepower developed by the improved V-type eight-cylinder engine, provides easy gear shifting and quiet acceleration. Rubber insulation has been used liberally on both this car and the Pontiac six which has been lengthened to a wheelbase of 112 inches. The Pontiac's 60-horsepower engine has been further refined and both the Oakland and Pontiac have new carbureter intake silencers, new electro-plated cylinders, stronger frames, and heavier rear gears.

The trend toward airplane lines noted in some of the new cars is considerably advanced in the Reo-Royale Eight, the first eight cylinder car to come from Reo engineers. The engine for this car, the leader of the new Reo line, is an L-head straight eight delivering 125 horsepower. The Flying Cloud Eight and Six, recently announced, are more powerful than before and are presented in new dress that adds to their appearance of fleetness. The Royale and the Flying Cloud models are equipped with "silent-second" transmissions; bodies have been made roomier; and slanting windshields are equipped with shatter-proof glass. In Reo's full pressure oiling system all tubing inside the engine for conducting lubricating oil has been eliminated. All the oil goes through an oil filter and then to passages drilled entirely in the engine body.

Nash has just announced four new groups of cars ranging in price from 795 dollars to 2025 dollars. Twenty models are in their three new straight-eight series and the six-cylinder group. The horsepower developed by the engine of the eight is 115 compared to 100 in the former Twin-Ignition eight. Perfected, twin-type carburetion accomplished by twin manifolding and duplicate fuel jets is a feature of particular interest. Other distinguishing features of Nash models include: rifle-bored connecting rods for force feed oiling to the piston pins; thermostatic control for water circulation; oil filter and air cleaner; new easy operating clutch; silent transmission; and automatic chassis lubrication.

The Franklin Automobile Company presents two new lines of cars with the well-known Franklin air-cooled engine. Ten body types are in each of these, one of which is known as the De Luxe line, the other as the series 15 Transcontinent. Both series employ the same power plant which is said to have an increased output without increase in size. In the De Luxe models, built on a wheelbase of 132 inches, the tread has been increased to 60 inches. These models also have four-speed transmission while the Transcontinent models have three-speed transmission. All models have shatter-proof glass in windshields, doors, and windows. Many other features have been improved and it is said that the new Franklin is more truly an airplane type—due to its airplane-type motor, lightness, and body design—than ever before.

The 1931 Chevrolet is presented in nine body styles. While the new car reveals no fundamental changes, it has a number of improvements, notable among which are a more durable clutch, smoother and quieter transmission, and new steering gear which makes for easier steering. The hood is longer on the new Chevrolet and the wheelbase is lengthened to 109 inches. The prices are lower than ever before.

In November production was started on the completely new Willys-Overland line. This new line ranges in price from the lowest priced Willys six roadster at 495 dollars through the Willys eight to the highest priced models of the Willys-Knight six at 1195 dollars. Double-drop frames, duo-servo four-wheel brakes, a reduction of the unsprung weight, an increase in the tread, a fuel pump to replace the vacuum tank, optional gear ratios, an entirely new carbureter, and a flame arrester for all carbureters to prevent fires that are caused by back-firing, are some of the more than 100 improvements in the Willys line.

An improvement of major importance is found in the installation of the Float-O oil device which assures adequate lubrication under all conditions. Normally the oil is sucked from the oil pan through a screen and suction bell which is permanently attached as close to the bottom of the oil as possible; but in the new device, the suction bell and screen are pivoted on an arm and float on top of the oil. As the oil decreases in volume, the Float-O device follows it down. The advantages of this arrangement are: the clean oil from the top of the pan is always that in circulation, and the dirt and sludge that accumulates in the bottom of the pan are always at rest. No matter how stiff the oil, the device eats its way down into the oil until it has reached the bottom of the pan.

This brief review will show that, taken as a whole, the automobile industry during the past year has been exceptionally busy preparing better, safer, more comfortable cars. And it is to the credit of many individual companies that they are giving this year more value than ever before; that, despite numerous improvements in design, mechanical equipment, and riding quality, prices on some cars have already been lowered.

We are indebted to the manufacturers for their kind co-operation in supplying the advance information contained in this article. We regret that, for various reasons, no information was available on those cars not mentioned.

BOOKS SELECTED BY THE EDITORS

PHOTOCELLS AND THEIR APPLICATION—*By Zworykin and Wilson, Research Engineers, Westinghouse Research Labs.*

THIS book fills a big hole and fills it full—there has been no good modern treatise on the photo-electric cell. So this is good news for experimenters, inventors, television workers, and everyone of scientific bent who wants to get an understanding of one of the most promising tools science ever has made available. "It is high time," say the authors in the preface, "that the public in general should be introduced to the modern 'electric eye' and be taught its normal characteristics and its special idiosyncrasies. It has been the distinct aim of this book to do just that thing. The authors have attempted to assemble reliable information from the thousands of articles scattered throughout the world's literature, sift the significant from the inconsequential, and present the residue in the light of their own training and long experience with the subject." These authors, we think, have made good that aim—the book is a treasure; not too technical but neither is it shallow; in short, a practical book for practical people.—$2.65 postpaid—*A. G. I.*

LIVING AFRICA—*By Professor Bailey Willis, Carnegie Institution*

HERE a noted geologist combines a running, popular account of his wanderings afoot and afield in eastern Africa with a scientific discussion of the great "rift valleys"—vast splits in the earth's crust which he went there to study. Students of geology will be able to follow the account in its scientific aspects and all will find the daily account of travels as fascinating as most travel books are.—$4.20 postpaid—*A. G. I.*

FLIGHTS FROM CHAOS—*By Professor Harlow Shapley, Director, Harvard College Observatory*

DR. SHAPLEY has undertaken the grandest task ever done—arranging in an orderly system of systems—wheels within wheels—everything in the known Universe, from electrons to solar system, from solar system to galactic systems and from galactic systems to the "Metagalaxy," the latter being possibly 100th the diameter of the as-yet unfathomed entire Universe. The most interesting chapters pertain to the vast astronomical entities which only now are being explored and measured. The book assumes an elementary knowledge of astronomy.—$2.65 postpaid—*A. G. I.*

THE MYSTERIOUS UNIVERSE—*By Sir James Jeans*

AGAIN Jeans has given the scientific world a notable book. His work of last year, "The Universe Around Us," a broad picture of modern cosmology, became a scientific best seller. The present work ranks easily as high, though it is different, being more philosophical, more thought-provoking, and centering around the one Great problem which never has been solved—that of the real ultimate nature and meaning of the universe. The chapter headings tell the contents quite fairly. These are: The Dying Sun; The New World of Modern Physics; Matter and Radiation; Relativity and the Ether; and a final chapter entitled, Into Deep Waters, containing Jeans' own attempt to explain the mystery of ultimate reality. Though it is not a large book it covers a remarkably broad territory, touching on everything new in modern physics, astrophysics, and cosmology. Many men of science now are leaning toward a non-materialistic interpretation of the universe and Jeans is one of these. Editors see many new books and perforce must skim or pass by most of them. This one is reserved for a second reading.—$2.40 postpaid—*A. G. I.*

PROFESSOR Einstein's visit to America has brought about an increase of interest in the theory of relativity. To meet this the following list of recommended works, listed in approximate order of abstruseness, has been prepared.

Bertrand Russell—A B C OF RELATIVITY. Considered the best of numerous popular expositions.....Postpaid $2.70

Bird—RELATIVITY AND GRAVITATION—*Scientific American* prize essays. .....$2.15 postpaid

Eddington—SPACE, TIME AND GRAVITATION. By Einstein's best nonpopular interpreter. .....Postpaid $5.20

Einstein—SPECIAL AND GENERAL THEORY OF RELATIVITY. In English. Requires high school mathematics and a little calculus, and represents the author's effort to lighten his most abstruse discussions. .....Postpaid $2.70

Einstein—MEANING OF RELATIVITY. In English. Requires a knowledge of advanced mathematics. Postpaid $2.20

Should additional information concerning references be desired, if you will address the Book Editor, L. S. Treadwell, he will aid you in every possible way.

A MANUAL OF CELESTIAL PHOTOGRAPHY—*By E. S. King, Prof. Astronomy, Harvard Observatory*

THOROUGHLY practical, and illustrated, this book contains 22 chapters of definite instructions for making astronomical photographs through refracting and reflecting telescopes large and small, both for professional and amateur astronomers. It includes equally practical chapters on the surrounding phases of this work and hobby, such as photographing spectra and meteorites in flight, special developing, and darkroom advice. This new book puts into readily available, usable form the lifetime experience of a noted expert, with all the little wrinkles and kinks which so often make the difference between failure and success freely thrown in. Amateur telescope makers not intending to make astronomical photographs will, nevertheless, learn much about everyday work around an observatory from this book.—$3.20 postpaid—*A. G. I.*

MAN AND THE STARS—*By Harlan T. Stetson, Director, Perkins Observatory*

ONE of our leading astronomers presents the most interesting aspects of astronomy in popular, readily assimilable, easy, comfortable-reading form, choosing the developmental approach; that is, he starts with early astronomy and follows its growth to our times. The second half of the book concerns the new astronomy and a final section discusses questions most frequently asked by laymen—Is there life on other planets? Has life any cosmic significance? Has science displaced religion? Readers are certain not to fall asleep over this book. 216 text pages.—$2.65 postpaid—*A. G. I.*

THIS THING CALLED BROADCASTING—*By Alfred N. Goldsmith and Austin C. Lescarboura*

TEN years of radio broadcasting finds the time ripe for an historical survey. But unlike most books to which the word "historical" can be correctly applied, the present one is full of human interest. In ten short years we have passed through a period in the development of communication and

FROM RECENT PUBLICATIONS

home entertainment in which events have happened with such bewildering speed that the average person has little concept of the background. This book goes behind the scenes from the earliest days of KDKA down to the present and supplies this background. The authors have broken up the text with trite and often silly and inappropriate sub-heads, but if one will disregard these and read the story of radio as a running narrative, we wager that he will be loath to put the book aside until finished. A chapter near the end of the book titled "Children of Radio" presents some of the developments in other fields that have come about as the result of discoveries in radio experimental work. Not a text book, nor technical in any sense of the word.—$3.70 postpaid—*A. P. P.*

HORTUS—*By L. H. Bailey*

THIS is a concise dictionary of gardening and horticulture for growers, propagators, landscape architects, botanists and students, by a world-wide authority who has been honored by the highest offices attainable in this branch of science. It gives brief descriptions, correct botanical and common names, and notes on culture and propagation for every group of plants in common cultivation in the United States and Canada. The format is particularly well chosen. Headings stand out with sub-matter in proper proportioned size type, bold in the smaller type accentuating the paragraph initial lines. For ready and quick reference we have seen no better dictionary arrangement. 7 x 10. 652 pages.—$10.25 postpaid.

CULTURE AND PROGRESS—*By Wilson D. Wallis, Prof. Anthropology and Sociology, Univ. of Minn.*

"IN this exhaustive study Professor Wallis offers the first comprehensive and critical account of the various phases of culture and presents the first comprehensive survey of the theories of progress. He treats of the theories of progress, considering them in their historical development, and discusses the more important Utopias from the earliest time to the present. The book is a new approach to the essential character of our civilization."—quoted from the publisher's blurb on the jacket, which appears to be accurate. This is not light summer reading; it is intended for people who really do think.—$5.20 postpaid—*A. G. I.*

LITTLE AMERICA—*By Richard E. Byrd, Rear Admiral, U. S. N. Ret'd*

DELIGHTFUL personal day-to-day observations of that most interesting of all polar explorations. Sidelights of human interest concerning men and animals, tales of hardihood and scientific accomplishment, all welded into a most readable story surely no one should miss. Just enough of the technical results is included to inform the layman accurately —the full technical papers will subsequently appear as the real accomplishment to justify all the preparation, expenditure, and personal contribution of the members of the expedition. 422 pages. 74 illustrations.—$5.00 postpaid.

AMERICAN FIGHTERS IN THE FOREIGN LEGION—*By Paul A. Rockwell*

IT is exactly this information that this reviewer has often been curious about. Just who were these men, what inspired them to enlist in the French Army, what did they really do, and what became of them? Because of the various scattered sources of record it has been a vast task to piece together the complete biographies and necessarily these years must have intervened. Here is the story, however, and every page of it is full of interest as we follow these Crusaders of modern times. No more human account of the war has been written than this absorbing record.—$5.20 postpaid.

THE MARKS OF AN EDUCATED MAN—*By Albert Edward Wiggam*

THE widely known author of "The Fruit of the Family Tree" and "The New Decalog of Science" offers us something a little lighter this time; a series of 27 chatty, almost breezy, chapters each of which centers around one of the simple tests by which those of us who are entitled to attach an M.A. or a Ph.D. to the south end of our names (and incidentally the rest of us who can't) may ascertain whether our schooling really was worth all the effort it cost or whether we still are educated fools—provided we are frank with ourselves. For example, if you cultivate the open mind, never laugh at new ideas, get along with people, have acquired the habit of success, know truth from magic, live "a great religious life" and some eleven other things, you are worth saving; otherwise you seem to be a total loss. George F. Babbit liked this book. But there really are a few educated fools, at that. A good gift book.—$3.20 postpaid—*A. G. I.*

ANDRÉE—*By George Palmer Putnam*

TRAGIC adventure in all its starkness or rather the preliminary picture of a Quixotic undertaking, this stresses the remarkably interesting human being, who was a character unto himself, set amid the surroundings which inevitably developed because of the psychological problems which Andrée's nature, actions, and environment forced upon him. It seems almost impossible that an aeronaut and explorer of attainments could have been so almost childlike in some of the reasoning which governed his actions.—$2.65 postpaid.

POPULAR QUESTIONS ANSWERED—*By G. W. Stimpson*

LIKE its companion book, "Nuggets of Knowledge," this scientifically answers a myriad of popular questions such as 'does the upper point of a wheel travel faster than the bottom,' 'what determined the width of standard railroad gage,' 'why a cat always lands on its feet,' 'slipping of car wheels on curves,' 'does odor have weight,' 'does a horse push or pull a wagon,' 'which is heavier, wet or dry sand?', etc., etc., covering a very wide range of subjects.—$2.15 postpaid.

THE CACTUS BOOK—*By Dr. Arthur D. Houghton*

IF we can judge by our florist's windows the cactus hobby is growing, for we see miniature Japanese gardens with the dwarf Japanese trees missing and cacti substituted. These plants require infrequent watering and little care, so those whose plants usually die have an excellent chance of becoming successful indoor cactus gardeners. There are, however, in the present book, minute directions for providing the proper soils, moisture, and special treatment of an immense number of species. These tables occupy 31 pages. Many of the most popular as well as the rarest of cacti are illustrated. This family of plants is strictly limited to the American continent, which is an interesting fact. There are some growers who deal in nothing but cacti and even issue catalogues.—$2.40 postpaid.—*A. A. H.*

FOR YOUR CONSIDERATION

ESPIONAGE—*By H. R. Berndorff*

ORIGINALLY appearing in German to record a very large sale, the author was an officer of the line, later attached to the secret service and lately on the staff of the Crown Prince. Although some of the characters and events here described are the same as have been mentioned in other books, we find no striking repetition, for the sources of information are quite different and the relating of the stories is individual —in fact one does not sense any uninteresting overlapping. The romance of such characters has a gripping interest, especially when exceedingly well told as in this instance.—$2.65 postpaid.

UNDIPLOMATIC MEMORIES—*By William F. Sands*

AS personal advisor to the ill-fated Korean Emperor, these recollections tell the story of an unsuccessful attempt to avert the Russo-Japanese War, the prize for which it was fought being the destruction of the Korean Empire. First of all the "career" diplomats in American history, the accounts of court life, his adventures throughout the country, the descriptions of native customs, and so forth, are portrayed by a trained observer in an extraordinarily varied career and told with urbanity, candor, and unfailing modesty. It makes most interesting reading.—$3.20 postpaid.

HOUDINI'S ESCAPES—*By Walter B. Gibson*

THIS book was prepared from Houdini's private notebooks and memoranda with the assistance of Mrs. Beatrice Houdini and Bernard M. L. Ernst, President of the Parent Assembly of the American Society of Magicians. The latter states that it was Houdini's intention to give to the world many of his tricks and that if he had lived he would have written this book. The writer of this review knew Houdini intimately for over 35 years, "assisted" in some of his box escapes and never received the slightest information as to how one of his tricks was done. Perhaps this was a judgment for refusing to buy Houdini's handcuff trick for 25 dollars in the early days when this sum looked very large to "Harry." Certain of his greatest tricks are not described in this book such as the "Chinese Water Torture Cell." Other methods and escapes now used by professional magicians are also withheld from publication in justice and fairness to conjurers generally. The Society of American Magicians and Houdini's brother all had a hack at censoring the book. We might suppose that with such severe deletions the emasculated form would be worthless, but as a matter of fact enough remains to be of considerable interest. The book has many line drawings which elucidate the text.—$3.20 postpaid.—*A. A. H.*

OUTDOOR SPORTS THE YEAR ROUND

HUNDREDS of ideas for new and popular sports and the making of the necessary equipment, as well as many of the old favorites which have appeared in *Popular Mechanics.* One is amazed at the number and range of practical objects that can be made with the simplest tools and a bit of mechanical handiness. 7 x 10, 352 pages, 650 illustrations. A book that should be the jealous possession of every energetic lad who loves the outdoors and wants to build things.—$2.25 postpaid.

EXPERIMENTAL ELECTRICITY
By Ralph H. Walters, Inst., Los Angeles College

A MANUAL of experiments in direct- and alternating-current electricity designed especially for use in a terminal course in industrial electricity. It is distinctly a book for the student who cannot avail himself of a college training but who desires a knowledge of enough of the subject to fit himself for minor executive positions in engineering fields. The manual covers 59 experiments which represent a wide variety of topics.—$1.65 postpaid.

AIRCRAFT PROPELLER DESIGN—
By Fred E. Weick, Nat. Advisory Com. for Aeronautics

THIS book presents a discussion of the important theoretical, experimental, and practical developments which have been made in aeronautical propellers, particularly the great advances made during the past few years. Special attention is given to the influence of propulsive efficiency of airplane and engine design. A simple method is given, together with working charts, by means of which propellers can be accurately and quickly selected to fit any airplane for any operating conditions.—$4.20 postpaid.

OIL CONSERVATION AND FUEL OIL SUPPLY
By the National Industrial Conference Board, Inc.

IN this 165-page study of the economic forces and scientific advances that influence the world's use of fuel oil primarily and of other mineral fuels incidentally, there is indicated the possibility of a decline in the supply of fuel oil due to more efficient methods of gasoline production. To the United States, consumer of 60 percent of the world's production of fuel oil, such a decline would be catastrophic. Accordingly, in this volume are analyzed in detail the problems that would arise in such an event. The relationship of energy to civilization, industry, and trade; the competition between modern sources of energy; world supply and consumption of fuels; production and consumption of fuel oil in the United States are treated exhaustively; and finally, in connection with a discussion of the effects of a decline in fuel oil supply, it is set forth that present conditions are favorable for undertaking an oil conservation program. This work has been carefully built, stone on stone, so that the resulting edifice is a book of utmost importance alike to producers and consumers of fuel and power.—$2.65 postpaid—*F. D. McH.*

A ROVING COMMISSION—*By Winston S. Churchill*

FEW who measure this picturesque character by his effective occupation of positions of highest honor and responsibility in the British government realize that his early career rivals in interest and wealth of experience the most fictitious tale of any soldier of fortune. Educated at Sandhurst, drawn by a spirit of adventure into the Spanish pacification of Cuba, then several years of Indian frontier service, in Egypt against the Dervish, with Buller in the Boer War when he was captured, escaped, and became world renowned; finally in the South African Light Horse he saw the general pacification established. One cannot afford to miss this splendid autobiography.—$3.65 postpaid.

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COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

Radio Tube Patent Held Valid

THE validity of the Irving Langmuir patent for vacuum radio tubes, owned by the General Electric Company, was upheld by the Circuit Court of Appeals for the Third Circuit in an opinion handed down, reversing a contrary decision of the District Court for the District of Delaware.

The suit, according to the opinion, was instituted by the General Electric Company charging the DeForest Radio Company with infringement of the Langmuir patent in the manufacture of its tubes. The patent at issue, 1558436, was granted to Mr. Langmuir in October, 1925.

The Circuit Court of Appeals found that the DeForest company was manufacturing a tube within the description of the Langmuir patent. The similarity of the patents was pointed out and the chief point of difference declared to be in the fact that the DeForest patent, coupled with what is termed the "Fleming valve," operated in a gaseous tube while the Langmuir tube was non-gaseous and "of a very high vacuum."

The DeForest company had previously manufactured gaseous tubes but abandoned it for the vacuum type, upon which action the suit was brought by the General Electric Company.

For the final analysis, the court said, usefulness is the test. The tube in question it described as an agency which "because of its stability, reproductibility, and power has made possible radio broadcasting, modern radio reception, and long distance telephony."

"The fact that a non-gaseous vacuum tube makes possible the present improved practice shows such practice did not exist before the Langmuir tube and no other device or devices, all important as they may have been in their spheres, did either singly or collectively produce the present practice."

Without disregarding the all important part DeForest's audion and Fleming's valve play in the utilization of them in the Langmuir tube, the court said it remained for Mr. Langmuir "to so couple and coordinate the two by means of eliminating gas and using vacuum as to produce the tube here involved."

It was pointed out that in the gaseous tubes there was vast difference in behavior while, on the other hand, "the current in the Langmuir tube is practicable, steady, reproducible at any particular voltage." As to replacement the court pointed to the advantage of the Langmuir tube in that another of the same type can be bought and placed in the same socket. This was not true of the DeForest audion.

Prior to the Langmuir tube, it was noted, the whole trend of the art was against the use of a vacuum and even after he had shown its use, it was deemed impracticable.

"For the DeForest company now to contend the use of these extremely high vacua by Langmuir was simply the natural and to be expected growth of the art is to credit the ordinary art with a scientific capacity, which a master of the art like DeForest did not himself possess," the opinion concludes.

"Advance, inventive and non-inventive, was being made in the art, but the efforts were in other directions. We would not detract from the great advance of DeForest as exemplified by his audion and by Fleming with his valve, but great as these steps were—both separately and collectively—and we regard them as the foremost in the advance of the art in the sphere here involved—the gaseous tubes still continued to be used and the art generally regarded gas as incident, if not, indeed, indispensable to their use," the court declared.

The opinion of the court was written by Judge Joseph Buffington, with whom Judge J. Warren Davis concurred. A lengthy dissenting opinion, covering over 20 printed pages, however, was returned by Judge Victor B. Woolley.

Judge Woolley, in his dissenting opinion, declared that the Langmuir patent was invalid because of lack of invention and prior use. The majority opinion, he stated, was based "on what I am constrained to believe is an erroneous theory or finding that all discharge tubes before Langmuir were gaseous and that Langmuir's invention is a non-gaseous tube." He cited a number of prior publications and patents to show that Langmuir was not the first person to make and invent a non-gaseous tube. The first and original inventor, he declared, was Arnold.

MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.
—The Editor.

Anne Nichols' Plagiarism Suit Lost

THE decision by Federal Judge Henry W. Goddard in dismissing the 3,000,000 dollar suit by Anne Nichols against Carl Laemmle, Harry Pollard and the Universal Pictures Corporation for alleged plagiarism of Miss Nichols' play, "Abie's Irish Rose," in the motion picture production, "The Cohens and the Kellys," was upheld unanimously recently by the United States Circuit Court of Appeals.

The opinion, written by Judge Learned Hand, held that the Federal copyright laws had not been infringed by the mere fact that there were similar characters in each of the productions. He held that it was scarcely credible that Miss Nichols "should not have been aware of the stock figures, the low comedy Jew and Irishman." Most of the ideas in both the play and the cinema had been developed previously so many times it was ruled that they were "as little capable of monopoly as Einstein's doctrine of relativity."

Judge Hand concluded his opinion, which was concurred in by Judges Augustus N. Hand and Thomas W. Swan, by criticizing the extended testimony given at the trial by expert witnesses. He intimated that in proceedings before a judge sitting alone it would seem advisable to exclude such evidence on the ground that it serves "only to befog the issues."

Miss Nichols' play ran for five years after its opening in 1922. Later she sold the motion picture rights to the Famous Players-Lasky Corporation. The decision by Judge Goddard was handed down in May of 1929.

Lack of Distinction Prevents Registration

ASSISTANT Commissioner Moore held that Walter L. Fry, of New York, N. Y., is not entitled to register, under the Act of 1905, as a trademark for seat covers, a mark consisting of the surname "Fry" printed in black, the name being written with a capital "F" followed by a capital "R" and a small "y", the top of the "F" extending over the other two letters.

The ground of the decision is that the name is not written in a distinctive manner and therefore its registration is forbidden by the statute.

Plant Patent Aid Provided

AN Executive Order (No. 5464) recently signed by President Hoover, directs the Secretary of Agriculture to furnish to the Commissioner of Patents certain assistance in carrying into effect the Act (Public No. 245) providing for plant patents. (See page 490, June 1930 issue of SCIENTIFIC AMERICAN.—*Editor.*)

The Secretary of Agriculture is directed to furnish such available information of the Department of Agriculture, to conduct such research upon special problems, or to detail to the Commissioner of Patents such officers or employes of the Department, as the Commissioner may request for the purpose of carrying the act into effect.

Trade Commission Rule Amendments

THE Federal Trade Commission has amended its rules of practice relating to the filing of answers to the commission's complaints so as to complete or clarify the text of the paragraph covering the waiving by respondent of hearing on the charges set forth in the complaint.

The new wording specifies that when the respondent waives such hearing, the commission shall be authorized, "without

a trial, without evidence, and without findings as to the facts or other intervening procedure, to make, enter, issue, and serve upon respondent an order to cease and desist from the method or methods of competition charged in the complaint."

Full text of the second paragraph of the commission's rule as to answers (Rule III, Answers), as amended, is as follows:

(2) In case respondent desires to waive hearing on the charges set forth in the complaint and not to contest the proceeding, the answer may consist of a statement that respondent refrains from contesting the proceeding or that respondent consents that the commission may make, enter, and serve upon respondent an order to cease and desist from the violations of the law alleged in the complaint, or that respondent admits all the allegations of the complaint to be true. Any such answer shall be deemed to be an admission of all the allegations of the complaint, to waive a hearing thereon, and to authorize the commission, without a trial, without evidence, and without findings as to the facts or other intervening procedure, to make, enter, issue, and serve upon respondent an order to cease and desist from the method or methods of competition charged in the complaint.

English Adopt Slot Machines

VENDING machines through which medicines and other drug store articles are sold are almost absent from the American market, although there are many in England, it was stated recently by J. A. G. Pennington, of the Specialties Division, Department of Commerce. These machines are not present to any great extent in any of the continental European countries, he added.

The recent importation of such a vending machine by a pharmacist at Johannesburg, South Africa, aroused considerable interest, according to a report from Trade Commissioner Edward B. Lawson, Johannesburg.

This machine is a typical British "shilling-in-the-slot" device and has 22 drawers, each labelled. Due to the range of articles which can be sold through automatic vending machines, if the initial introduction is successful, other drug stores are expected to follow the lead.

Hair Tonic Advertising Copy Toned Down

A HAIR tonic sold in interstate commerce will no longer be advertised by the corporation producing it as a sure treatment for cultivating growth of the hair.

Signing a stipulation with the Federal Trade Commission, the company specifically agreed to cease and desist from advertising that its product is an effectual, or guaranteed, or a sure treatment for cultivation of hair growth; or that a fresh growth of hair is assured by use of the tonic; or that the company's method is the only way to grow hair; or that application of the tonic will produce a growth of hair.

Among representations in advertising to be discontinued by the firm, are the following:

"No need to be bald."

"Bald men grow hair quick."

"The only hair treatment yet devised which goes direct to the source of baldness."

"What I accomplished on my own head and on others I can do for you."

"I will prove to you free that I can grow hair quick."

"We know it will help you to re-grow your hair."

The company also agreed to stop the use of special or free offers unless they are made in good faith, or of other representations having the capacity to mislead buyers into the belief that the product described will produce the results mentioned, when such is not the fact.

Patent Applications Increase

RECEIPTS of applications for patents, including many for radio and talking picture equipment and refrigerators, during the 10 months ending Oct. 31, show that 1930 was the biggest year in the history of the Patent Office, Commissioner Thomas E. Robertson stated recently.

Applications for radio patents, the Chief Clerk, J. A. Crearley, said, have become so numerous that one entire division and portions of two other divisions have been assigned to this work. Requests for patents on sound picture equipment and refrigerators also have increased greatly in the last few years, he said.

Applications received during the 10-month period, Mr. Robertson said, showed an increase of 500 over the number for the corresponding period of last year. The total for the previous "peak" year, 1929, was 75,402, he explained, while from January through October this year the applications have reached 75,868.

An increase of over 1300 occurred in applications for trademarks during the first 10 months of this year, Mr. Robertson added, but there was a slight falling off in applications for "design" patents.

At the present time approximately 112,838 applications are pending before the Patent Office awaiting action. During the past six weeks this number of pending applications was reduced by over 5000. This was accomplished by the addition of a number of examiners authorized by the last session of Congress, and it is estimated that the total number of pending applications is now being decreased at the rate of 1000 a week. Nearly two years, at this rate, will be required before the Patent Office will be able to reduce the accumulation so that it can act upon every application within 60 days from the date it is filed.

Ice Cream Quality Protected

"BOOTLEGGING" ice cream is to be stopped by the Pennsylvania Department of Agriculture, according to a statement issued by the Director, Dr. James W. Kellogg, of the Bureau of Foods and Chemistry.

The substitution of an inferior product for a well-known recognized brand of ice cream is unlawful, the statement says, and a check is being made of the advertising and selling of ice cream throughout the Commonwealth.

The statement follows in full text:

The practice of "bootlegging" ice cream, which has come to the attention of the Department recently, consists of an unscrupulous manufacturer taking advantage of another manufacturer's contract for the sale of a well-known recognized brand of cream by submitting the former's own brand to be sold under the advertising devices and contracts of the other manufacturer.

In some cases these manufacturers entering into such a competition buy so-called ice cream mixes from wholesalers and without much equipment can arrange to complete the product by addition of flavors, fruit, etc., at a much lower cost than the person can afford to manufacture and advertise when operating a well-equipped ice cream factory.

Such a substitution of ice cream is in direct violation of the Ice Cream Law, section 3, which makes it unlawful for any person to sell any ice cream from any container which is falsely labeled or branded or to misrepresent in any way the place of manufacture of ice cream or the name of the manufacturer.

While the practice has not gained a very strong foothold in Pennsylvania, ice cream dealers are warned against the sale or substitution of so-called "bootleg" ice cream for the product which they may be selling under contract with other ice cream manufacturers.

A checkup is being made by agents of the bureau regarding correctness of advertising and selling ice cream throughout the Commonwealth and any persons found engaging in dispensing "bootleg" ice cream will be held responsible under the provisions of the Ice Cream Law.

Soap Maker Will Stop Patent Misrepresentation

A CORPORATION soap manufacturer signed a stipulation with the Federal Trade Commission agreeing to cease the use, on labels attached to the containers in which its products are packed and sold, of words indicating that it has a patented process, when such is not the fact.

(Names of individuals or firms signing stipulation agreements are not mentioned in the commission's press releases or publications, but the facts in each proceeding are presented to show methods of competition condemned by the commission as unfair, for the guidance of industry and protection of the public.)

Conflicting Shoe Mark Refused

IN a recent decision, Assistant Commissioner Moore held that Murray M. Rosenberg Inc., of New York, New York, is not entitled to register as trademarks for shoes, marks, the dominant feature of which consists of the words "Miles Shoes," in view of the prior registration by the W. H. Miles Shoe Company, Inc., of marks, the dominant feature of which is the word "Miles."

In his decision the Assistant Commissioner stated that the dominant feature of the registered marks is the word "Miles," the words "Blue Ribbon Brand" and "Extra Quality" appearing therewith being phrases relating to the grade of the shoes and the words "Greatest Values in the City" being merely an advertising slogan.

He then said:

"It is observed that the cited registrations are owned by the W. H. Miles Shoe Company, Inc. and it is believed that the average member of the purchasing public would believe that the 'Miles Shoes' originated with or are owned by the Miles Shoe Co."

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