

TRANSPORTATION TODAY

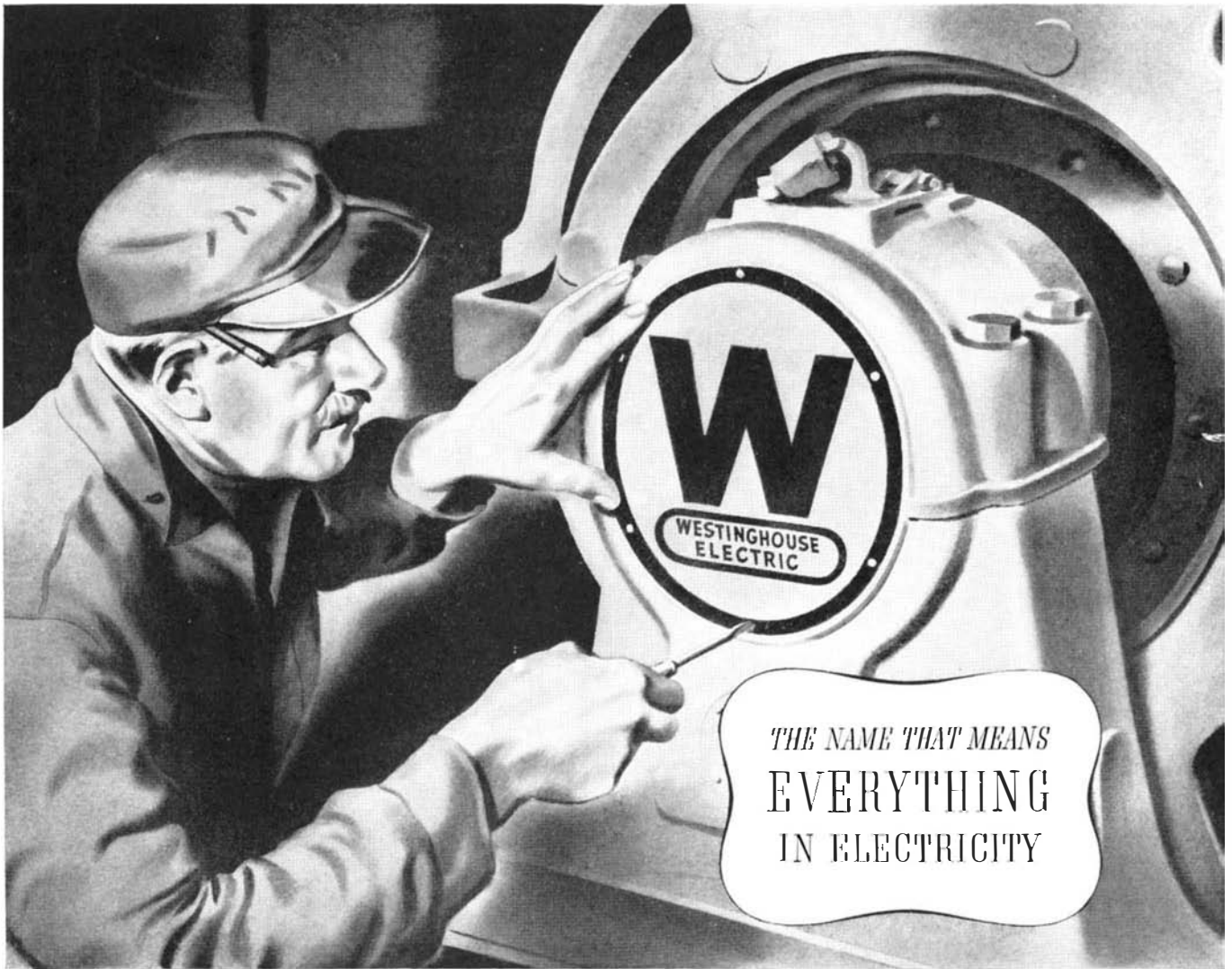
SCIENTIFIC AMERICAN

February • 1937

35c a Copy



ROBERT YARNALL RICHIE



In the dual meaning of a phrase is expressed the double foundation upon which a great institution stands: quality, and scope of service.

THE workman who attaches the Westinghouse name plate to a motor knows that it stands for 50 years of development, constant research, a reputation for dependable performance that is the pride of every Westinghouse man and his responsibility to maintain.

“The name that means everything” might call to mind a laboratory worker, searching for a better way to control power leakage. A workman at a bench, perfecting a

special tool for doing his job a little better. An inspector with his microscopic test equipment, as impartial and impersonal as a baseball umpire.

“... everything in electricity,” of course, suggests motors, meters, controls, circuit breakers, giant locomotives, heating and lighting equipment, household products of every sort. Its meaning should also include the equipment needed to *make and distribute* electricity: tur-

bins and water wheel generators, transformers, remote control systems — the list seems endless; some 30,000 products.

And so “the name that means everything in electricity” has a dual significance when applied to Westinghouse: a source of supply for practically everything electrical; a concern so thoroughly identified with electrical achievement that anyone may buy its products with utmost confidence.



Westinghouse

The name that means everything in electricity

The
SCIENTIFIC AMERICAN
DIGEST

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NINETY-THIRD YEAR

ORSON D. MUNN, Editor

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PERHAPS more romance is woven into the fabric of railroading than can be found in any other phase of transportation. Thus it seems peculiarly appropriate that this issue, containing as it does a series of articles on vital phases of transportation, should have for its cover illustration the dynamic photograph of a steam locomotive doing its prosaic every-day job of hauling traffic, yet holding a thrilling, romantic appeal.

50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of February, 1887)

POUGHKEEPSIE BRIDGE—"A glance at any map of the Eastern and Middle States will show the need of a bridge over the Hudson River at a point midway between New York and Albany. All traffic between the New England States and the West and South over either of the lines having a terminus at Jersey City is subjected to more or less delay, caused by crossing the Hudson at that point. The Poughkeepsie bridge, together with about twelve miles of road to be built between Poughkeepsie and Gardiner, will obviate this difficulty by making an almost direct route from Boston and Springfield to Scranton and the anthracite coal fields and Harrisburg."



INVENTORS—"By all means let us give every encouragement and aid possible to inventive genius. Instead of contracting, let us enlarge in every manner possible the scope and usefulness of the Patent Office. Instead of sneering at the 'crank' inventors of patent devices, let us honor them as the greatest benefactors of their race."

DIAMONDS—"Among the many theories existing as to the formation of the diamond, that of Professor Simmler, of Switzerland, is certainly not the least probable. . . . If carbon be soluble in liquid carbonic acid, it would then only be necessary to subject the solvent to slow evaporation; the carbon would thereby be deposited, and, by taking proper care, assume crystalline forms."

STUDY—"The acquisition of learning without study is like the acquisition of wealth without labor. It is as necessary for the mechanic to study out his problem when it comes to him to be studied as it is for him to finish his task by his handicraft."

SUBMARINE—"Submarine boats are a much older invention than is generally conceived; but they are now coming prominently forward . . . because modern devices have rendered it possible to construct vessels which can be propelled safely beneath the surface of the water. Who first suggested the idea is not known; but it seems well authenticated that in the reign of James I, a Dutchman named Drebbel designed a boat which was actually propelled by twelve oars under the surface of the Thames, the air being re-vivified by some liquor, the composition of which Drebbel kept a secret."

SALT—"One of the most remarkable salt formations in the world is located on the isle of Petit Anse, Southwestern Louisiana. . . . The deposit is pure crystal salt. So far as it has been traced, there are 150 acres of unknown depth, explored 140 feet down."

YACHT—"The Harlan & Hollingsworth Company has lately finished for Mr. William K. Vanderbilt the steel yacht *Alva*, the finest pleasure ship afloat, at a cost, it is said, of about one million dollars."

TRAIN HEATING—"The frequency of accidents and loss of life arising from car-heating stoves is awakening public attention everywhere, and even

railroad officials are beginning to realize the necessity for some safer means of warming their cars than are now in use. The heating of cars by steam from the locomotive would seem to be the most effective and the least objectionable method; but railroad engineers are almost unanimous in their condemnation of the use of steam for the purpose."

FUEL—"It appears, after an experiment of several months, that ferry boats plying between San Francisco and Oakland, which have been fitted up for burning petroleum, have now gone back to coal. The economy, as we understand, so far as the consumption of fuel is concerned, is said to be decidedly in favor of petroleum; but the trouble in its use came from the intense heat produced, by which, or by the peculiar nature of the combustion, the iron of both the furnaces and boilers began to indicate rapid deterioration."

COCAINE—"A number of cases of confirmed cocaine habit have recently been reported. While some of them lack confirmation, it is certain that several physical and mental wrecks have been caused by the excessive use of this alkaloid. . . . If the cases continue to multiply, there may be room for questioning the utility to man of the discovery of this anesthetic. It is doubtful if all the services in local anesthesia rendered by it can compensate for the ill it has already done."

SWING BICYCLE—"The bicycle shown in the accompanying engraving is the invention of Mr. Nathaniel Brown, of Emporia,



Kans. The wheels are secured to the outer ends of two hollow axles or shafts, which are mounted upon a central shaft, and are formed with ratchet wheels and friction disks. . . . The pulling of the levers downward starts the main wheels forward, and at the same time swings the seat forward, thus moving the pawls carried by the arms supporting the seat backward. . . . As the levers are moved forward, the swing of the seat toward its normal position will act to advance the bicycle, and by so reciprocating the levers it will be seen that a pendulum motion will be imparted to the seat, which will, when once started, propel the machine for some time."

STRAW HOUSE—"At the forthcoming American Exhibition in London, we are promised . . . a house of straw . . . two and a half stories high, and covering a space of 42 feet by 50 feet. It is constructed entirely of materials manufactured from straw—foundations, timbers, flooring, sheathing, roofing, everything in fact, including the chimneys—the material being fire proof as well as water proof. The inside finish is to be in imitation rosewood, mahogany, walnut, maple, ash, ebony, and other fine woods, the straw lumber taking perfectly the surface and color of any desired wood."

DAMS—"Among the most important dams built in California are:

The Bowman dam, height 100 feet, length 425 feet; three dams owned by the Milton Mining and Water Company, forming the English reservoir, the largest of these having a height of 131 feet; the Fordyce, of the South Yuba Canal Company, 567 feet long and 75 feet high, catchment basin, 40 square miles; the Eureka Lake dam of the Eureka Lake and Yuba Canal Company, length 250 and height 68 feet."

AND NOW FOR THE FUTURE

☞ *Consider the Dinosaur*, by Roy Chapman Andrews

☞ *The Cruiser in Naval Tactics*, by Walton L. Robinson

☞ *The Problem of the Holy Shroud*, by Paul Vignon, Sc. D.

☞ *More Power for the Locomotive*, by Prof. Edward C. Schmidt

☞ *San Gabriel Dam, A Mighty Engineering Project*, by Andrew R. Boone



SAVE

HOW MUCH DOES THE TELEPHONE ~~COST?~~

It is easy to figure how much the telephone costs. It is not easy to reckon how much it saves.

A single telephone call may save a life—brighten a friendship or a day—sell a bill of goods or land a job.

One telephone call may be worth more to you than the cost of the service for months and years to come.

The telephone saves you priceless hours of time each week—spares you trips through snow and storm these uncertain winter days.

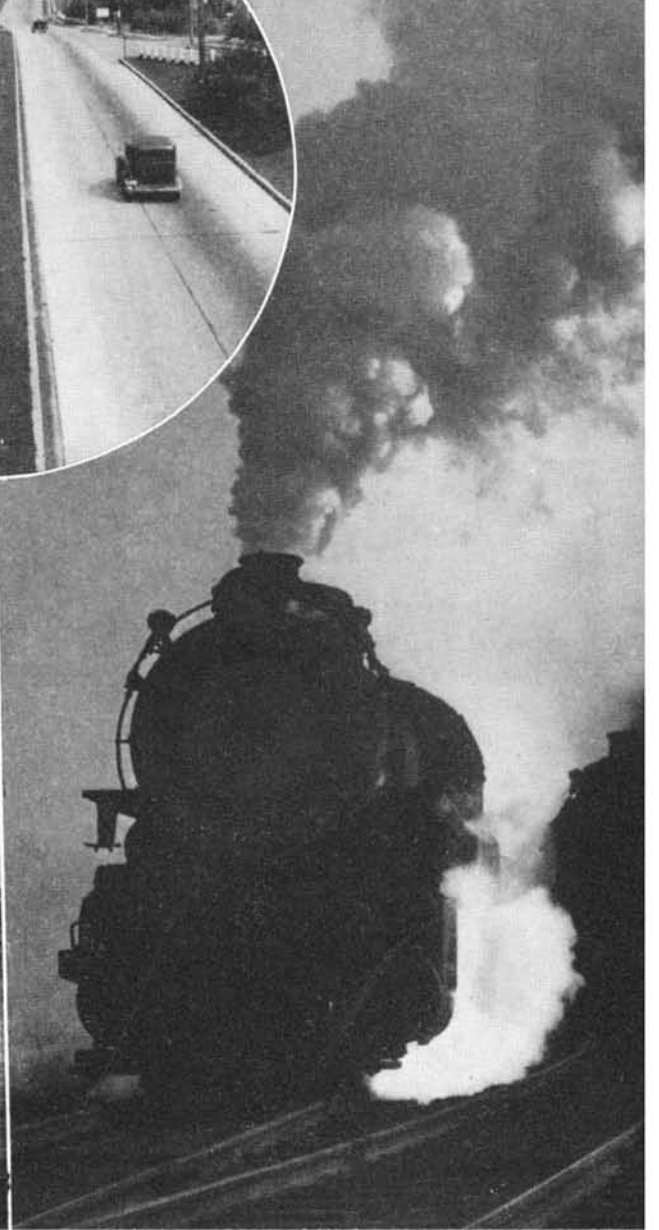
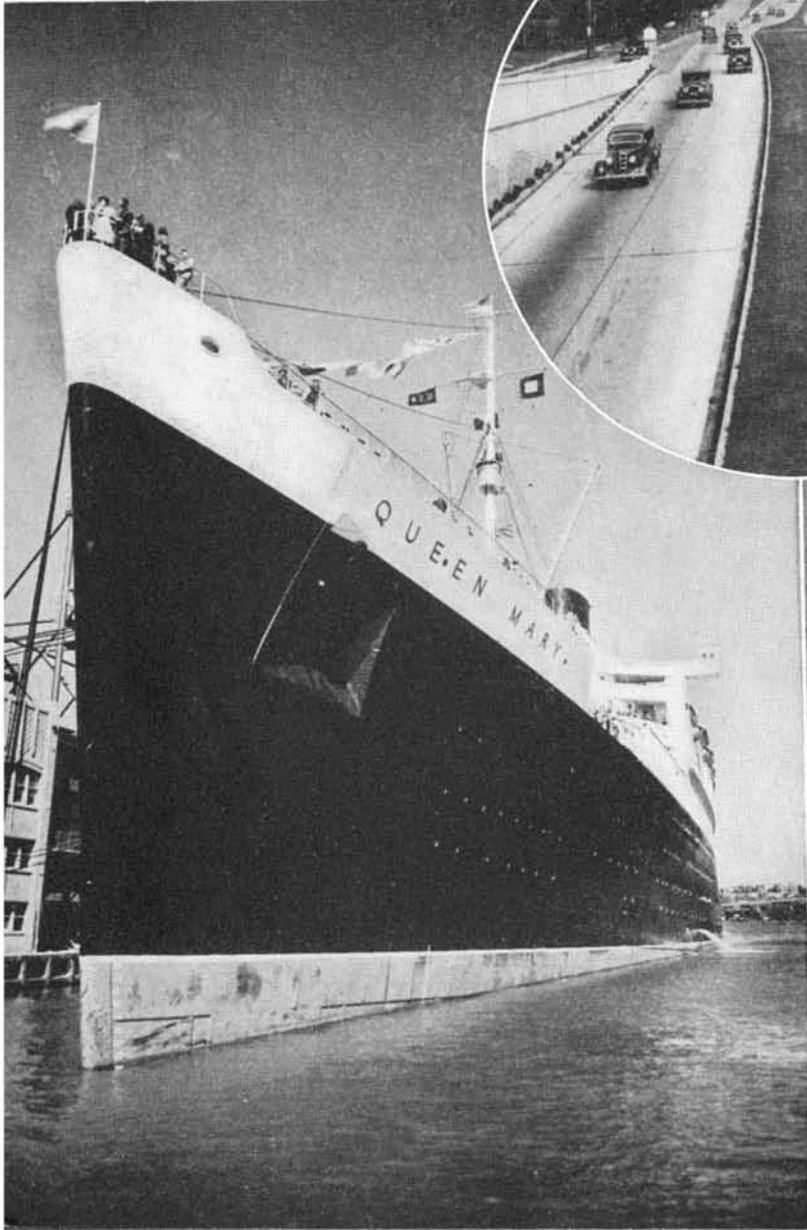
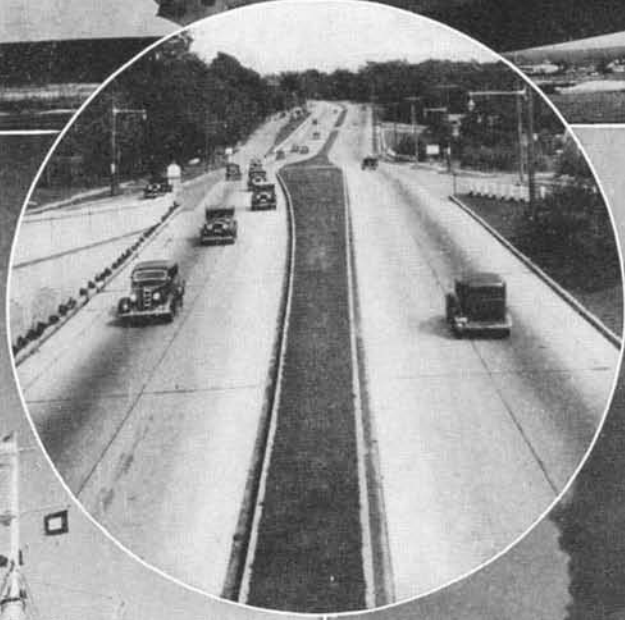
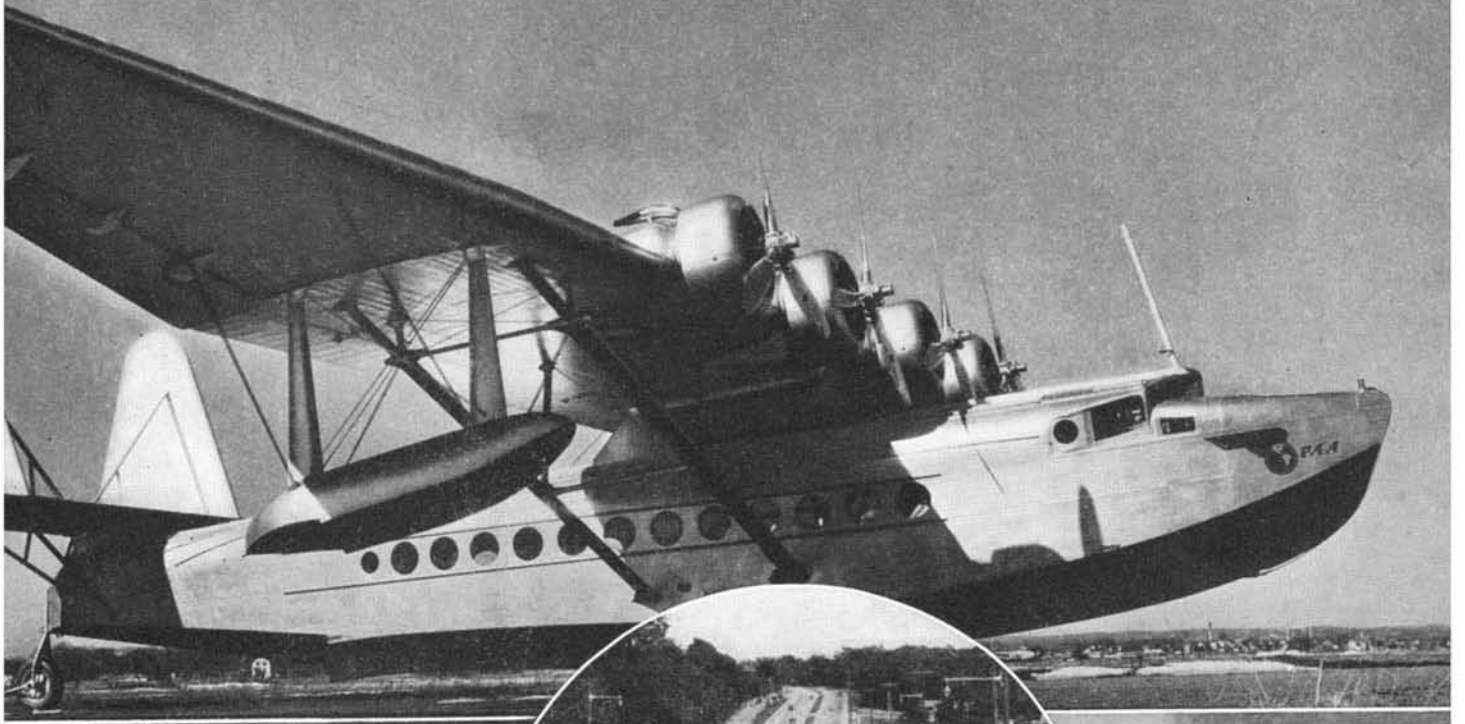
Without moving from the warmth and comfort of your own fireside, you are in touch with stores and friends and office—by telephone. The cost is but a few cents a day. In return, the telephone offers you

increasing measure of security, convenience, happiness and achievement.

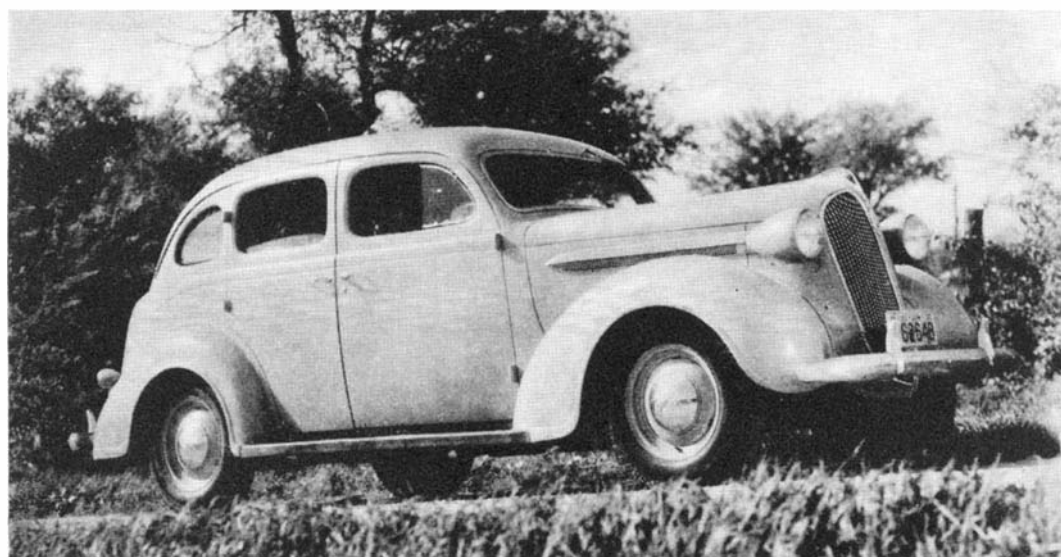
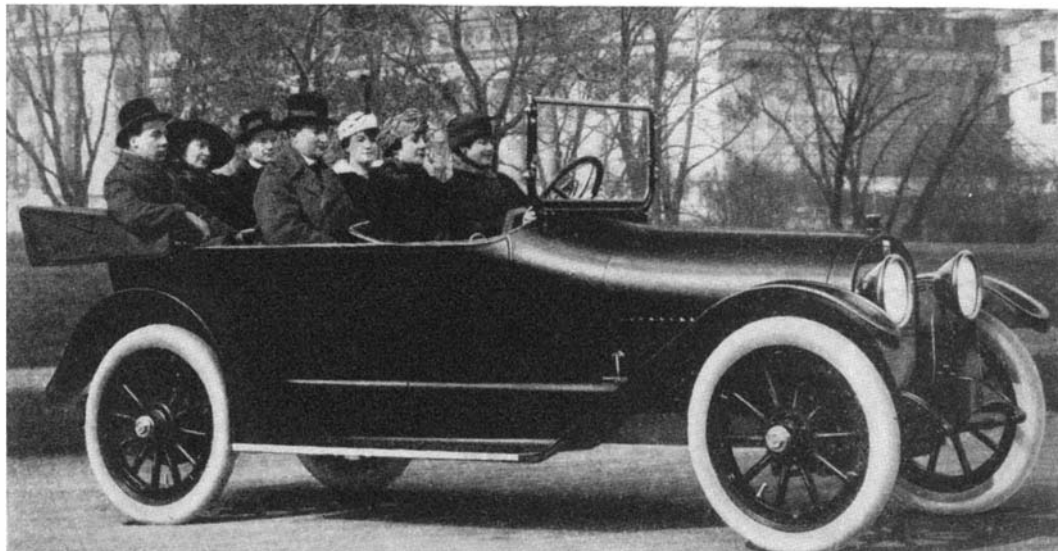
Every time you call a number, you use some part of a nation-wide telephone system that cost more than four billion dollars to build and employs about 300,000 people. The facilities of this entire organization are yours to command—anywhere, any time, and at small cost.



BELL TELEPHONE SYSTEM



In 1915 you would have had to pay 1550 dollars for this touring car that offered plenty of fresh air and sunshine, a not too smooth running motor, high-pressure tires, one-man (?) top, noisy gears, and other modern—at the time — improvements, including electric lights, but . . .



In 1937, you can buy this four-door touring sedan for 680 dollars, f.o.b., with low-pressure tires, safety glass, silent gears and hypoid rear end, quiet motor, ventilated interior, and all the other advances in automobile construction that have been made possible by improvements in materials and production

THE RÔLE OF THE AUTOMOBILE

IN the history of the various forms of transportation, the automobile has a unique place. Before its advent the railroad had dramatically reduced the time necessary for transporting both goods and passengers to a fraction of that required in the days of the Conestoga wagon or the stage-coach; since its development the airplane has cut this time element to a still smaller fraction. The rôle of the automobile has been to provide an *individual* means of transportation, available for the great mass of people, which has succeeded in annihilating distance to an extent that we can realize only by comparing travel today with travel only a short forty years ago.

If automobile manufacturers had envisioned their industry only as producing

**Individual Transportation . . . Has Transformed
The National Scene . . . Steady Decline In Price
. . . Safety A Paramount Issue In Design**

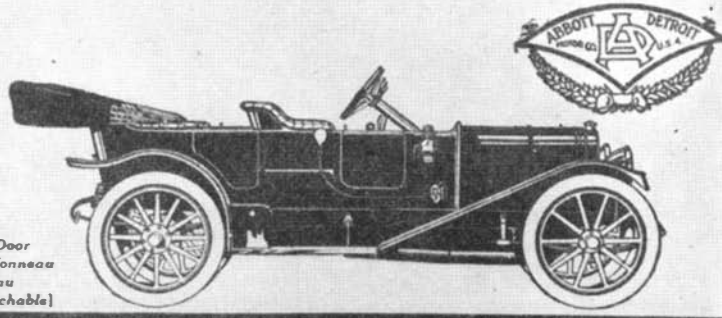
By WALTER P. CHRYSLER

Chairman of the Board, Chrysler Corporation

another means of transportation, the automobile would not today hold anything like the place in American life which it now commands. It would certainly be important, but it would not be necessary. As an individual means of transportation within the reach of something like two thirds of all American families—and rapidly being extended to this final third—it has transformed the national

scene. The American people have obtained a mobility which is one of the outstanding phenomena of the present age. In conjunction with the roads, construction of which it has fostered, the automobile has brought the country to the city and the city to the country; it has broken down all barriers of distance; it has offered millions a recreational activity whose popularity is at-

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Fore-Door
 Demi-Tonneau
 (Tonneau
 Detachable)

The \$1500 Abbott-Detroit
In Many Respects Equals \$4000 Cars

THE Abbott-Detroit is the one fully standardized motor car sold at \$1500. It equals in many features and in its record many cars sold up to \$4000. Its painting and trimming specifications are parallel to those of any \$4000 car on the market. The Abbott-Detroit has Chrome Nickel Steel Construction in the transmission and rear axle with imported F. & S. Annular Bearings and Timken Roller Bearings. The Abbott-Detroit has a complete electric light equipment of two electric head-lights and combination electric and oil side and rear lamps and Bosch High Tension or Splittorf dual ignition system.

**We Cannot Mention Here All
 The Features You Should
 Know About**

If we had the space to point out to you every part of the Abbott-Detroit has been brought to such a state of perfection that we find it impossible to make any improvements, we could make you an Abbott-Detroit enthusiast. We simply ask you, however, to consider this conclusive evidence of thoroughbred quality—that the Abbott-Detroit has never failed to place in a race of endurance run and has defeated some of the best cars built regardless of price.

**Let Us Send You All
 The Vital Information You Need**
 The Catalog of the Abbott-Detroit will open your eyes to the fact that when you purchase the Abbott-Detroit, you will get more for your money than you ever expected to get in any motor car. We can show you a purchase that will be one of the real satisfactions, the genuine value of your entire experience.

**Just Sign Your Name
 And Address To The Coupon**
 Then tear it out and mail it. We'll send you the Abbott-Detroit Illustrated Catalog by return mail and prove to you that this is the car you want and must have just as soon as you realize what a wonderful car the Abbott-Detroit car is, especially at \$1500. And to Dealers wanting territory not already closed we'll be glad to make our regular Agency Proposition. Our production is limited and large contracts are closed. Prompt action is important. **PRICE** Model B, Five Passenger Touring Car, Standard Equipment, \$1500 F.O.B. Detroit. Roadster, Standard Equipment, \$1500 F.O.B. Detroit. Four-door Touring Car, Standard Equipment, \$1500 F.O.B. Detroit. Standard Equipment, \$1500 F.O.B. Detroit. Coupe, Standard Equipment, \$1500 F.O.B. Detroit.

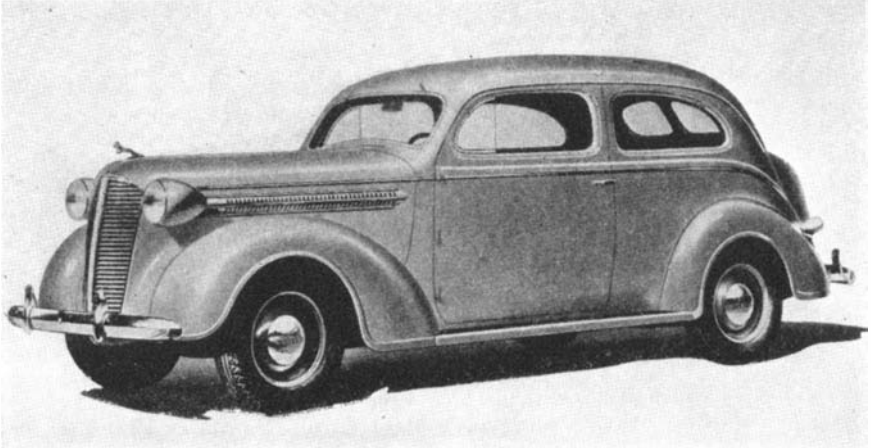
Abbott Motor Company
 121 Waterloo Street Detroit, Michigan

"The Place for You to Sign"

Name _____
 Address _____

tested by traffic on our highways every day of the year. This has been brought about by the relentless pursuit on the part of automobile manufacturers of two major objectives: consistent improvement in the mechanical operation of the automobile, and a steady reduction in its price to purchasers. The inventive genius, the patient industry, the forward-looking spirit which were the hall-mark of the inventors of the automobile, have characterized the industry since its inception. It has never been content to rest on its laurels; it has never been content to accept last year's models as the best it could produce. As everybody knows, the popularity of the automobile has increased by leaps and bounds. What has made possible this remarkable growth in the number of automobiles is an even more absorbing chapter in the history of transportation. It would not have been possible

Above: Reproduction of an advertisement that appeared 27 years ago in Scientific American, extolling the virtues of a car of the times. Compare the details with the photograph, below, of a 1937 motor car that represents the latest in automotive engineering and body design



except for the development of mass production and the steady decline in prices of motor cars as patient research has developed more economical methods of manufacture. In achieving these twin ends, the industry has also provided a means of livelihood, on a steadily ascending scale, for an ever larger number of persons—it today does so, directly and indirectly, for some 6,000,000 wage earners, one out of every seven gainfully employed.

OFFICIAL figures for the industry in the United States and Canada show that the average value of the 4000-odd passenger automobiles produced in 1900 was over 1000 dollars and during the next decade this average figure increased rather than declined. There was a vast improvement in the construction of the automobile, but this improvement meant higher costs. The average value of the automobiles manufactured in 1906, for example, was almost 2000 dollars apiece. By 1912, however, this trend was definitely reversed. The average value fell to less than 1000 dollars and in the years just prior to our entry into the World War the average value of an automobile was not much more than 600 dollars.

In succeeding years economic conditions caused an interruption to this downward trend but it was soon resumed and in 1929, when production reached its peak with an output in that one year of 4,795,000 passenger cars, the average value of an automobile was again about 600 dollars. But if the industry was then forced to curtail production, the depression brought no halt in its intensive efforts to build at the same time better and more economical automobiles. The average value of the greatly reduced number of cars manufactured in 1932 was approximately 550 dollars and in 1935, with production again on the upward grade, this figure had still further declined to a little more than 500 dollars. It need hardly be stated that this reduction in the price at which the average citizen could purchase an automobile

was not brought about at the expense of quality of the product. In ease of operation, in efficiency, in durability, in appearance, in economy, and in safety, the automobile of today represents as marked an improvement over that of a decade ago as did the automobile of 1927 over that of 1917, or the 1917 model over that of 1907.

More money has been expended during 1936 to meet the steadily rising demand for automobiles than in many years. New plants have been built and equipped with the most modern labor-saving machinery, obsolete machinery has been replaced, and manufacturing processes have been improved and speeded up all along the line.

BUT possibly the most important development in the manufacture of today's motor cars has been the very definite increase in their safety. The automobile industry fully recognizes its responsibilities to the public, and no expense or effort is being spared to make the modern car as safe as is humanly possible.

Figures compiled by the National Safety Council, Inc., show that motor transportation is today the safest of all means of transportation on the basis of occupant mileage. It is being made safer every year. With the support of the motoring public, still further progress should be assured for the future.

The industry is meeting the problem directly with its manufacture of safer cars. The safety steel body, hydraulic brakes, safety interiors, safer steering, easier control, and better vision are steps along this path. The modern car is practically unbreakable, and the danger of faulty parts has been almost entirely done away with. But manufacturers cannot control the human element in automobile operation. If complete safety is to be assured, these remarkably safe cars must be driven

Century Chainless Automobiles
No. 2 Steam Horizontal. Price, \$900.
Have many exclusive features: Flexible Frame, One Hand Control, Bevel Gear Drive—No Chain, Facile and Transmission running in oil, Large Fuel and Water capacity, Instantaneous Foot Reverse, and a Horn with a pilot light that doesn't blow out.
Like Ribbon Wiper Long Island Engine, Valve Control. Second of its kind. New Catalogue Ready.

Tubular Steel Wheels
... for ...
AUTOMOBILES
AMERICAN TUBULAR WHEEL CO.
Dept. C.
JERSEY CITY, N. J.

OUR STEAM CARRIAGES EXCEL IN EASE OF HANDLING
Reliability, Running Qualities, Strength and Finish, impossible to tell all about them here. Write us for catalogue. Inquiries cheerfully answered. Desirable agents wanted.
THE CONRAD MOTOR CARRIAGE COMPANY.
117 Niagara St., BUFFALO, N. Y.

DISPENSE WITH A HORSE
and save the expense, care and anxiety of keeping it. To run a motor carriage costs about 3¢ cent a mile.
THE WINTON MOTOR CARRIAGE
is the best vehicle of its kind that is made. It is handsome, strong and yet light-weightly constructed and elegantly finished. Easily managed. Speed from 8 to 24 miles an hour. The hydrocarbon motor is simple and powerful. No odor, no vibration. Suspension Wire Wheels. Pneumatic Tires. Ball Bearings. \$275. Send for Catalogue.
THE WINTON MOTOR CARRIAGE CO., Cleveland, Ohio.

Cribune Bicycles
\$50.00 and Upward.

Orient Motor Cycle

At the turn of the century. Ads from Scientific American. One at lower left (1898) was the very first automobile ad to appear in any national publication



A "side winder," an old Peerless Voiturette. Photo by Turner

safely. To this end, the industry is cooperating in a nation-wide drive to promote reasonable safety policies.

In the development of the modern car, the industry has not by any means come to the end of the road. The 1937 models will not long stand as the last word in automobile construction. Research departments are working on further improvements as steadily as at any time in the past.

The record of the past few years, which have seen such a marked increase in the demand for automobiles, provides striking evidence of the public's reaction to this program for building better and safer cars. Automobile manufacture should continue to stand in the forefront of American industrial progress as this country once again renews its onward march in raising our national standard of living.

OUR POINT OF VIEW

Transportation and Recovery

TO borrow a cliché of the tripper and add substance to it: "The world is such a small place, after all—after all the shrinkage to which it has been subjected by scientific achievements in communications and transportation." To some, this, too, may sound like an old story but it is not except perhaps in the phrasing. Communications, it is true, have long since been stabilized so far as basic details are concerned; their most recent conquests have been primarily a matter of mileage and refinements. Not so transportation. Here, a great complexity of elements have had the attention of as complex a group of specialists. Transportation, in the past ten years, has made mighty strides; and its advances in the very recent past certainly is a new story. Has that story anything to do with our economic recovery? Perhaps.

In the past, the United States usually found and conquered a new frontier to lift itself from the depths of panic and depression. There was a belief that expansion of credit and re-employment of idle men depended upon new inventions opening up huge new fields of endeavor or the tapping of hitherto idle resources. In earlier days, it was a trek westward and a great forward surge of inventions that brought new wealth, employment, and a higher standard of living. More recently, a new industry, radio, is given the principal credit for our recovery from the economic distress of 1921. In the recovery of 1936, however, it seems to us that an old frontier, transportation, an old set of inventions have led the way.

The articles in this issue give but a brief résumé of the amazing accomplishments chalked up to the credit of various forms of transportation. To discover the part they have played in recovery of national well-being, one must, however, read between the lines. Whence came the initial impulse, is even less definite. Both the railroads and the automobile industry played star roles, with, perhaps, the latter having the edge.

The initiative of the automobile industry in laying out an aggressive, forward-looking program, in offering a finer product, expanding plants, employing more men, and in holding their national shows in the fall of 1935, started an unprecedented surge of buying which had repercussions throughout the industry and all those allied with it. Prosperity is contagious. Bonuses, higher divi-

dends, re-employment have resulted. Cars and trucks made in 1936 were 4,565,000 (estimated) as against 4,119,811 for 1935. Yet, as was noted in our January issue, the cars on the road today have an average age of five years, thus contributing a tremendous replacement market that has yet to be satisfied. Who will dare predict the number of cars that will be made in 1937 to take up this back-log!

What of the railroads? Long criticized for a complacent superiority complex that admitted no possibility of real competition on the American scene, these giants have bestirred themselves. The criticisms were never quite merited for the railroads have always moved forward quietly, unostentatiously. The time came, however, when competition and the depression so reduced income that a spectacular fight became necessary. The start of the fight probably dates back to the first air conditioning of trains by that grand old road, the Baltimore & Ohio, something the public could understand—and enjoy. Other roads rapidly followed suit. Then suddenly, like a meteor streaking across the land, came the first streamlined train. The public was enthralled. A score of similar trains followed rapidly. The public once more became railroad-conscious; and with the increased revenues the railroads are buying new locomotives, finer cars, rails, equipment. The final touch—a master stroke, say the experts—was the reduction of fares! For months now, all comment regarding railroads invariably has included an expression of amazement at the crowding of trains, the recapture of passenger and freight traffic by the roads. They are making money for the first time in years, and so are their employees and industries doing business with them.

We have left little space to discuss other phases of transportation. It is not that their part in recovery is doubted but rather because, with the above examples before you, you can, as we hinted, more readily read between the lines of the discussions in this issue. The progress and future possibilities of waterborne transportation is succinctly told by Kermit Roosevelt; aviation's very real progress by Reginald M. Cleveland; the mushroom-like growth of the trailer industry by Philip H. Smith. Buses fill an important niche in the question as I. B. Babcock so ably explains; and neither automobiles nor buses would take so important a part in American life were it not for our splendid

highways of which Alfred H. Swayne writes.

"Seven," to the ancients, was a magic number, as it is to some wood-knockers today. Seven important phases of transportation are discussed in this issue. Let us not deceive ourselves, however, for it is no magic that has placed these seven in the vanguard of national recovery. Rather is it a combination of virtues inherent in American industry that discovered and is conquering this new-old frontier. Initiative, enterprise, and courage, operating under the oldest, most successful economic system extant today, are lifting the country out of the depression "by its own bootstraps."

Dr. Diesel

JUST 40 years ago an inventor was elated when his invention blew up; to him the explosion proved the soundness of the principle he had so carefully developed. Shortly thereafter his invention was perfected, and since has slowly found an ever-widening use as it was slowly refined and improved.

The inventor was Dr. Rudolf Diesel, a university-trained engineer; and his invention, the compression-ignition, or Diesel, engine. Today it powers vehicles of the land, sea, and air, and supplies the driving force in practically every field where power is used. Its recent rapidly growing use is most remarkable, as is indicated by production records: Capacity of all Diesel engines built in the United States in 1934 totalled 750,000 horsepower; in 1935, 1,200,000; in 1936, 2,000,000!

Transportation is accountable for much of this more recent growth in Diesel use. In this field, Dr. Diesel's invention has a significant future; and our story of transportation would not be complete without tribute paid to the inventor and all those scientists and engineers who, following him, have tempered and strengthened the link in the chain of progress which he forged.

Diesels have a future so bright that no one can predict the ultimate extent of their use. Rapid headway is being made by them in many directions, and particularly in the field where spectacular effects are being obtained. How far such headway will carry them, only time will tell. But if Dr. Diesel could return to view the present results of the creation of his brain, on this its 40th anniversary, he could not help but feel a justifiable pride in his achievement. He builded better than he knew!

DOWN TO THE SEA

**Modern Liners... Efficient... Comfortable... Safe...
Speedy . . . Great Recent Improvements . . . Scien-
tific Design And Equipment . . . Air Competition?**

By KERMIT ROOSEVELT

Vice President, United States Lines;
President, Roosevelt Steamship Company

WE all know from our early study of geography that the earth's surface is only one quarter land—the rest is water. The thousands of miles that separate the divided portions of land have been crossed as far back as history is recorded. The type of vessel employed by "those that go down to the sea in ships" has changed over the years, but there has always been the one fundamental difference between water transportation and land transportation. A ship does not ride on the surface of the water as a wheeled vehicle does on land, but rather through the water.

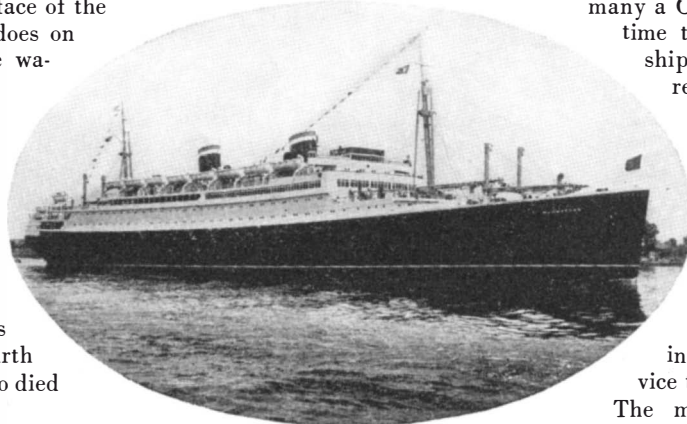
My earliest recollection of firsthand information regarding travel by sea comes from the stories my old nurse used to tell me of her voyage from Ireland to New York. She had been my mother's nurse, and indeed had first come to my mother's family before my mother's birth to take care of the brother who died and after whom I was named.

In those days ocean travel was no luxury even for those who could afford the best accommodations obtainable. Of course the greatest degree of discomfort was decidedly among the slave traders of the North and South Atlantic and the "blackbirders" of the Pacific. Not much better were the accommodations provided for the convicts sent by Great Britain to her colonies. It was an excellent opportunity for a visual picture of just what these conditions were when the resurrected Australian convict ship made its tour of American ports not so many years ago.

During the days of the peak of immigration travel to this country, North Atlantic living conditions for the Steerage Class were far from good and these were not altered appreciably until shortly before the World War. The Steerage passengers were bunked as many as a hundred in one compartment as standees. There were two tiers of bunks and the traveler provided his own

bedding. Of comfort there was none, and anyone who has made a rough channel crossing under the somewhat higgledy-piggledy conditions can to a small degree appreciate what a rough transatlantic crossing must have meant.

Great strides have been made toward the comfort of the passengers and in the main these are of very recent origin. Although they are most striking in the Third Class (formerly Steerage), where



**Not the largest, but more efficient.
Our luxurious liner *Manhattan***

in the North Atlantic trade the standee is as extinct as the dodo, they are almost equally marked in every class. Even the lower priced ships carry an increasing proportion of rooms with baths and the time when you can get four people cheerfully to pay tariff rate while sharing an inside cabin without any running water is gone.

Formerly the dining salon consisted of a number of long tables where the passengers were automatically seated without any opportunity to express a wish with regard to their table companions. There was as little flexibility in meal hours as there was in the laws of the Medes and Persians. When a dinner gong rang, you appeared at table, and if you were late, you started in at whatever course the dinner had reached upon your arrival. Another inflexible regulation was that the ship permitted no

woman to enter the smoking room. I have myself seen both of these rules in force within the last twenty years. Today the latitude assumed by the steamship company in seating and serving its passengers is as great as is observed by any first class hotel on land, and the demand for tables for two people must be heeded.

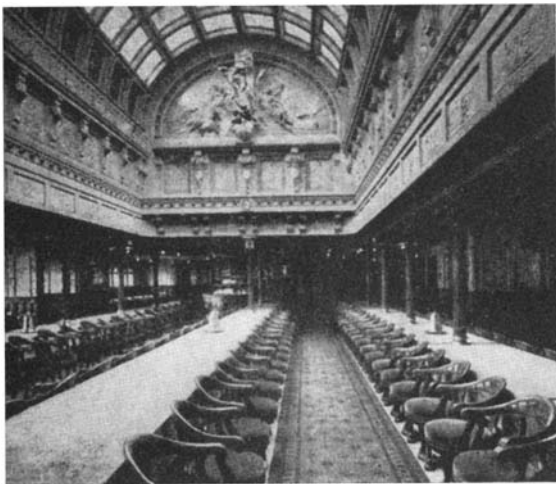
INDEED, the analogy of the hotel holds true throughout and the leading steamship companies are really running efficiently staffed and equipped ambulatory hotels. The department that looks after the comfort of the passengers must be as efficient as that which looks after the safety of the vessel and its physical propulsion through the water.

Equally great changes have come to pass in the speed and size of the vessels. When steam first entered the field of competition, it was as an accessory, and many a Clipper ship could make faster time than the contemporary steamship. As far as reliability of progress was concerned, the steamer could by no means be placed first. Many of us can remember the joy with which in the early days of automobiles we would pass by a stranded motorcar and shout out "get a horse." Many a captain of a sailing vessel may have found himself in a position to shout similar advice to a steam propelled rival.

The modern science of designing ocean liners is hardly a century old, and as a matter of fact, the first vessel to make a transatlantic crossing with the aid of steam, while also assisted with sail, was the *Savannah* in 1819.

Quite naturally the period of proof has lasted much longer with the steamship, comparatively speaking, than it has with the automobile and airplane. The days of sail as a method of commercial transportation were slow to die, and indeed they have not even yet forever passed from the picture. The most important field in which they have survived has been in the Australia-European grain trade, and much lumber is still carried in sailing vessels. On the inter-coastal routes, particularly in South America and in the Far East and along the African Coast, sail still plays an important rôle.

The degree of speed did not increase with anywhere near the same rapidity on water as it did on land or in the air. The Blue Ribbon for a transatlantic crossing



By way of contrast—above: the First Class dining room of the S. S. *St. Louis*, crack American ocean liner of 1895; and at right: dining salon of the modern S. S. *Washington*

is indeed a luxury. As is known to all, there is an economic speed at which a vessel can travel, and beyond that every additional knot entails a cost far out of proportion with its relation to the total speed. To illustrate: the most economical speed of a given ocean liner might be thirteen knots on 22.1 barrels of fuel per hour, which should be translated into maximum movement forward resulting from a given quantity of fuel. When we step up the speed of the ship, the additional cost per mile is in a far higher proportion. In other words, it would cost \$1.90 per nautical mile at 15 knots consuming 27.2 barrels of fuel per hour, whereas it would cost \$2.61 per nautical mile at 20 knots with a consumption of 49.75 barrels of fuel per hour.

The transatlantic, or any other, Blue Ribbon is of somewhat intangible value to appraise. Before the War the *Mauretania* and the *Lusitania* called for admiration and envy with their speed. After the World War the Germans built the *Bremen* and the *Europa*, and quite justly capitalized on their achievement by

every means possible. Since then the *Normandie* and the *Queen Mary* have made their appearances, but it looks as though some time would elapse before any new vessels would be launched to attack the speed supremacy of those already on the sea.

In matter of size it would seem as though we had for all practical purposes reached a definite limitation. In the first place, the initial cost of a monster liner

necessity of explaining this failing at a stockholders' meeting.

It is easy to argue in either direction as to the value of a super-liner in demonstrating the supremacy in the realm of commerce of the nation of which it flies the flag. It is not so easy to justify its value as a naval auxiliary in time of War. This might be disputed from the angle of having so many eggs in one basket when the vulnerable area not only from

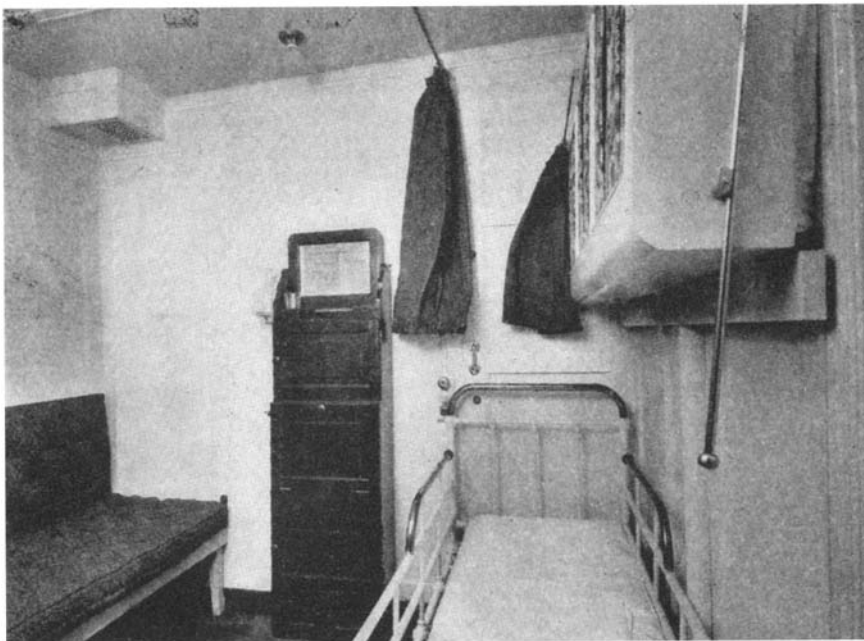


is excessively high. Indeed, it is practically impossible for any private company to undertake one, securing the funds from the public, and economically justifying the expenditure. The government of a large country can, of course, afford to build vessels of colossal size, practically the only limitation being the capacity of ports of call. A government is also in a position to disregard the return on any investment without the

the ocean surface, but from both below it and above it has so greatly increased. It is also obvious, of course, that there are only a limited number of harbors in the world capable of receiving the largest type of vessel, and even so, it is often necessary to await flood tide. This fact has often led to a misconception as to the definite saving of time in crossing on a super-liner. As a matter of fact, a large percentage of the traveling public seems to be equally, if not more, contented, crossing in ships of the type of the *Manhattan* and *Washington* which, while not offering the same speed, still afford a rapid passage and fulfill every requirement in accommodation and table.

WHILE the *Manhattan* and *Washington* are of 27,000 tons as compared with 70,000 ton monster liners, the difference in size has no effect with regard to comfort. The *Manhattan* and *Washington* offer every convenience required to the maintenance of the high standard of living to which we moderns are accustomed.

There will always be a certain percentage of travelers who go to one extreme or the other. Some like to feel that they are on the fastest ship, or the largest ship, and that they can make the whole crossing, weather permitting, without realizing they are not stopping at some gigantic hotel. Others, perhaps for atavistic reasons, want to feel more a part of the sea and prefer the smallest



First Class state room of the S. S. *St. Paul*, sister ship of the *St. Louis*, mentioned above. By modern standards, these accommodations appear very crude

vessel that will provide them with adequate comfort. A few days longer spent in crossing is to them an additional attraction. When they are walking the decks they want to know they are at sea and not hundreds of feet above the water where perhaps they can't even see it. Many passengers on such vessels as those of the American Merchant and Baltimore Mail Lines will tell you that they regard it as a yachting voyage, that they go to sea to be at sea, and that even if they are on a business trip, a few extra days amount to nothing to them in their work.

THE first great forward step in the creating of laws that provided for greater safety at sea was the bill introduced by Samuel Plimsoll in England in 1875. A permanent memorial to his memory appears on the hull of every ship in the form of a mark that indicates the limit to which a ship may be loaded, and this mark is generally known as Plimsoll's mark. Since his time there has been a constant increase in the number of safety devices and laws, the most exacting of the latter having been passed by our own United States at the last session of Congress.

The progress in safety devices of every sort has been incredible. First and foremost there is, of course, the radio, which is only 35 years old. In the old days, the only news received before the vessel reached sight of land was when some



One of the 12 charming period suites on the *Washington*, consisting of sitting room, bedroom, bath, foyer, and trunk alcove. This one is French provincial

to chart out a ship's progress with the utmost accuracy.

The Sperry gyroscope is a fairly recent development of very great value. The system of fire detection whereby direct connection with the bridge reports the start of fire in any portion of a ship adds greatly to the element of safety. The inception of a fire is far more unlikely since steel and iron hulls replaced

of this article, but steamship owners and operators, particularly where engaged in fast passenger traffic, may well spend much time in speculating as to what effect the airplane and lighter-than-air craft are going to have in the possibly very near future. We have had ample opportunity to study their effect on land transportation and are already being afforded a chance to envision their possibilities over the longest of open ocean stretches.



A reminder of the article "Our Merchant Marine To Be" by the Hon. Daniel C. Roper, in our October, 1936, issue, seems particularly apposite. We quote: "I take it as a happy augury that the Merchant Marine Act of 1936 becomes effective at a time when we are rapidly emerging from the depression . . . it should give us, within the next few years, a strong and adequate merchant marine, capable of competing with the ships of any nation, and of meeting the demands of an expanded Navy in time of national peril . . . ship building programs will stimulate activity in the heavy industries, furnish maximum employment for American shipyards. . . ." —The Editor.



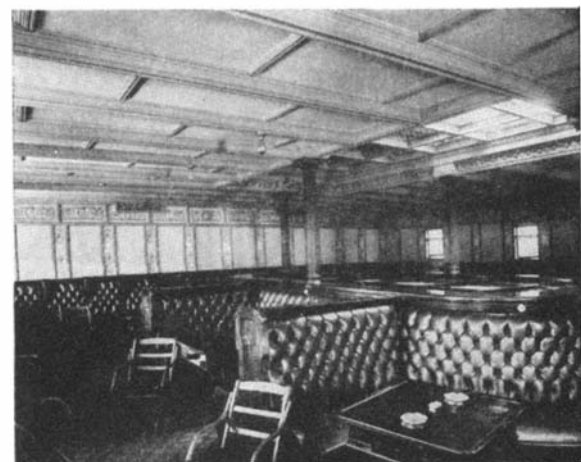
Smoking room of the *Washington*, above, and of the *St. Louis*, at the right. The difference is obvious

other ship "spoke" her and through faster speed or because she was going in a direction that would bring her to her destination quicker, was able to make a report in advance.

Many a vessel disappeared off the face of the waters leaving no trace. One of my own forebears set off on one of his ships which was never reported again. Such instances do occur today, but usually it is some small ship that is not equipped with wireless. We are now able

wood, and even the wood-like parts of a ship are usually constructed of infinitesimally thin veneers of wood forming such a practically integral part of the steel or other non-inflammable substances, as to make it impossible for them to cause an outbreak of fire.

One of the most interesting fields for speculation does not fall in the province



A RELATIVISTIC ECLIPSE

What Might be Seen from a Planet Conveniently Placed Near the Companion of Sirius . . . Perfect Tests of General Relativity that are Unavailable

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. President of the American Astronomical Society.

IT is a familiar aphorism that the theory of relativity, despite its enormous importance, both in physics and philosophy, may be forgotten in ordinary practical life. There is a good reason. In almost every known case its results agree so closely with those of the older "classical" theories that very accurate observations are required to distinguish between them. Thus, for example, the famous Michelson-Morley experiment requires long series of the most careful measures. The three famous tests of the general theory (which includes gravitation in its scope) are of this sort. The advance of the perihelion of Mercury presents itself in observation as an increase above the much larger, but definitely calculable, amount due to the attractions of the planets. The bending of light rays which pass close to the sun is so small that it can be detected only by observations of stars in the field surrounding the totally eclipsed sun, employing a host of precautions to eliminate sources of error. The slowing of "atomic clocks," which reveals itself as a displacement of spectral lines toward the red, is so minute for the sun that its exact value can hardly yet be determined by observation. In all cases, the results of the best observations agree decisively with the theory of Einstein; but these observations themselves are triumphs of the art of exact measurement. Outside the solar system, the line-shift in the spectrum of a white dwarf star, like the companion of Sirius, is a little larger, but still small enough to demand accurate work to find its value. One related effect, however, is certainly not small—namely, the red-shifts in the spectra of the remoter nebulae. But, enormous as the change in the spectrum is, the nebulae which show it are so faint that even with the greatest telescope, their spectra remind one of Merlin's book of charms, written in "text no larger than the limbs of fleas"—and the shift, though great, can hardly be called conspicuous.

It is natural to inquire whether, under favorable circumstances, the effects of relativity could become more obvious.

For observers on earth, the answer appears to be in the negative. The most promising chance would happen if one star should pass exactly between us and another, so that the light of the more distant body, bent inward all round the nearer one by its gravitational field, might be brought to a focus. The conse-

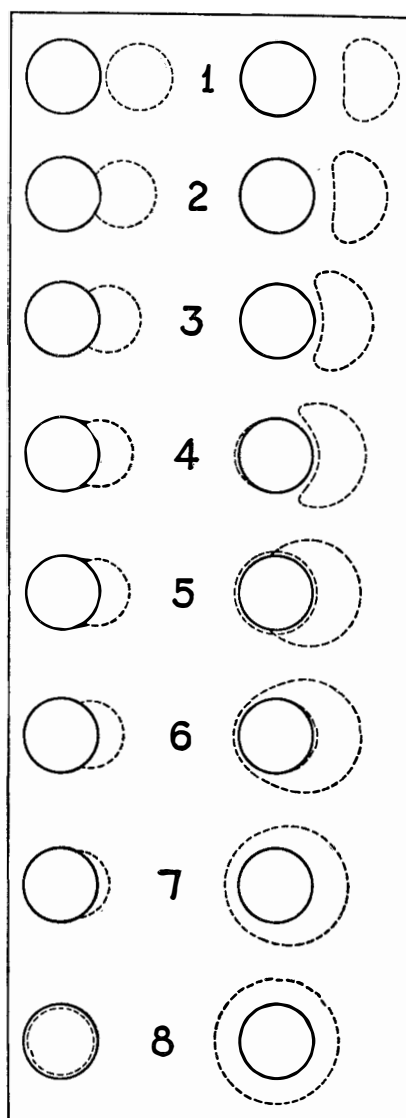
quences of such an event have just been worked out in detail by Professor Einstein himself.¹ From a point exactly in line, the distant star would appear to be expanded into a ring of light surrounding the other; but, at actual stellar distances, this ring would be too small to be resolved by even the greatest tele-

scopes, and would escape our observation altogether, even if we were watching for it. The focusing effect, however, would concentrate the light of the distant star to a notable degree. For a star which appeared as a mathematical point, with no angular diameter at all, the increase in brightness would be infinite. But any real star must have a finite angular size, however small, and for such a star the increase in brightness, though it might be large, would have a limit.

If a bright star passed in front of a fainter one, its own light would drown out the effect; but if one of the faint red stars, which are really more abundant than any other sort, should get directly between us and a distant super-giant, like Canopus or Rigel, a really conspicuous brightening would occur.

The chances of such an event are, however, negligibly small. The notable increase in brightness happens only when the observer is distant but "a few light-seconds," as Einstein puts it—that is, a million miles or so—from the line through the center of the two stars. The chance that the earth would pass so very near this line is excessively minute. Even if it should do so, we would remain within the critical region for only about a day, and the rare phenomenon would probably be missed, unless previous observations of the approach of the two stars had warned us when to watch for it.

We earth-bound creatures, then, must depend for our tests of relativity upon refined measurement. Would this be true for observers anywhere in space, or would there be a better chance somewhere? By giving play enough to our imagination—for example, by creating, in our dreams, stars of enormous mass and density—we could get anything we liked. But this is begging the question. Let us make the more modest assumption that an observer, with observing powers and intelligence on the human level, could wander at will through the starry heavens. Give him a planet to live



¹See *Science*, Vol. 84, No. 2188.

on and let him locate it at will, without bothering too much about its atmosphere, temperature, and the like; but let him be confined to observing, from his chosen viewpoint, the real stars, about which we actually know. Could our imaginary space-tourist locate his planet so that the effects of general relativity would at times become conspicuous to the immediate gaze, without taking the trouble to make measures?

THERE is no hope of doing this with the motion of a perihelion, or with the shift of spectral lines—indeed, we can now observe the latter, in the spectra of white dwarfs, as well as we could if we were nearer. But the deflection of light passing close to a star is more hopeful. The amount of this, for a ray just escaping the star's atmosphere, is proportional to M/R —the mass divided by the radius. To get a large deflection we need large mass and small radius, and we shall do best with a white dwarf. For the companion of Sirius, for example, Milne concludes that the mass is 95 percent of the sun's, and the radius $1/37$ (11,700 miles). This makes the deflection 35.2 times as great as for a ray grazing the sun ($1''.75$), or $61''.6$. The "focal length" at which originally parallel rays grazing the body on both sides would meet comes out as 3350 radii of the star, or 39,000,000 miles. (For the sun the corresponding distance is 51,000,000,000 miles.) To get the most remarkable effects, we should put our planet a little farther away than this, so that rays grazing the surface of the white dwarf will cross behind it. Let us place it so that the apparent radius of this star is $50''$. Its distance will then be 48,300,000 miles, or 0.52 astronomical units, and, by Kepler's Third Law, its period of revolution will be 140 days. Seen from this distance, the companion of Sirius would be a brilliant object. It would be of $1/19$ the sun's apparent diameter. Since it is hotter on the surface it would send the planet about $1/100$ as much light as the sun sends the earth—quite enough to light it up, though not sufficient, of course, to keep it warm.

To complete our attempt, we must have something else which can get behind the companion and have its light deflected, and yet be bright enough to be seen in the glare. Sirius itself is just what we want. According to Milne, its diameter is 1.54 times the sun's, while the well-determined orbit and parallax show that its distance from the companion varies from 8.4 to 32.4 astronomical units. Adding 0.52 more to allow for its being seen from our planet when an eclipse is imminent, we find that the angular radius of Sirius would be $166''$ when nearest, and $45''$ when farthest away. In the first case, we would have a transit of the companion

across the far larger disk of Sirius, but in the second, if there were no gravitational deflection of the light rays, Sirius would appear to be only $9/10$ the size of the companion, and the eclipse would be total. According to the spectral types, Sirius is somewhat hotter than the companion, and should shine more brightly for equal area—so there would be less than no difficulty about seeing it. Eyes like ours would need dark glasses to cut down the glare, and a moderate tele-

FOR the benefit of those who are further interested, Professor Russell states that the drawings on the opposite page were made as follows:

Let D be the distance of the planet P from the companion B , and $AB (=62.3D)$ the further distance to Sirius. A ray starting at P , at an angle x seconds of arc to the axis, deflected by y seconds near B , and carried back to A , will be at a distance from the axis $63.3D x \sin 1'' - 62.3Dy \sin 1''$. Seen from P , this distance will subtend the angle $z = x - 0.984y$. Now $y = 3080/x$ ($61.6''$ if $x = 50''$). Hence $z = x - 3030/x$. Plot this curve; read z for any point on a diagram of geometrical eclipse; lay off the corresponding x on the line through the center of B .

scopic power to reveal the disks (which would look about twice as big as Jupiter does from the earth).

We must still make sure that eclipses will happen; but as our planet is an imaginary one, we must just set it moving in the plane of the orbit of the wide pair, in which case there will be 190 eclipses during every revolution of the latter in 50 years.

It is now perfectly easy to calculate just what the eclipse of Sirius by the companion would look like, when seen from the planet at the time when the stars are farthest apart. The results of a fairly careful calculation are shown in the figures. The left-hand diagram in each pair shows what would be seen if there were no relativistic deflection of light. The succession of events is commonplace—very much like a total eclipse of the sun, except that the difference in size of the two disks is greater. The right-hand figures, in which the Einstein effect is taken into account, are remarkable. In Figure 1, where on geometrical principles the stars would be approaching contact, the bending of the rays makes the two disks seem to be still widely separated. Since this is greatest for the rays which have passed nearest the eclipsing body, Sirius is conspicuously distorted and, since the deflection takes place radially outward from the center of the companion, Sirius

appears to be enlarged vertically. Similar, but smaller, effects would have been visible some time earlier in the eclipse.

In Figures 2 and 3 the geometrical eclipse has advanced until a considerable part of Sirius is hidden behind the companion; but the deflected image, though increasingly distorted and enlarged, is still clear of the other.

In Figure 4 the distortion is very great; and a bright crescent has appeared on the *opposite* side of the eclipsing disk. This is produced by light coming from the part of the geometrical disk of Sirius nearest the center of the companion and deflected around the far side of the latter.

FIGURE 5 shows the situation when, geometrically, the edge of Sirius just passes through the center of the companion. The original distorted image has developed pointed horns, while the narrow crescent has grown and shot out horns to meet them. After a short time we have Figure 6. The two parts have coalesced to form an irregular ring completely surrounding the eclipsing disk, while, on the other side, a narrow dark crescent appears. This represents the region where rays grazing the eclipsing companion are so much deflected that they strike the sky outside the disk of Sirius.

In Figure 7 this crescent has vanished, and Sirius appears as a ring surrounding the companion, while in Figure 8 for central eclipse, it looks like an annular eclipse of a large disk by a small one, instead of the actual total phase. From this point, all the previous phases occur in reverse order. The most remarkable changes, Figures 4, 5, 6, would appear rapidly. The advance of our planet in its orbit from each to the next is only $5''$. With a period of 140 days, this would take 47 seconds of time, by our reckoning.

Our hypothetical space-tourist, therefore, could settle down with his planet in such a place that general relativity would no longer be a matter of the utmost refinement of theory and observation. It would instead be needed to account for the most bizarre and spectacular phenomena of the heavens, as he saw them. No other place in all the known universe would give him the same opportunity. One other white dwarf is double; but its companion is faint and red, so that it could hardly be seen at the time of an eclipse. Should he be near an isolated white dwarf we would have to invent a moon to eclipse it, and let him photograph stars around it (as we do here on our own planet).

My hearty thanks are due to Professor Einstein, who permitted me to see the manuscript of his note before its publication.—*Princeton University Observatory, December 2, 1936.*



Illustrations courtesy Pan American Airways, Inc.

Over the Andes. A 14-passenger Douglas in service in South America

TWENTY-FIVE years ago the first sack of airmail was carried from Nassau Boulevard to Mineola, a distance of ten miles. Today, airmail reaches all five continents; a letter mailed today in New York will be delivered in Buenos Aires in five days, in Hongkong in six, or to any major city in the United States before the business of tomorrow gets underway. This year, first-class mail will be carried by flying boat from England to the remote corners of the British Empire at ordinary postage rates. There are 28,000 miles of airways in the United States over which, day and night, under clear skies and in storm, the airmail is sped at cruising speeds which approach 200 miles an hour. About fifteen million pounds of airmail traveled the skyways of this country in 1936.

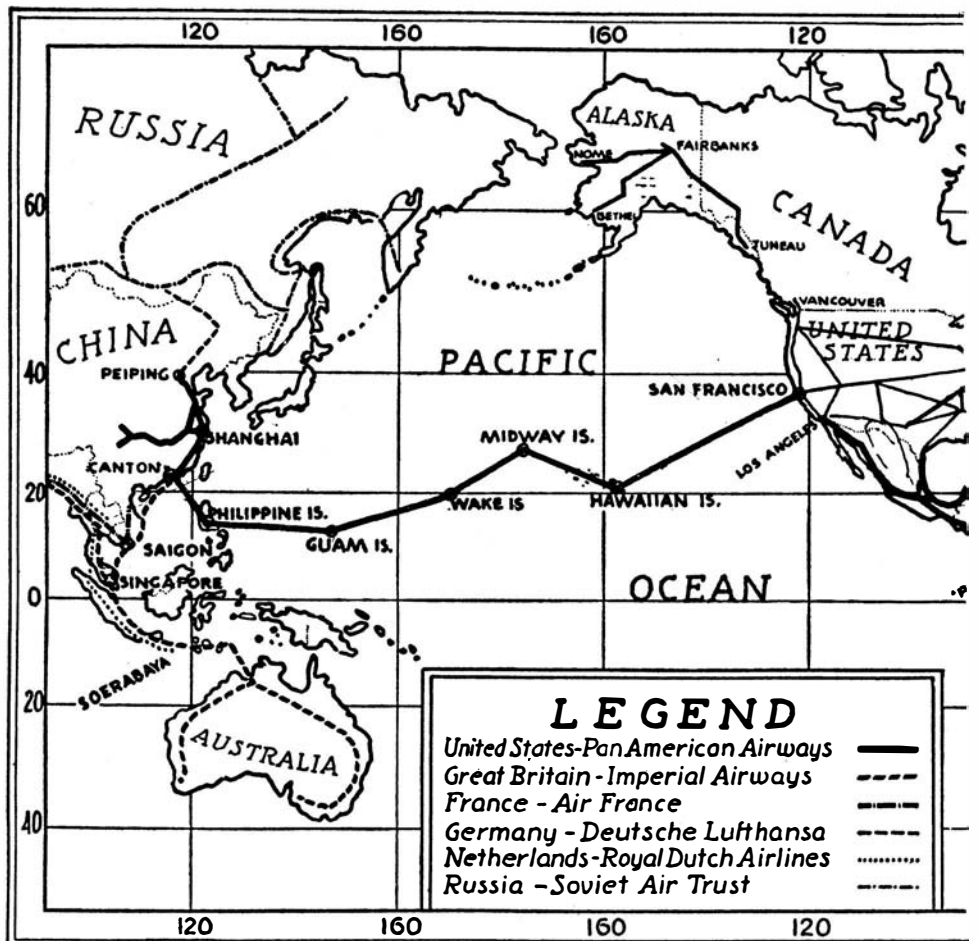
The route mileage of the world's airlines now approximates 300,000 miles. This enormous network has been spun in less than 20 years. In the first year of true commercial air transport, 1919, only about 3000 miles of routes were in operation. On these routes the pioneers of air transport of today flew about a million miles. In five years the figure for miles flown was multiplied by a little more than eight, and from 1925 on, the rate of progress continued to increase. Figures recently compiled by the British Air Ministry tell the story of this growth.

Year	World Air Route Mileage	Miles Flown During the Year
1925	34,000	13,011,000
1926	48,500	16,824,000
1927	54,700	22,242,000
1928	90,700	34,005,000
1929	125,800	53,379,000
1930	156,800	69,505,000
1931	185,100	83,500,000
1932	190,200	90,372,000
1933	200,300	100,580,000
1934	223,100	103,432,000
1935	278,200	149,342,000

The past year saw immense new additions to the airway map in the Far East, in Russia, in China and, most spectacular of all, the opening of the wide Pacific as a road of the air which alone added some 9000 miles to the existing air-transport routes. The year also saw accom-

plished services and interesting experiments in the Atlantic.

With a regularity and a success which confounded utterly the opponents of lighter-than-air, the airship *Hindenburg*, the world's largest rigid, made 20 scheduled crossings of the north Atlantic, linking New York through the naval air station at Lakehurst and Frankfort in a service which averaged less than three days westbound and about two and a half days eastbound. The Germans also made successful exploratory flights in this field using airplanes with a mother ship after the method which they had found so successful in the south Atlantic. From a small vessel, the *Schwabenland*, converted for the purpose, the Dornier-18 flying boats, *Zephyr* and *Aeolus*, were catapulted to make non-stop flights in both directions between the Azores and New York, Bermuda and New York, and Nova Scotia and the Azores. Neither passengers nor mail were carried so that the flights must be regarded wholly as experimental, which was their announced purpose, but they served



A net-work of far-flung air transport

OF AIR TRANSPORTATION

as a herald of actual mail service to come.

With a safety record which, despite a few spectacular disasters, has on the whole been most encouraging, the domestic airlines carried close to a million passengers in the United States last year. They increased the number of their schedules, they somewhat augmented their already high speed and they put in service airplanes of advanced design which offered a new degree of comfort and roominess.

Both the day and night versions of the Douglas DC-3 took to the air. Already 64 of these large ships have been constructed or are on order. In the sleeping plane version they accommodate from 14 to 20 passengers in spacious and comfortable berths. American Airlines has put them into service in this form on its southern transcontinental route. It has also employed one of the day versions of cabin arrangement in which the plane seats 21 passengers for non-stop flights between New York and Chicago and between New York and Boston.

Past . . . Present . . . Future . . . Air Mail Reaches All Five Continents . . . World-Wide Development . . . Catapults May Become Important

By REGINALD M. CLEVELAND

For this company, power is furnished by two 1000 horsepower Wright Cyclones.

United Air Lines placed in service the same type of plane powered with 1000 horsepower twin-row Wasps. Some of the 28 ordered have a different cabin arrangement in which only 14 completely revolving and adjustable chairs were installed, leaving an exceptionally large and roomy lounging area. Others are 21-passenger day planes; eight 14-passenger sleepers. These big monoplanes, of which some are also on order for TWA and Eastern Air Lines, show new advances in appointment and sound-proofing and the pilots flying them speak very well of their handling qualities.

In the Pacific, the Martin *Clippers*, after pre-view flights, began their regular passenger schedules on October 21st. They carried the house flag of Pan American, already familiar in the countries and colonies of the West Indies and Latin America, in China and Alaska, to Hawaii, the atolls of Midway and Wake Island—ready, cap-a-pie, with 40-room hotels—to Guam, Manila, and Hong-kong.

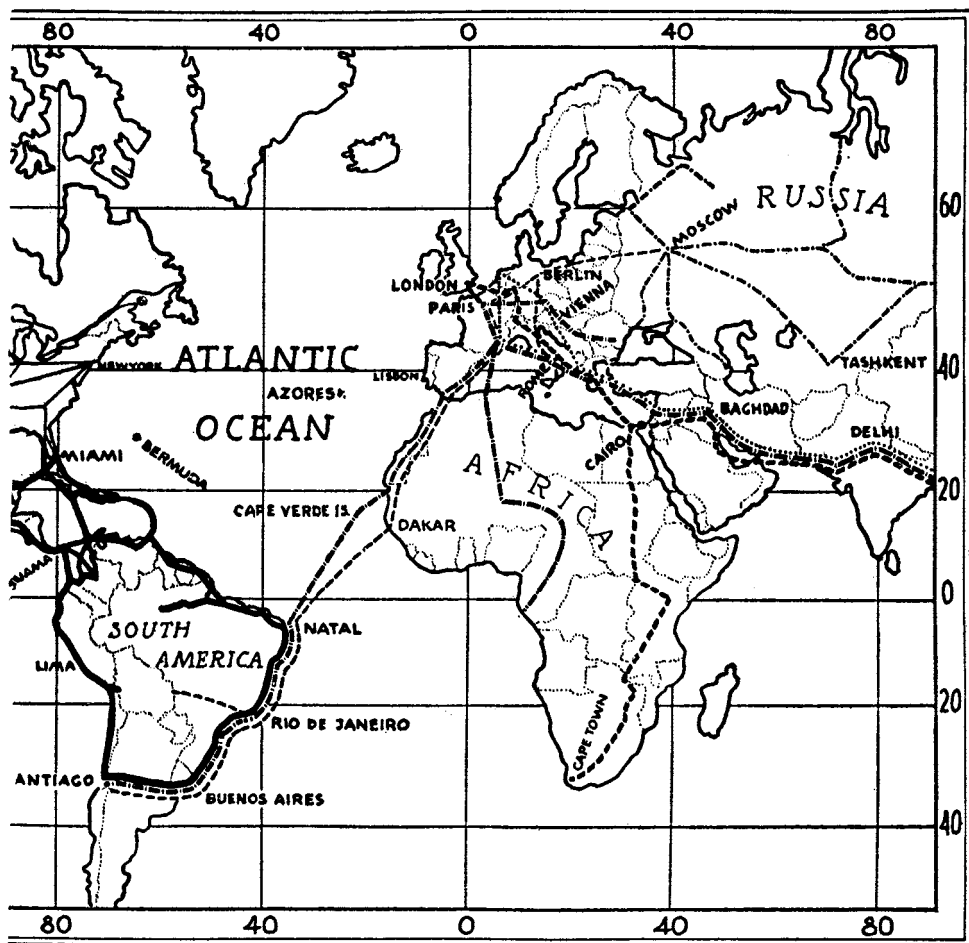
Sikorsky S-43 amphibians and Douglas DC-2's brought new speed and comfort to the lines of Pan American-Grace in the Canal Zone and along the high breastwork of the Andes on the west coast line in South America. Shorter lines in the United States, like Northwest, Chicago and Southern, Delta, Central, and Braniff, stepped up their service with Lockheed Electras.

Abroad, fast new transports appeared on the lines of Air France, in Italy, and in Germany. They were 14 to 18 passenger bi-motors, much on the pattern of the clean American designs, which brought entirely new cruising speeds to European transport.

IN Great Britain, the first of the Empire boats were launched. This fleet of Short flying boats will knit the Dominions and colonies more closely than ever before. Troublous times in Europe and the threat of political difficulty along her far-flung routes convinced Britain that she must once again take to the sea for safety and an unbroken thread of communication, so that her citizens and her mails could fly to the far reaches of her domain without the necessity of crossing alien land.

Of these 18-ton boats, the majority will be used on the African, Indian, and Australian routes; one will be shipped to the United States, assembled here and used in experimental service between New York and Bermuda. Another, stripped of elaborate passenger accommodations, including berths, and fitted with extra tankage, will be used for exploratory non-stop flights between Ireland and Newfoundland.

Important as they have been, the de-



lines covers the face of the world

velopments of 1936 in air transport are, however, but the prelude to much more startling advances which may be expected this year and next.

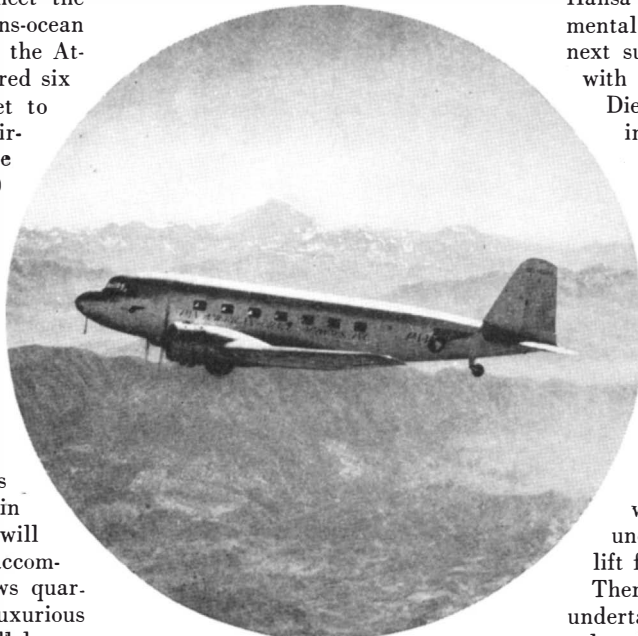
It has been clearly demonstrated that size is no bar to the efficient operation of heavier-than-air craft. True of land planes, given adequate airports, it is true even in a more unlimited sense of flying boats. Aircraft now on order and under construction plainly reflect the trend to larger size. For its trans-ocean service in both the Pacific and the Atlantic; Pan American has ordered six of the largest flying boats yet to be built from the Boeing Aircraft Company at Seattle. These giants will have a span of 150 feet, a gross weight of 82,000 pounds and capacity for 60 passengers, or 40 in berths by night. Speed is expected to be in the neighborhood of 200 miles an hour, and range 4000 miles. High-wing monoplanes of all-metal construction, they will resemble the Martin *Clippers* in that they will use stub wings or sponsons for stability when on the water in place of wing tip floats. There will be two full decks, the upper to accommodate the control cabin, crews quarters and galley, the lower for luxurious passenger accommodations. Still larger boats are in the offing.

The Douglas *DC-4*, joint creation of five of the major airlines and the manufacturer, nears completion. It may even be in the air for test by the time this issue appears. It marks a great advance, not merely in range with load, but in real spaciousness, over anything yet attempted in a land plane. The berths for 20 passengers are wider and longer than those of a sleeping car. Some can be made up into double berths, while between compartments small curtained corridors become miniature dressing rooms. The pilot's compartment, carried as a sort of high bridge in the nose, is noteworthy for vision and for a convenient grouping of instruments. The Sperry automatic Gyropilot controls, for example, are immediately at hand below the wheels. A comfortable swivel chair for the navigator-captain enables him either to work at a table behind the pilots, or swing himself into a position directly behind and between them.

THE scale of these great machines is so large that it has become possible to generate 110-volt electric current from independent small engines housed in the wings rather than to put the great strain on the battery and generator involved by the many electric accessories. The plane has a span of 140 feet, length of 95 feet, and an overall height of 20 feet.

Performance figures, of course, are

not yet available, but judging from other Douglases which have been built to specification, specified performance is altogether likely to be met in the *DC-4*. This would give it a top speed of around 230 miles an hour and a range with load of 2000 miles. One of the clauses of the book of specifications, which is a fat volume, requires takeoff with full load in a run of 3000 feet when any one of



the four engines has been cut 1000 feet after the start of the take-off.

This giant transport is only immediately around the corner. A little farther ahead lies the promise of very interesting developments, not only in the extension of plane scale, which must go hand in hand insofar as land craft are concerned with the development of better airports—especially the development of landing strips of sufficient solidity and base to withstand the shock load—but also as to application of new technique to flight, especially at high altitudes.

Various airlines are making engineering studies of the feasibility of high-altitude operation with large transports. If this is demonstrated the lines will cooperate in the development of an experimental airplane which might well cost one million dollars. Lieutenant Commander D. W. (Tommy) Tomlinson has been making test flights for TWA up to altitudes of 35,000 feet in an especially equipped Northrup *Gamma*. He and his associates are making studies of oxygen and pressure requirements.

Operation at these high levels obviously means pressure cabins as well as supplementary oxygen supply. What the aircraft will be remains to be ascertained. However, it is an open secret that the Curtiss-Wright Corporation has gone far with studies and mock-up of a four-engined, pressure cabin transport

of very large size, suitable for sleeper equipment and probably for two-engine cruising when the upper levels are reached. It is also understood that the Glenn L. Martin Company and at least one other important builder have gone far with studies of pressure cabin planes, of which no details have as yet been revealed.

It is reliably reported that Luft Hansa is planning a series of experimental flights over the north Atlantic next summer. This work will be done with flying boats powered with four Diesels. Although details are lacking at the time of writing, the results will be awaited with great interest.

Great Britain is about ready to try its bold and interesting experiment with the Mayo composite airplane, in which a carrier plane with light wing loading will take aloft to a suitable level a heavily wing-loaded mail plane and act as a flying catapult by giving its parasite, as it were, sufficient flying speed to get away with a load which it could not, under its own power alone, safely lift from the ground.

There are many who believe that this undertaking, while very intriguing, involves difficulties which could be more easily overcome by the extension of the catapult idea on the ground. Indeed, it seems highly probable that this method of launching will find itself applied not merely to the military aircraft, the small mail planes of ocean liners, and the somewhat larger flying boats, such as the *Zephyr* and *Aeolus*, but to the very large transport types which have been discussed in the preceding paragraphs.

IT is contended that by having a long catapult run which, however, need not be nearly as long as runways on major airports, heavy loads, including passenger loads, can safely and surely be launched without the discomfort of too great acceleration and shock. There is reason to believe that the modern example of the ancient weapon which served, with its hurled stones, to breach the walls of cities, may be the medium for giving huge craft with their loads of passengers, mail and freight to their natural medium, the air.

Amazingly rapid as have been the strides of air transport, which is but little more than out of its 'teens, there can be no doubt that the surface has only been scratched. This year, passengers will know new speeds, new regularity of operation, new comfort. In the next decade, they will see development, both in aircraft themselves and in their method of use, more spectacular than any of the history-making exploits which have gone before.

PROGRESS ON RAILS

**Railroads Alert to Problems . . . Look Ahead . . .
Build for Efficiency, Safety, Comfort, Speed . . .
Constant Research Meets Modern Demands**

By J. J. PELLE

President, Association of American Railroads

GUIDED by their experiences of the past but geared to the tempo of the present streamlined age, the railroads of this country are now in the midst of a new era of development. From it are emerging continued improvements in all phases of rail transportation which are giving the railways a new importance in the commercial and economic development of the nation.

Ever since the first railroad was built in this country, improvements have continued to be made to locomotives, cars, and roadbed, and in methods of operation. Railroad managements have always been alert to the advantages that come from such improvements. Had it not been for the progressive policies adopted by railway managements in the past, many of the developments now being made would have been impossible.

In this new era of railroad development, however, science is playing a greater part than ever before. Through the scientific microscope the whole transportation picture is being carefully examined with the purpose of ascertaining what further improvements can be made that will best serve the public and the rail carriers themselves. Before any change is made, however, each one must undergo a test as to what effect it will have on safety, comfort, dependability, economy, and efficiency.

THE railroads, in 1923, adopted a program calling for the furnishing of an adequate transportation service to the shippers of this country. In accordance with that program, arrangements were perfected for the necessary co-operation between the railroads themselves and the shipping public, and also for expenditures required in order to provide adequate additions to existing facilities with a view to bringing about greater efficiency and economy in operation.

Under the stimulation of that policy, the railroads not only successfully met the heavy traffic demands of the pre-depression years but later years as well.

At the same time, they have steadily continued to improve their efficiency and economy in operation. As a result, the people of this country are today being furnished with the cheapest, safest, and most dependable rail transportation to be found in the world. To produce transportation which can be sold at a price averaging less than one cent for hauling a ton of freight one mile is an achievement in management, operation, and research.

Installation 40 or 50 years ago of automatic couplers, air brakes, electric lights, and the many other improvements made up to 1920 were important. They added greatly to safety and efficiency in operation. Those changes, however, did not have the appeal to the public favor that has come from air-conditioning of passenger equipment, operation of streamlined passenger trains and locomotives, changes in the interior arrangement of passenger equipment which add to the safety and comfort of the traveler, speeding up of both passenger and freight service in general, and many other improvements which have been made in recent years by the railroad systems of this country.

The increase that has taken place in the past five years in the speed of passenger trains is without parallel. More than 400 trains using steam, internal combustion, or electric power, and covering in excess of 19,000 miles, operated on schedule runs timed at 60 miles an hour or better at the beginning of 1936. Since that date, further increases in many instances have been made. In 1930 there were only 30 regular runs, covering a total distance of 1100 miles, which operated at 60 miles an hour or higher. By this increase in the speed of trains, distant points are being brought closer and closer together.

So far as benefits to the public are concerned, the remarkable improvements made in freight service in recent years are of far greater importance. Freight trains on many railroads today operate virtually on what were once passenger train schedules. Over-night

delivery of freight from points as far away as 400 miles and more is common in many parts of the country. This means that from one terminal to another, including time occupied at intermediate points, many of these freight trains must average more than 40 miles per hour. This general acceleration of freight-train movements stands out as one of the most noteworthy improvements in railway service. By reducing the running times between important centers, substantial reductions have been made possible in investment in stocks on shelves and goods in transport. The distance between business localities has been shortened from the standpoint of time.

FREIGHT moving from Chicago and St. Louis, for instance, now arrives in New York for third morning delivery compared with six or seven days required for a freight shipment some years ago. Six years ago the fastest regularly scheduled freight train between Chicago and New Orleans made the run in 55 hours. Now the southbound run is being made in 41 hours and the northbound run in 38 hours, although banana and fresh fruit trains make it northbound in considerably less time.

From the Pacific Coast cities to Chicago, Omaha, and Kansas City, eastbound freight schedules generally have been reduced about 24 hours in recent years, while fruit shipments from California destined to eastern points are now handled on an expedited schedule which is about 30 hours faster than in 1930. The schedule for freight traffic from Denver to Chicago has been materially reduced. Livestock at the present time, for instance, arrives in Chicago for unloading within the 36-hour law, doing away with the necessity of unloading it *en route* at least once for feed and rest. Perishable and other carload traffic from Denver is now transported on freight trains which give second morning delivery in Chicago.

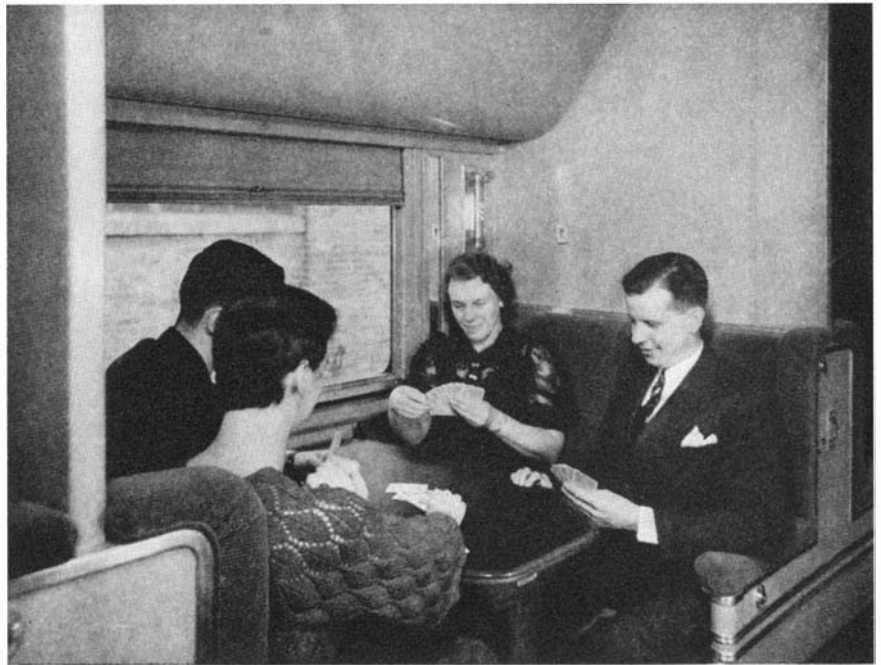
Between Kansas City and Cleveland, St. Louis, and Buffalo, the running time of freight trains has been reduced by 24 hours, which enables the delivery of freight on the second morning; while between Chicago and Cleveland the shipper now receives over-night service. From Florida, the time required for transporting carload lots to Philadelphia, New York, Boston, and other northern cities is now 48 hours less than five years ago.

Not only has the average speed of

freight trains throughout the nation been increased by 55 percent since 1920, but there also has been an increase in the amount of freight carried per train.

Remarkable improvements in locomotive construction have been made in recent years. The effect of these improvements has been to increase the tractive power without a comparable increase in weight or fuel consumption. An indication of the results obtained through this improvement is the fact that in 1935, for each ton of coal consumed in freight service, the railroads hauled $8\frac{1}{3}$ gross tons one mile. This was an increase in fuel efficiency of 44 percent compared with 1920 when the average was $5\frac{3}{4}$ tons. This increased efficiency in fuel consumption has resulted in a substantial saving in the amount of money expended for fuel by the railroads.

MANY railroads today have in operation in their passenger service locomotives which can maintain sustained speeds from 80 to 90 miles per hour and are capable of running for some distance at from 100 to 110 miles an hour. Numerous railroads have increased the size of their locomotive tenders in order to reduce the necessity for frequent stops for water and fuel. One large eastern railroad is using a locomotive tender which has a capacity of 30 tons of coal



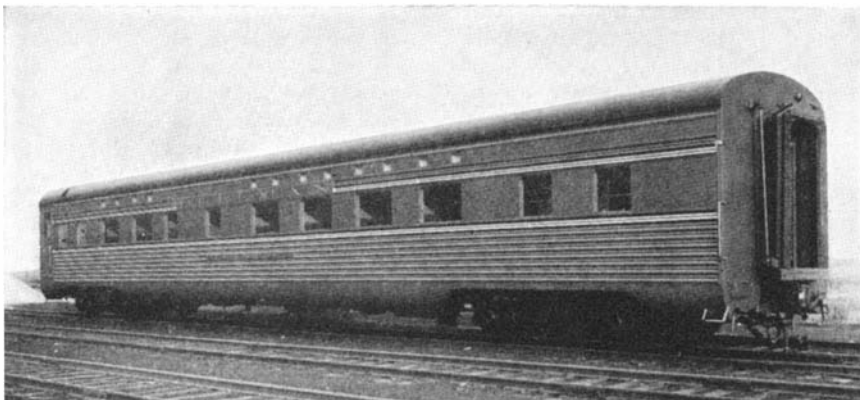
The latest in Pullman sleeping cars. It is constructed of light weight steel alloy on a truss frame and has numerous new comfort features. Note the wide window

alloys developed in recent years is most suitable for railroad use. Four years ago, after extensive experiments, a new type, light-weight, steel car was adopted as standard by the railroads of this country. A newly designed box-car made of alloy steel and weighing approxi-

mately 8000 pounds less than the standard car adopted four years ago is now being subjected to a series of rigid tests to determine its suitability to meet present-day operating conditions.

One of the most important research activities now being conducted is that sponsored by the railroads of this country and the leading steel manufacturers in an effort to ascertain what can be done to bring about a still better quality in steel rails. As a result of extensive experiments so far conducted in the laboratories of the University of Illinois, where the tests are being made, there has already been a marked improvement.

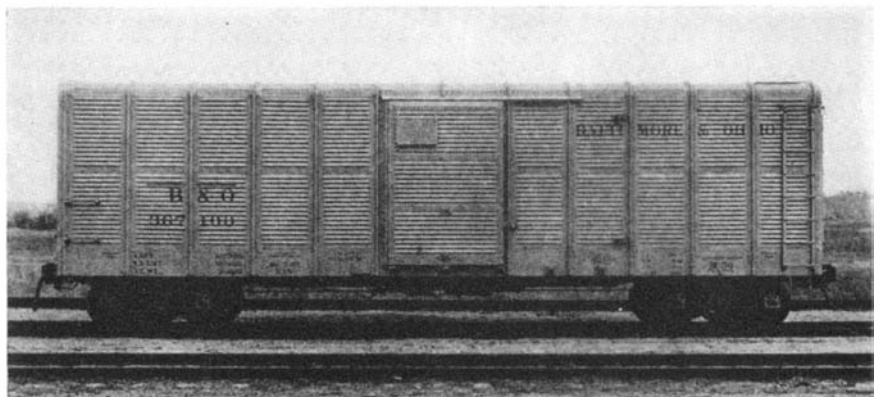
These experiments have shown that in some of the rails which have been examined there are small imperfections called "shatter cracks" which are located in the head of the rail. These shatter cracks are so narrow that one hundred thousand of them side by side would not extend more than an inch.



In appearance, the new Pullman car offers a contrast to those now in common use. It has eight sections, two bedrooms, and two compartments en suite

and 25,000 gallons of water, which enables that road to operate heavy passenger trains a distance of approximately 300 miles, and heavy freight trains a distance of about 250 miles before it is necessary to replenish the supply of coal and water. Due to the improvements that have been made in locomotive construction, steam locomotives in passenger service in many parts of the country now travel 500 miles or more before they are replaced with fresh locomotives, whereas some years ago they were changed each 100 or 150 miles.

Experiments are now being conducted by the Association of American Railroads and by individual roads to determine which of the more than 10,000 steel



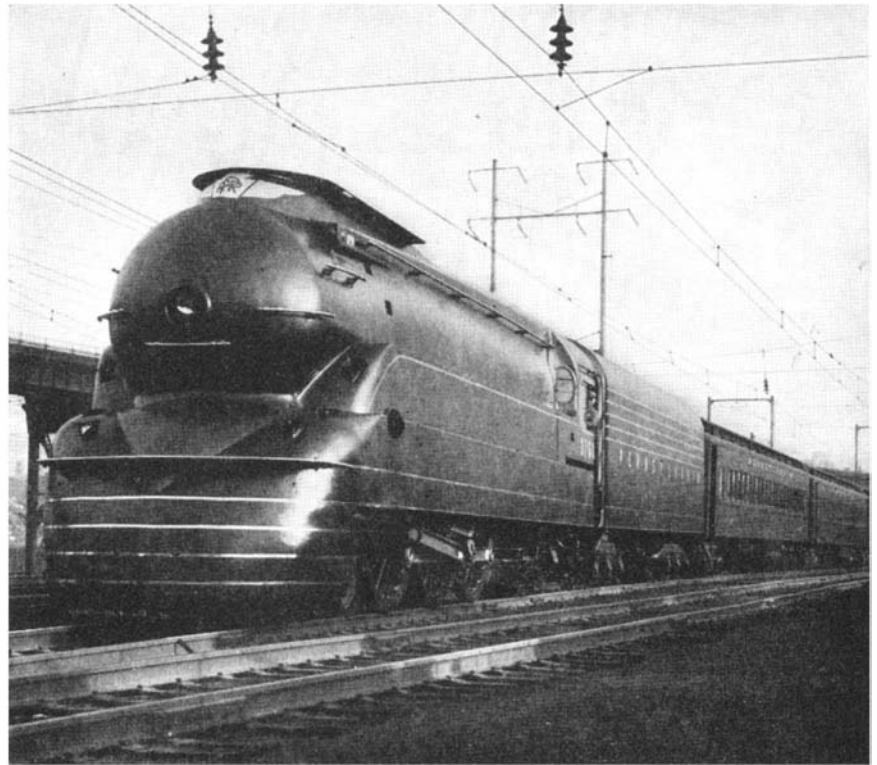
One of the large number of modern freight cars of light weight built by the Baltimore and Ohio Railroad for more efficient and speedier handling of freight. It is sheathed with steel and is lined with Masonite compressed wood board

Tests have developed the fact that an excessive load on a rail may cause these shatter cracks to grow into a transverse fissure which, to a rail, is comparable with a cancer in the human body. One way to produce shatter cracks under controlled conditions in the laboratory, according to these tests, is to heat a piece of steel in hydrogen and then let it cool in the open air. By controlling the temperatures of steel rails after they have emerged from the rolling mills, it has been demonstrated that shatter cracks can be prevented. As a result, a method of regulating the cooling of rails has been adopted by the rail manufacturers and a better quality of rail is now being produced at only a slightly increased cost.

Some years ago an apparatus was invented which locates transverse fissures at a relatively early stage of growth, but no method has so far been developed by which the minute shatter cracks in a steel rail can be detected without destroying the rail. Development of some means of ascertaining whether a steel rail has shatter cracks is now being carefully studied at the University of Illinois.

IN connection with this investigation, research work is also being conducted to ascertain the practicability of hardening the ends of rails in order to reduce the wear at the joints where it is the most severe. Some years ago the standard length of the steel rail was 30 feet but was later increased to 33 feet and a few years afterwards was increased to 39 feet. By increasing the length of the rail from 30 to 39 feet, the number of joints was reduced 23 percent.

The railroads conduct extensive laboratory experiments at Purdue Univer-



The Pennsylvania Railroad's contribution—a steam streamliner

sity to ascertain what improvements can be made to draft gear, the mechanism just behind the coupler that absorbs the shock of starting or stopping of trains. As a result of these continuing tests an improved draft gear is now being used.

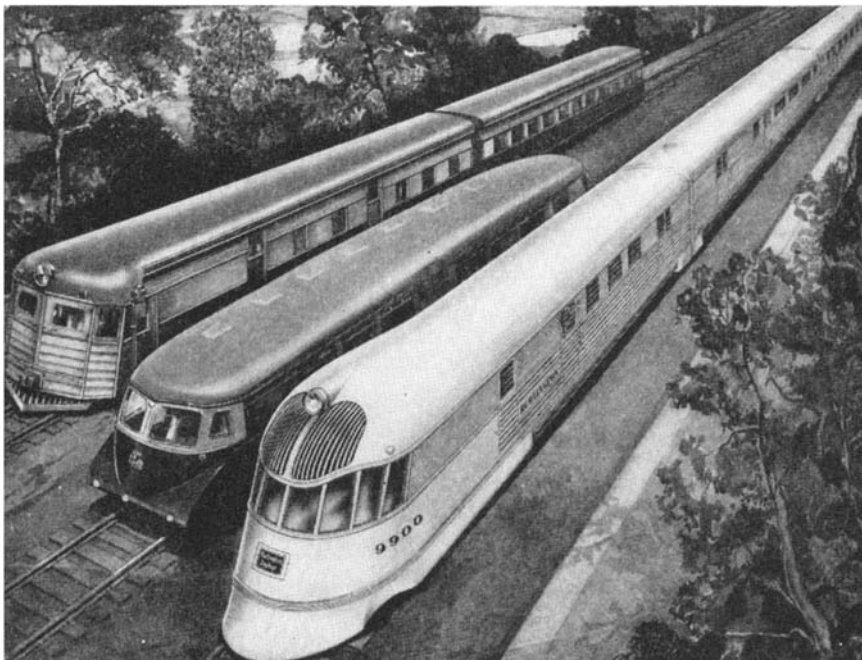
The railroads, about 10 years ago, initiated a long series of laboratory and road tests of air brake equipment. These tests cost more than 2,000,000 dollars and extended over a period of years. With this improved air brake now being installed in freight cars, only eight seconds elapse from the time the engineer

operates his brake valve until the brake sets on the last car, sometimes as much as a mile and a half away. This can be shortened in the case of emergency brake applications.

The Association of American Railroads is now just completing an investigation of air-conditioning of passenger equipment to determine what improvements can be made in the methods now in use by the principal railroads throughout this country, and also to what extent these systems can be standardized and the cost of installation and operation reduced. The result of these tests has not so far been determined.

Enumeration of the many improvements which the railroads have made in recent years, and which have brought about better service to the shippers and increased efficiency and economy in operation, could go on indefinitely. The general effect of the results which have been obtained can best be shown, however, by the fact that in 1935 the operating cost of moving 1000 tons of freight a distance of one mile was \$6.63 compared with \$10.78 in 1920.

The railroads are not content to rest on their laurels. Where improvements are possible they want to make them. While, in my long railroad experience, I have always found railway managements receptive to ideas and anxious to develop those that can stand the practical test, I have never seen them work with as much zeal as they are working today in their effort to make the rail transportation industry the greatest example of efficiency to be found in the world.



Three typical trains of the new, fast, streamlined type

FURTHER LIGHT ON MAN'S ANCESTRY

ABOUT a dozen years ago Prof. Dart of Johannesburg startled the world by announcing the discovery of a new type of anthropoid ape the skull of which had just been found fossil in a cave at Taungs near the southwest corner of the Transvaal, South Africa. The skull, which shows the face in almost perfect condition, is that of an ape-child of six years. Photographs, figures and restorations of this remarkable skull have appeared in *Scientific American* [August 1929, pages 119-122.—*Ed.*] and in various other publications, and are to be found in most textbooks on anthropology.

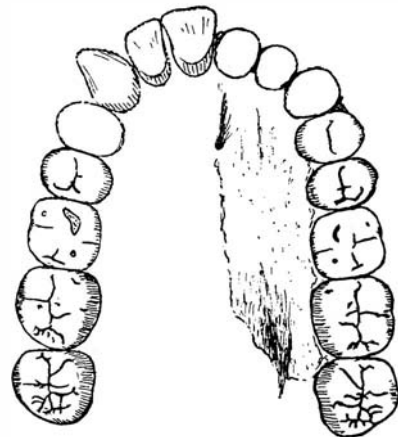
Prof. Dart considered that the little ape in its relationships came nearer to man than to the chimpanzee or gorilla. The brain he estimated to have had a volume of over 500 cc, and he thought it probable that an adult might have had a brain of 750 cc—not so very far below the lowest known human brain of 950 cc. He also believed that the shape of the brain indicated that the little ape was approaching man in walking much more erect than do any of the living apes, and that the little Taungs ape was very near to man's ancestor and to be

thus the long looked for "missing link." Some scientists both in Europe and America considered that Dart had claimed too much for his little ape, and that it is only a variety of chimpanzee. When Dart, however, later removed the lower jaw and was able to display the crowns of the teeth it was seen that the milk teeth of the little ape-child are in structure exactly like those of human children and not in the least like those of the chimpanzee or gorilla. Gregory of New York considers that in nearly every dental character *Australopithecus*, as the little ape has been called, agrees with man and differs from the chimpanzee; and Romer of Harvard, who examined the skull in 1929, has stated that, whatever the affinities of the ape, it is "certainly not a chimpanzee or a gorilla."

Still, as the skull is that of a very young child and the infantile characters are a little deceptive, many have considered it safest to suspend judgment until an adult specimen could be obtained.

Early in 1936 I commenced an exploration of the limestone caves of the Transvaal, in the hope of finding further evidence of *Australopithecus* and of pos-

sibly finding remains of primitive man; in any case I was certain of finding many new extinct types of mammals. So far I have found no traces of man, but I have discovered over a dozen new species of fossil mammals, some of which belong to new genera. Then, about the middle of August, on a visit to the caves at Sterkfontein near Krugersdorp, Mr. G. W. Barlow, the manager of the limeworks, gave me the brain cast of an anthropoid ape that had been blasted



The upper dental arch of *Australopithecus transvaalensis*, Broom. As shown it is three fourths natural size. The sockets of the left incisors and canines are shown as preserved. On the right side the incisors and canine are restored. The exact width between the posterior molars is uncertain but the restoration is probably nearly, even if not wholly, correct as shown

out a few days before. I had asked him the previous week to keep a sharp lookout; and as he had been employed at Taungs when the Taungs ape was discovered, he knew exactly what I was after. A two days' hunt with a considerable party of assistants resulted in my finding in the debris the nearly complete base of the skull and much of the cranial wall. In the matrix by the side of the base of the skull there were later found detached both upper jaws with beautifully preserved teeth, and the third right upper molar tooth was also found detached.

When all the remains were cleaned out it was seen that we had the nearly complete skull with only the lower jaw missing. As, however, the face is not in contact with the brow, there is a little uncertainty as to the angle the face should make with the top of the head. Still, the side view of the skull given in the figure must be nearly correct. If this be compared with the skull of a chimpanzee it will be seen that the brain case is rather larger and rounder and that the supraorbital ridges are less developed, and that the face is a little less simian. The front view of the skull is also not unlike that of the chimpanzee, though the face is a little more refined.



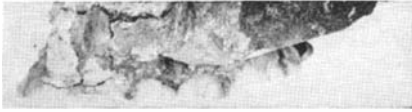
All photographs by Herbert Lang

The cave at Sterkfontein where the fossil anthropoid ape was found. Most of the roof has been blasted away. Dr. Broom is sitting on part of the floor of the cave with his left hand on the spot where the skull lay. The cave deposit is only about three feet thick. The upper and lower rocks are dolomite

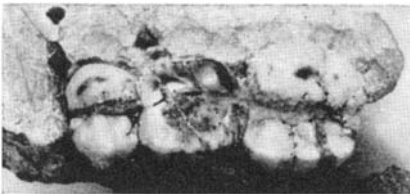
The Fossil Ape Newly Found in South Africa is Probably Closer to Man than the Living Apes

By R. BROOM, F.R.S.

Transvaal Museum, Pretoria, South Africa



Side view of the right upper 2nd premolar and 1st and 2nd molars, with some parts of the roots of the canine and 1st premolar teeth



Occusal or chewing surface of the upper 2nd premolar and 1st and 2nd molars of *Australopithecus transvaalensis*, Broom. The teeth have been slightly broken and the several portions pushed apart during the process of fossilization

When we examine the teeth, however, we see that the fossil ape cannot be at all nearly allied to the chimpanzee or the gorilla. The premolars and 1st molar are typically human in size and structure, and they differ markedly from those of any living apes. The canines, which are represented only by the sockets, are relatively small—larger than in man but smaller than in living anthropoids. The incisors are also represented only by the sockets. They are a little larger than in man, but apparently not dissimilar. Then we have a startling human character revealed. In all apes there is a gap between the canine and the 2nd incisor, for the accommodation of the lower canine. In males of the chimpanzee and gorilla the gap is large: in females it is small. In man the teeth form a continuous series, with no gap. In this new fossil ape the condition is exactly as in man. The 2nd and 3rd molars are fairly like those of man but considerably larger, also very much larger than the corresponding teeth in the chimpanzee.

The Sterkfontein ape is probably of later date than the Taungs ape. The latter may be Lower or Middle Pleistocene, while the former is most probably Upper Pleistocene. And, as the brain is somewhat differently shaped and the 1st molars are also a little different, I have placed the new fossil form in a distinct species and called it *Australopithecus transvaalensis* [to which science adds "Broom," as per regular custom.—*Ed.*]

Besides the nearly complete skull we have a sacrum with part of the pelvis of probably the same individual as the skull, and I have secured much of the hind leg of what I believe to be a second skeleton of the same species, which was discovered in another cave some months ago. If these remains belong to *Australopithecus* then it must have been, like the chimpanzee and gorilla, relatively short-legged, standing about four feet in height. It was probably much better able to walk on its hind limbs than any of the living large anthropoids. [The orang, chimpanzee, gorilla. The gibbon, fourth anthropoid, is not "large."—*Ed.*]

Exactly what the relationship of this ape to man may be will take some time to determine, as it will take weeks before a detailed study of the skull, pelvis, and limb bones can be completed. The fact that the Taungs child fossil skull has the milk teeth typically human in pattern, and that the Sterkfontein ape shows the adult teeth to be also strikingly human, seems to lead to the conclusion that these apes are much more nearly related to man than any of the living apes.

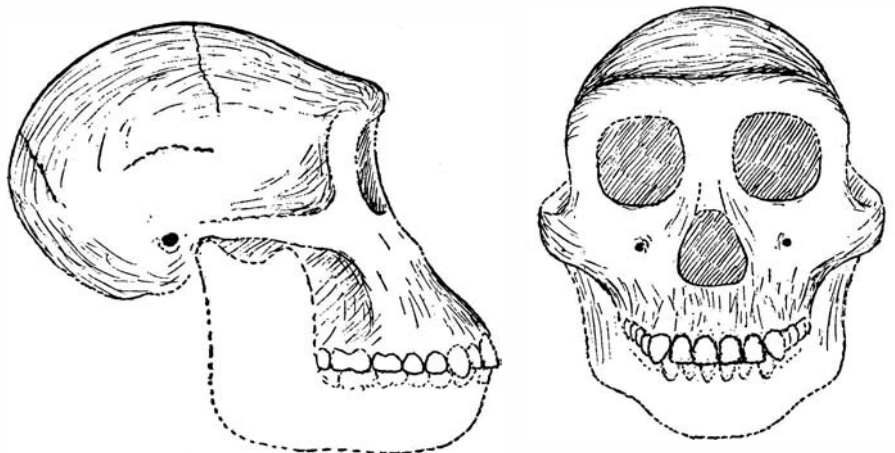
OSBORN has argued that man arose as early as Eocene times—perhaps 30,000,000 years ago, but with the exception of Wood-Jones no responsible scientist so far as I am aware holds this view. Keith thinks man may have arisen in Oligocene times—say 20,000,000 years ago. But few support such an

antiquity for man and I know of no evidence in favor of the view. Gregory, McGregor, and Elliot Smith are all in favor of man having arisen in the Miocene epoch—say 10,000,000 years ago, and this is the opinion that finds most favor in the scientific world at present. There is certainly no undoubted evidence of human remains before Upper Pliocene—a little over 1,000,000 years ago, but man was already at this time so typically man that he must have originated some millions of years earlier. Still I do not see any reason for thinking that man is older than Middle or Lower Pliocene—arising perhaps 3,000,000 to 5,000,000 years ago.

The Taungs ape is probably not older than 500,000 or 750,000 years, and the Sterkfontein ape probably not older than 100,000 years, and they are thus too recent to have been man's ancestors. But we now know for certain that large anthropoids inhabited South Africa during Pleistocene times and that these apes, unlike the living anthropoids, lived on the plains and among the hills and sheltered in the caves. We are probably safe in assuming that somewhat similar non-forest living apes inhabited South Africa in Pliocene times, and it seems not at all unlikely that it was from some member of this group that the first man arose.

Monboddo in 1774 suggested that Africa would prove to be the ancestral home of man, and Darwin also held that it was much more likely that man arose in Africa than in Asia; and Elliot Smith, probably the greatest living anatomist, has for long held the same view.

The discoveries at Taungs and Sterkfontein of fossil anthropoids which are by far the most man-like of the apes seems strongly to support Darwin's views of Africa having been the "Garden of Eden."



Restoration of the skull of *Australopithecus transvaalensis*, Broom. About three eighths natural size. The mandible is unknown, most of the zygoma (cheek bone arch) is lost, and the upper nasal region is unknown, but otherwise the skull is nearly complete. As, however, there is no contact between the face and the cranium the exact relations of the face are not quite certain, but the position of the face must be nearly as here restored. Possibly the lower part of the face and the mandible ought to be a little narrower

HIGHWAYS UP-TO-DATE

HIGHWAY development in the United States has followed a rather checkered career, starting with the trails of the Indian and leading up to the traffic arteries of the present day. With the advent of the white man as a permanent resident of this country, came a desire and need for communication between settlements; hence the stage-coach or post-roads. For a time canals or water highways claimed a large measure of attention; then came the railroad. With the tremendous developments of railway rights-of-way, little attention was given to the roads which were then used largely for local individual transportation by foot and by horse, and the result was the deterioration of those few roads which had already been built. Soon came the bicycle with its demand for relatively smooth surfaces, and a background was developed for the highway system of today.

At the turn of the century a new factor entered the field of transportation and completely changed the complexion of the entire situation. The motor-driven vehicle created, almost over night, a demand for comparatively broad highways that would be usable in all kinds of weather and would withstand the wear and tear of constantly increasing traffic.

Faced with these new problems, en-

Greatest Need is for "Freeways" . . . What is Being Done in Foreign Countries . . . The Inter-American Highway . . . Much Work Remains

By **ALFRED H. SWAYNE**

First Vice President and Chairman, Highways Committee, Automobile Manufacturers Association

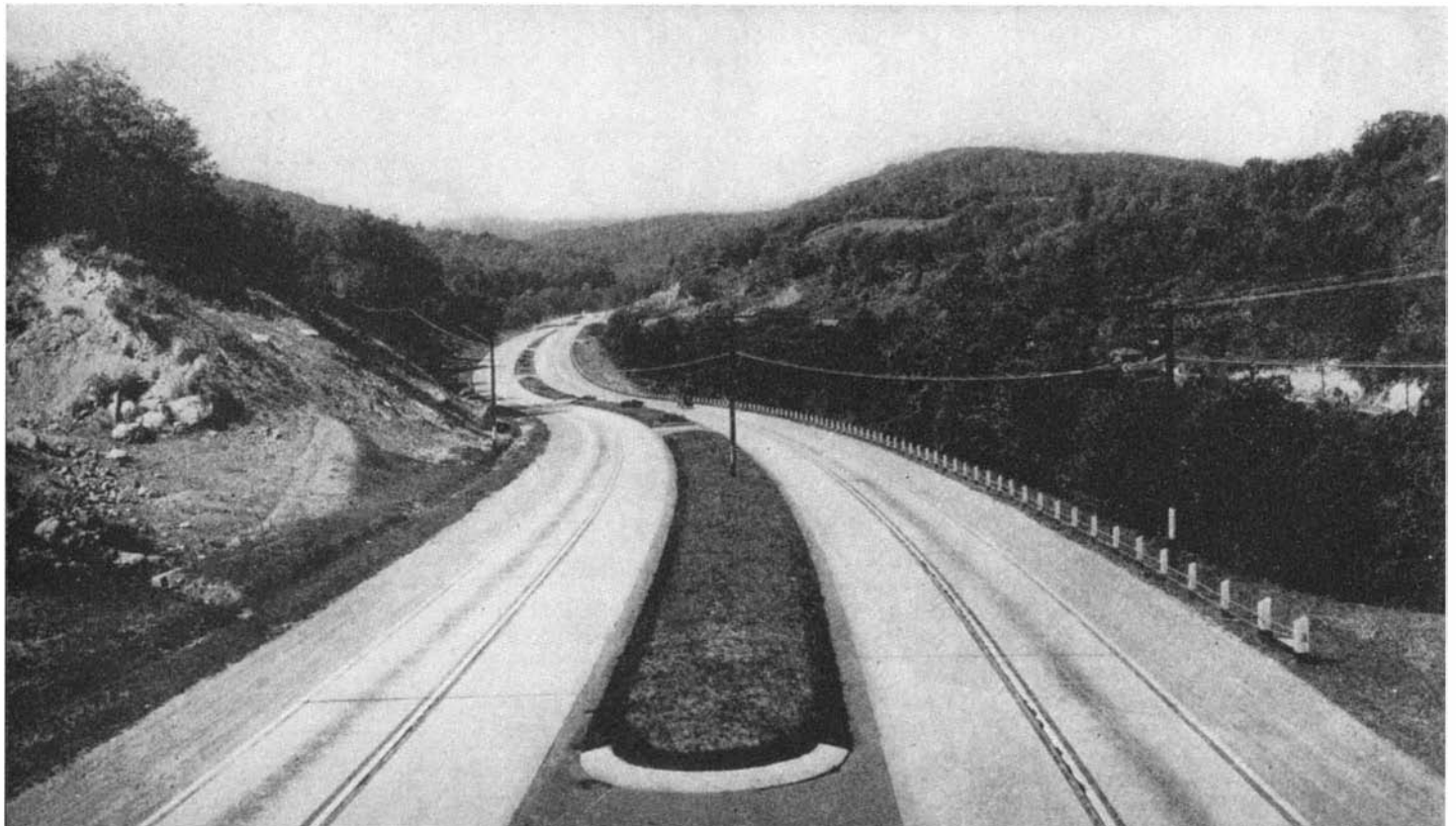
gineers took up the study, and sporadic road-building for motor vehicles started in various parts of the country. But as knowledge of the technical requirements of road-building advanced, the motor vehicle advanced in numbers in a ratio that constantly out-distanced the efforts of the highway engineer.

WITH the establishment of the Bureau of Public Roads in 1916 and the co-ordination of efforts and financial requirements toward improved highway systems, road-building spurted ahead. However, because of the permanence of roads after construction as contrasted to the relative impermanence of motor vehicle units, traffic outgrew the roads almost as rapidly as they were built. Motor vehicle accidents increased as congestion became intolerable in certain localities, cost of road construction grew beyond desirable limits, and it became

obvious that a thorough analysis must be made of the entire situation as a whole if satisfactory results were to be achieved. Highway objectives are, in general, as follows: to facilitate the fullest possible movement of a maximum volume of traffic, with maximum safety, at a maximum degree of economy.

Obstacles to the attainment of these objectives are the difficulties of condemnation of land for road building and lack of funds to meet immediately *all* of the widespread demands for building and maintaining highways regardless of their relative value to the number of vehicles which may use them. If these obstacles can be overcome, and I believe that they will be, highway engineers can construct roads that will meet all the requirements and continue to meet them as traffic increases. One of the greatest highway needs in the United States is for "freeways" or "limited

A modern section of New Jersey State Highway 23, with center unpaved strip to separate traffic



ways" in concentrated population centers. These freeways, as proposed by the Regional Plan Association, call for a strip of public land devoted to the movement of traffic and over which the abutting owner has no right of light, air or direct access. Essentially they will be well-designed express highways but lacking the multitude of "hot dog" stands, billboards, and gasoline stations, which so frequently decrease the efficiency of a road and introduce danger points on curves and hills. Some of the plans and methods of design that are commonly used on modern highways will be used in freeway design, such as traffic flow

alignment with a central unpaved strip to separate vehicles moving in opposite directions, banking of curves, and various methods of handling intersecting traffic. One of the greatest advantages of the freeway will be its "express" characteristics and it will undoubtedly reach its first use in connecting congested traffic areas with vacation lands in the mountains and at the seashore. Thus, for example, a freeway from Washington to Boston would provide a safe high-speed transportation medium for motor vehicles which, by using it, could avoid all cities and towns and still could have access to the freeway at many points not too widely separated. Such a freeway would open to motor vehicles all of the vacation lands of the eastern United States and would provide, as mentioned above, free movement of a maximum volume of traffic with maximum safety.

ANOTHER large and significant factor in highway design is the separation of traffic within and near large cities. This point involves not only motor vehicles but also pedestrians, who constitute a large proportion of motor vehicle fatalities. By the construction of grade separations of various types and the provision of sidewalks for pedestrians with over- and underpasses, many of the problems can and will be solved.

In the meantime, there is much that is being done to develop existing highways with the funds that are available. Curves can be properly banked and made more sweeping, perspective for the driver can be increased so that approaching danger can always be seen and thus avoided, and highways can be made wider to accommodate a greater volume of traffic.

In order to see clearly what can be done in the matter of highway construction, it is advantageous to survey work



Photographs courtesy Bureau of Public Roads, U. S. Dept. of Agriculture

A traffic circle relieves congestion at an intersection near Central Airport, Camden, New Jersey

being done in other countries, which work, incidentally, is based largely on American research and engineering practices. No other nation has gone so far in sub-soil research, in perfection of construction, or in maintenance, to mention but a few of the many important phases of road construction, as has our own under the leadership of Thomas H. MacDonald, director of the United States Bureau of Public Roads.

In what has been done in Europe and in what is happening there are both significant differences and significant analogies with the progress which has been made in the United States. The differences of course are very deep. The countries of Europe have a mixed traffic, the like of which is not found anywhere in our country. In some places, millions of cyclists crowd the road and are met all over the highway by the impatient motorist. In some lands the farmer lives in the village or town and goes to work on his farm each morning as he has done throughout the centuries since the time when his personal safety at night required that he and his stock should find a common resting place with his neighbors in self-defense. So herds of cattle, pedestrians and flocks of indolent geese through the highways as night comes on.

Horses and even oxen are found plodding their way with heavy loads. Pigs and chickens have not yet learned that the roadway is unsafe. The road is a cross section of communal life on which the peasant performs part of his daily labor, or on holidays and Sundays moves en masse along the road, gossiping with his neighbors, marching in festal, singing array, searching his way to quiet, restful spots for a family picnic or day in the open.

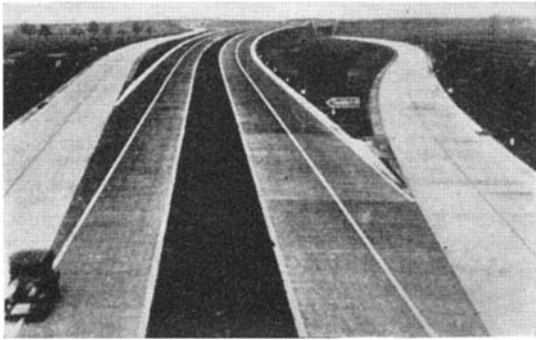
Behind the basic differences in standards and ways of living presented by

these conditions, so different from those of the United States, there are other equally fundamental differences in government to be considered. The man who controls the destinies of a people can sit at his desk as Napoleon did and draw the lines for his roads with pencil and ruler. Expropriation of needed lands follows as a matter of course. Funds can be concentrated, specifications drawn, construction undertaken in a way and on a scale which a democracy only reaches through painful stages.

THERE is neither the long drawn out court procedure to oust the unwilling proprietor from strips of land which are necessary to the public welfare, nor is there the excessive cost which frequently results from appraisals made by local officials when land is finally condemned in this country. Nor is there the immediate necessity for consideration of a public opinion which insists that each locality, sometimes even each resident, shall secure his part of the public appropriation for his road regardless of the larger interest.

In Germany, for example, there is now under way a program for the construction of 5000 miles of completely separated highways — *autobahnen* — each having two lanes of traffic moving in either direction with a parkway between them. Bridges or underpasses take care of cross traffic of both motor vehicles and pedestrians. Take-off roads of varying designs, usually from 10 to 15 kilometers apart, permit traffic to enter or leave the main road. At the time of writing, approximately 1000 miles of this program is complete, the surfacing of another 1000 miles is under way, and about 1000 miles are in the blueprint stage or under preliminary construction.

Overshadowing the amazing undertaking of Germany, largely because of



Highway separation as achieved on an *autobahn* in Germany. Note the underpass in background. Eventually there will be 5000 miles of these roads

Below: A section of the Central Highway of Panama which is included in the route of the Inter-American Highway



the international scope of the program, is a highway which eventually will connect London, England, with Calcutta, India, and Capetown, South Africa. Parts of this route are already in service and other parts are well under construction. Of similar importance and just as romantic in conception is the Inter-American Highway, which will run from Nuevo Laredo, Mexico, to Panama City, through Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama.

Work now being done in Paris, France, represents one of the most fas-

inating projects in highway construction in progress anywhere in the world, and gives a key to the solution of traffic problems in congested areas. The ring of fortifications which surrounded ancient Paris has been converted into a circular belt highway. Farther out from the city, French engineers are now constructing a second belt with others projected still farther out as traffic developments may require them. At intervals on these belts, highways converge in the form of squares or circles.

With these brief glimpses of what has been done, is being accomplished, and

will soon be consummated, it becomes apparent that the highway engineer has a complete grasp of the situation. He is able to provide safe, fast highways adequate to take care of traffic conditions for some time to come after completion, and will do this just as rapidly as funds and legislation permit. An excellent summation of the entire highway situation as it exists in the United States today is given by Mr. MacDonald, in the Annual Report of the Bureau of Public Roads, as follows:

“IN the immediate future a large amount of work should be done in making more adequate for traffic that already exists those highways deliberately improved under a policy of stage construction to a degree known to be less than that ultimately desirable. There is also a need for the further extension of improvements to the more useful secondary and land-service roads, many of which still await improvement. Needed improvements on the main highways include considerable improvement of alignment, reduction of grades, and elimination of railroad grade crossings and separation of grades at intersections.

“Although much work of the kind described is necessary, there is no reason whatever to assume that the main highway system, as a whole, is substantially inadequate. The need for further improvement exists principally on a limited mileage of heavily traveled highways, especially near large cities in industrial sections and on those roads which, because of their early importance, were the first to be improved and were therefore constructed according to lower standards than have since prevailed. Viewing the work of past years as a whole, the system of highways created is remarkably adequate.”



Traffic on three levels. Two separated highways with a railroad right-of-way on the center level

Twelve Years of

MOTOR COACHES

Early Systems "Just Grew" . . . Co-ordination Resulted in Progress . . . Comfort and Convenience for Passengers . . . What of the Next Five Years?

By I. B. BABCOCK

President, General Motors Truck and Coach

TWELVE years in history is a brief period. Yet reckoned by events rather than by mere calendar years, the past 12 have provided an epoch unparalleled for progress in our transportation system.

During this period the motor coach, once classed as a "fad," became an integral part of our economic and social structure, taking its place in our scheme of transportation alongside of electric railways backed by 50 years of experience and the steam railroads with more than a century of history behind them.

In the early days of motor coaches, they were a mixture of cumbersome truck chassis and improvised bodies, many of them simply being planks placed across the truck frames. Motor coach systems were like "Topsy" of Uncle Tom's Cabin fame; they "just grew."

Although there are records of motor buses having been operated as early as 1904, it was not until the outbreak of the World War that the economic need for motor buses began to be realized. Almost overnight, streets of cities throughout the country became crowded with "jitneys" which created great traffic hazards and, while providing a more rapid means of transportation, could not either give adequate service or protect those who rode.

In the early 1920's there were but few cities in which motor coaches were being operated, and a 35-mile operation in inter-city work was regarded as a long haul. But as manufacturers developed more dependable vehicles, with better paving in the cities and concrete highways extending to all parts of the country, the use of motor coaches grew by leaps and bounds, each year increasing in popularity and building transportation by motor coach into one of the major businesses of the country. All this occurred in a period of but 12 years.

A glance at the history of motor-coach transportation is interesting and of importance in that it reveals how quickly the American public will accept that which is new when it is better. When

Grover Cleveland was elected president in 1884, local transportation, except for a few cable lines, was dependent entirely on animal power. In 1888 came the first successful application of electricity as a power for transportation vehicles, when a system was established at Montgomery, Alabama. Within the next 10 years city after city joined this electrification trend, completely replac-

ing animal power. The street railway had become the electric railway. mand evolved coaches which provided a safe, comfortable ride, capable of rendering a flexible type of transportation quite different from anything previously possible.

The year 1924 saw the motor coach actually take its proper place in the transportation system. In that year large and small electric railway properties began to use motor coaches and steam railroads started toward a co-ordinated system of rail and buses. Revolutionary results followed the adoption of motor buses in local transportation and the electric railway industry became the transit industry.



One of the "all-service" coaches pioneered by Public Service Coordinated Transport of New Jersey. These vehicles are equipped with both gasoline and electric motors and can be run either on a double-wire trolley system or under gasoline engine power on any highway, making for flexible service

ing animal power. The street railway had become the electric railway.

Then came the great development—the invention of the internal combustion engine, which made private transportation over streets and highways available to nearly every family in America. This opened new marts of trade, carried people from the congested districts of cities out into new residential territories away from established electric and steam railway lines—resulting in the evolution of a new transportation vehicle, the motor coach. People were not to be content with improvised buses; they demanded better transportation, and from this de-

WHEN the industry was carrying two billion passengers a year back in the 80's, it was regarded as big business. There was talk then that the opportunities for further progress had been exhausted and that the era of expansion was about over. Today the transit industry is carrying over 12 billion passengers a year, with a gross revenue in excess of one billion dollars.

This is a greater volume of business than the steel industry did in 1931. It almost equals the combined revenue from telephone and telegraph service. The industry has the largest number of customers for a single product of any business in the world.

Yet the motor-coach business, despite the sensational progress it has made in the past few years, is still steadily growing. We are now well into another era in motor-coach transportation—an era of modernization. There are in existence in the United States at the present time 22,000 street cars known to be 20 or more years old. In addition there are another 15,000 street cars known to be



Transportation sans comfort: A motor bus of the vintage of 1911

from 15 to 20 years old. In addition to this rolling stock there are more than 10,000 buses in city service approximately five or more years old.

Thus the transit industry alone faces the prospect during the coming five years of having on its hands 47,000 pieces of equipment that have passed the age limit of economic usefulness. Estimating conservatively, it is reasonable to predict that at least 50 percent of this obsolete equipment will be replaced with new rolling stock at an expenditure of 235,000,000 dollars—approximately 50,000,000 dollars per year.

How swiftly the public has accepted motor coaches for transportation is shown in the record of achievement. In 1922, only 18 cities depended exclusively upon motor coaches for transportation, while 560 cities depended exclusively upon rail service. Another 197 cities were supplementing their rail service with coaches.

By 1932—10 years later, 300 cities had gone "all bus"—a third of the cities in the United States—and 447 additional cities were enjoying the advantages of co-ordinated transportation—rail and bus. Today, 419 cities depend exclusively on motor buses for their public transportation. From 1925 to 1935 the transit industry increased the number of buses operated by it from 1200 vehicles to 18,200 vehicles. During the past five years 75 percent of the equipment bought by city operators has been gasoline buses.

There are several causes for this rapid substitution of motor coaches in city

transportation service: 1. The difficulty of amortizing original investments. 2. The relatively low capital investment required to operate bus service. 3. The desire of the public for quicker, more convenient, and low-cost service.

WHEN business skies started to brighten early in 1935, many city operators took advantage of the upturn in riding and started programs to rehabilitate, and in many instances, completely modernize their properties. These modernization programs resulted in the biggest coach-buying year of all time. However, the record lasted but a short time, 1936 setting another new all-time high in the purchase and delivery of coaches.

Among the many important and interesting highlights of these modernization plans was the substitution of coaches by The New York City Omnibus Corporation, on the street railway lines of New York Railways. This substitution required 768 coaches. This gigantic venture was an immediate success. Riding increased sensationally, revenues shot upward.

Public Service Coordinated Transport of New Jersey, the largest city operator of motor coaches in the country, embarked on a 6,800,000-dollar program of modernization. Among the 377 coaches purchased by this company were 27 Diesel-electrics, the first coach fleet in the United States to utilize Diesel power and the first in the world to use Diesel-electrics.

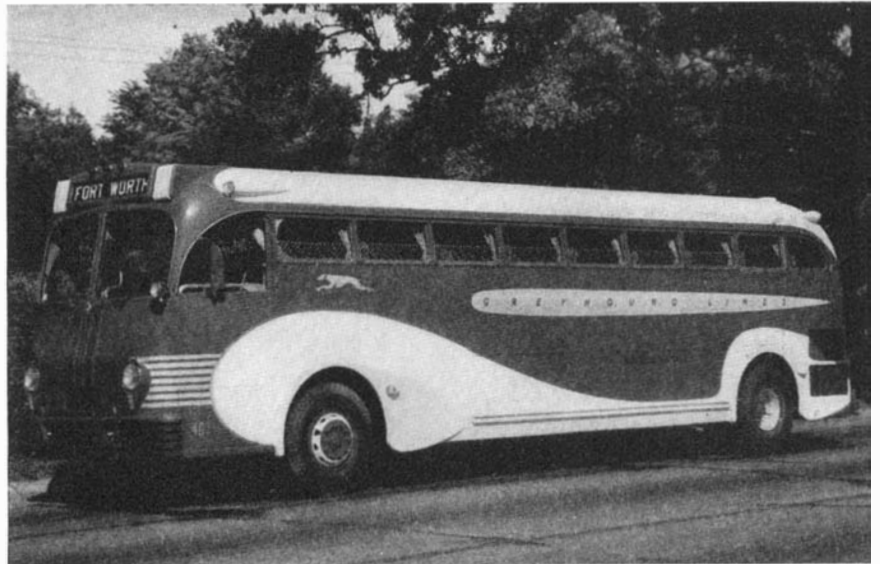
Chicago Motor Coach and Fifth Avenue Coach Company placed in operation nearly 200 double-deck



An ultra-modern coach, seating 72 passengers, with the engine mounted in the rear, and, above, a view of the upper deck, showing the seating arrangement

coaches, seating 72 passengers and embodying every modern feature for passenger comfort. St. Louis, Boston, Kansas City, Houston, Dallas, New Orleans, Memphis, and hundreds of other cities have been active in improving their properties. In the inter-city transportation field Greyhound placed the largest single coach order of all time, purchasing 505 modern highway cruisers to augment a fleet of 325 such coaches placed in service during the year. The National Trailways System, composed of five of the leading inter-city operators, organized to give coast to coast service—hundreds of other inter-city operators placed new equipment on their lines.

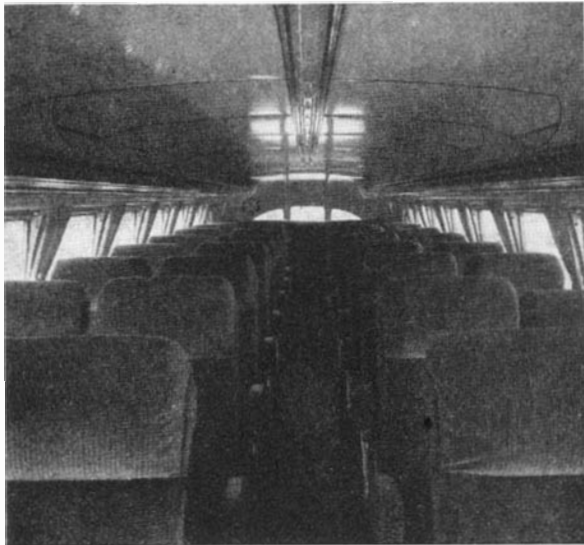
In nearly all modern motor coaches the engine, heretofore located at the front end of the coach under a hood, has been mounted in the rear of the



Greyhound recently ordered 505 of these coaches after operating 325 of them. This is the largest coach order of all time. *Left:* Interior of one of these new highway cruisers, seating 36 passengers

systems provide fresh air throughout the coaches at all times, without draft.

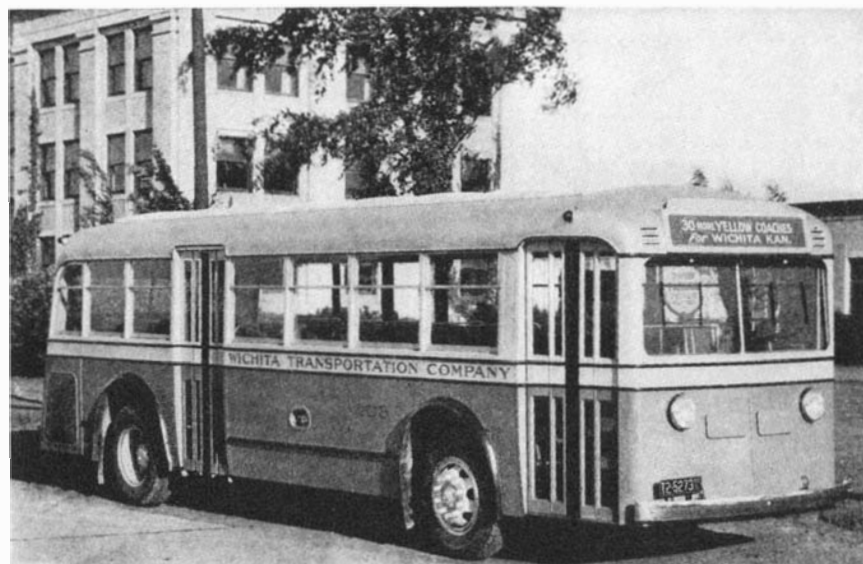
Through the use of rear engine mounting, modern coaches have perfect weight distribution with $\frac{1}{3}$ of the weight on front single tires and $\frac{2}{3}$ of the weight on rear dual tires. Not only does this



coach, providing an entirely unobstructed interior for passenger use, and leaving fumes and engine noise behind.

Seats have been modernized to give the utmost in comfort; new lighting systems and color schemes give restful interiors; newly developed ventilation

Below: One of the most popular city coaches of all time, seating 32 passengers and with rear engine. Nearly 1000 of these have been placed in service. *Right:* An interior view



result in smooth, comfortable riding qualities but it is a great safety factor. Safety is further enhanced by the use of all-metal bodies.

What has been the effect of this rapid trend to motorization in transportation? The public has been given a fast, convenient, and low-cost service, being able to board the coaches near their homes and to alight near their destinations; the operator has been able to build strong, efficient, and profitable transportation lines; the coach manufacturer has become a leading figure in our transportation picture.

In speculating on what the future holds for city and inter-city motor-coach transportation, there is every indication that it will continue to move forward rapidly to give to the riding public the benefits of years of successful operation.

THE HEALING MAGGOT

One Superstition that Turned out to be a Fact . . .
Science Went to Work, Maggots Went Out, Allantoin
Came in, Followed by Urea . . . Now We Understand

By T. SWANN HARDING

FOLKLORE has made many contributions to the science of medicine. Many remedies now esteemed by the very best doctors were at one time derided as superstitious. Withering, in 1776, learned that foxglove was used by old women to cure dropsy, which was then regarded as a disease; he tried it in his practice and became convinced of its value. It was very much later that digitalis was purified from this plant and adopted as such by pharmacy.

This sort of thing had happened over and over again, quinine from Peruvian bark being another example. In some cases, of course, the empirical remedy—vipers, salamanders, cockroaches, lice, or whatnot—seemed merely to have the limited, negative virtue of being unpleasant even to think about. More often than not the folklore remedy was really worthless, though the possibility that such old wives' cures may be of value should always be considered.

Nothing could be more revolting, for example, than a maggot-infested wound; nothing could be more grotesque than the treatment of wounds with the excrementory product of insect larvae; nothing could be more fantastic, or has been more derided, than the external use of urine for medicinal purposes. Yet just these substances and processes have recently found their way into scientific medicine and have assumed considerable importance.

In the apocryphal book called *Maccabees* we are told about the terrible death of the Greek ruler Antiochus, an early persecutor of the Jews. His maggot-infested wounds are held up to our horror. Yet, centuries later, the so-called "father of French surgery," Ambroise Paré (1517-1590), observed the frequent presence of fly larvae in wounds, and appears to have had some idea that their effect was beneficial.

INDEED, there is nothing new under the sun, for the so-called maggot treatment of bone injuries, in which larvae of blowflies were placed in wounds to clear up decayed tissue and hasten healing, is not new. It was known to the French surgeon, Baron D. J. Larrey, in the time of Napoleon. While the Syrian wounded were usually ter-

rified by the appearance of blue-fly larvae in their wounds, the Baron said: "Nothing short of experience could convince them that these insects, so far from being injurious to their wounds, promoted rather their cicatrization, by cutting short the process of nature and by causing the separation of the cellu-



These were some of the clean, pampered and socially select, sterile maggots, as formerly applied

lar eschars which they devoured. These larvae are, indeed, greedy for putrefying substances alone, and never touch the parts which are endowed with life."

The modern use of maggots to clear up wounds, especially those of the bones, dates from field observations made during the World War. The well-known Cleveland surgeon, Dr. George W. Crile, called attention in 1917 to the more rapid healing of wounds containing maggots. But it was the late Dr. W. S. Baer of Johns Hopkins who made the first extensive clinical tests, developed a technique of using the maggots, and vigorously advocated its general adoption.

Many cases of stubborn, deep-seated

bone infections came to Dr. Baer's attention "over there." In one instance two seriously wounded soldiers had lain on the battlefield about a week before they received attention. Their wounds had become infested with maggots of the common blowfly, making them horrible to behold. Yet these serious and infested wounds, when cleansed by the physicians, healed with marked rapidity.

Despite their long exposure these men made a rapid recovery, in marked contrast to the high death rate of others from similar wounds. Some years later, when treating cases of the chronic bone disease called osteomyelitis, in Baltimore, Dr. Baer remembered this battlefield experience. As a last resort he tried the blowfly maggots on two young girls who suffered from this dreadful disease. They worked like magic!

THEREAFTER maggot treatment for osteomyelitis spread rapidly throughout the United States, as it is said all really good, sound remedies do spread. However, it seemed possible that the maggots might at times carry dangerous infective germs and the problem arose of raising sterile maggots wholesale. Ap-

peal was made to Dr. William Robinson of the Bureau of Entomology and Plant Quarantine in Washington.

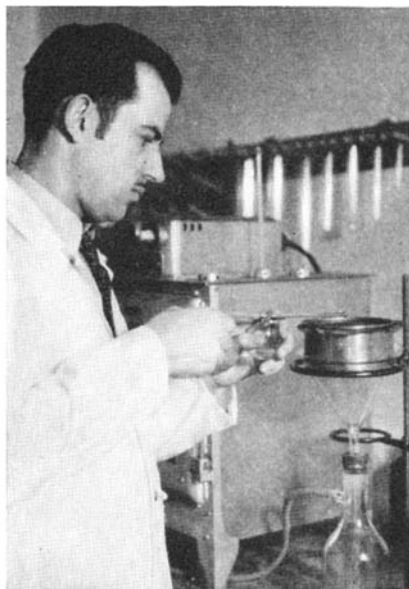
Dr. Robinson and his associates solved the problem of mass production of sterile maggots. They made the maggot treatment safe, but it was still revolting. Patients disliked it. Doctors disliked to submit them to the treatment. The question arose: What do the maggots do or produce that enables them to cure wounds? Just as pure digitalis had been prepared from foxglove, so now some curative principle must be prepared in pure form from maggots—and exactly that look place. In 1935 Dr. Robinson was able to announce that blowfly maggots cured wounds because they pro-

duced "allantoin" as an excrementory product. This colorless, odorless chemical compound, which, it was discovered, had been used 23 years earlier in the treatment of non-healing ulcers by Dr. C. J. Macalister, and not the maggots *per se*, effected the cure. Allantoin is harmless, painless, and inexpensive, a moderate-size application costing but five cents and being in no way revolting.

It promotes the healing process in the wound from the bottom up. It is present also in the embryos of certain animals, mixtures of which have a healing effect on wounds. Maggots therefore healed the wounds involuntarily and merely because they happened to excrete allantoin. General granulation of the tissue with rapid healing could be produced by packing wounds with allantoin-saturated cotton. Non-healing wounds, burns, and ulcers yielded to its magic.

EXPERIMENTATION started in a Washington hospital but soon doctors all over the country were using the new method. Weak solutions of allantoin were effective; the excretions placed in wounds by the live maggots were very weak in strength indeed. Case after case showed improvement. Stomach ulcers, bladder inflammation, and other internal irritations began to be treated. (Self-medication is not advisable, however, so consult your physician always.)

As explained at the convention of the American Medical Association in 1936 by Dr. S. W. Simmons, also of the Bureau of Entomology and Plant Quarantine, certain body cells become dormant and seem unable to grow or to reproduce themselves when wounds occur. But contact with allantoin gives them power both to grow and to multiply. However, allantoin does not cause the excessive and abnormal type of growth characteristic of cancer.



Science on the trail of knowledge. Extracting allantoin from maggots

Exactly what happens in the living cell is still a mystery and until this is solved medicine must always be much impeded. But the factor that enables dormant cells to grow and heal wounds may, if lacking, apparently be replaced with allantoin. This penetrates the cell and causes its nucleus to regain its lost power of activity. When allantoin is applied, healing takes place in bone, muscle, and skin.

Chemically speaking, allantoin is a derivative of urea, a waste product of the body excreted in the urine. In August 1936 it was not surprising, therefore, that Dr. Robinson announced in the *American Journal of Surgery* the fact that a 2 percent solution of the chemical urea, made with sterile water, would itself produce healing if applied to stubborn wounds.

Urea can be made by combining ammonia with carbon dioxide. It is made from the gases of the air on large scale, for it is widely used as fertilizer. It also occurs in human tissues and in many plants, though it derives its name from the fact that it was first discovered in urine.

UREA has great historical significance because it was the first chemical having its origin in living organisms which was made synthetically in the laboratory. In 1828 the German chemist Wöhler announced that he had succeeded in producing urea without the aid of a kidney. He had made it by heating ammonium cyanate. Until then it had been supposed that so-called "organic" chemicals, other than carbon dioxide and water, could not be made artificially. The average person excretes a little over an ounce of urea daily.

In his latest work Dr. Robinson cites many case histories provided by physicians, surgeons, and dentists. They have used weak solutions of urea in treating osteomyelitis, gangrene, old ulcers, stubborn wounds, infected burns, and non-healing gums and tooth sockets. The reports are encouraging. Many of them are sensational. If this good work is borne out by additional clinical tests carried out under close control, the discovery will be one of major importance.

Medicine must make haste slowly, as always. It must not jump to conclusions, even though no ill effects have yet been recorded. It is an odd coincidence and a significant one that human urine is roughly a 2 percent solution of urea. Consequently there may have been sound reason for its medicinal use as an application to wounds. Fortunately urea itself is an entirely inoffensive substance. It is present in the tissues and blood of animals and of human beings. It occurs in many plants used for food, notably in spinach. It is an almost snowlike, crystalline chemical. Under the microscope a pinch of it looks like a



Dr. William Robinson, who solved the problem of mass production of sterile and socially eligible maggots. They almost became pets

miniature log jam of sparkling sticks of ice. It is made commercially by the ton by combining three gases that occur in air and in water—nitrogen, hydrogen, and carbon dioxide.

Treatment with allantoin was inexpensive but with urea it is still cheaper. Pure urea, long used by doctors as a diuretic, sells for a small fraction of the price of allantoin.

But why did it occur to the scientists that urea might be as valuable as allantoin? This was not because it was associated with allantoin in the maggot excretions so much as because the picture or structural formula of allantoin, as written out by organic chemists, showed how easily a "side chain" of allantoin might be chipped off so as to leave urea.

THE formula of allantoin is written by organic chemists in the form of a square with an NH and a CO group at the bottom corners and an NH and a CH group at the top, left to right, the letters standing for nitrogen, hydrogen, carbon, and oxygen. But, attached to that CH at the top right of the square the chemist put this: CH—NH—CO—NH₂, and all of that which is written after the CH is nothing but urea. Hence he reasoned that the NH—CO—NH₂, or urea, was probably chipped off from the allantoin in the wounds, and just that proved to be the case.

There you have the story to date. Man first used blowfly larvae and then one of their excretions to heal wounds. Finally he came to see that the white crystalline chemical urea, which occurs as a human excretory product, was the real healing agent.

AFTER CARS COME TRAILERS

EIGHT years ago there were a mere dozen manufacturers of tourist trailers and their combined output numbered in the hundreds; in 1935 the number of producers had swelled to 300 and they turned out about 25,000 trailers. This year, over 700 manufacturers will produce something like 80,000 homes on wheels.

These 700 manufacturers, large and small, comprise the heart of this soaring, incalculable industry which seems to have taken these United States by storm. Fringed around it are concerns which do nothing but supply parts such as wheels, axles, springs, frames, windows, and hitches, while less closely associated are established manufacturers working overtime to furnish such materials as plywoods, veneers, composition boards, and good solid wood.

Yes, we've got a brand new industry. One that rose like the Phoenix out of the depression and appeals to the public as nothing else has since the advent of the automobile. With the lure of home, sport, and travel all rolled into one, few of us escape being smitten and that makes for talk however strong or weak our desire for ownership.

Maybe you thought the output of tourist trailers was larger than it is. Well, commentators have been prone to double every figure, thinking, no doubt, that fancy would become honest fact before the comments got into print. But the truth is striking enough because rarely has an industry grown with more rapidity. If it had grown any faster it couldn't have had its present substance.

Despite expansion, trailer manufac-

Mobile Homes for Everybody . . . What They Offer . . . Designs . . . Construction . . . Booming Trailer Industry . . . How Long Will it Boom?

By PHILIP H. SMITH

ture is still an infant industry, likely to develop into almost any kind of a child. In its origin, way of going about it, public response, and character of growth, it parallels most closely the development of the automobile industry. Whereas the automobile issued from carriage builders and machine shops, the trailer comes largely from commercial body builders, carpenter shops, and garages. Only within the past year has large scale production been undertaken by companies organized purely for trailer manufacture. The bulk of the 700 companies still think of output in terms of single units—to make of it a handicraft proposition.

THE earliest products were designed primarily for camping. They were frequently of the expansible type and scantily fitted in true camping style. Today's product simulates a fully-equipped, modern apartment in which the routine of year-'round living can be carried on. Take off the wheels of the trailer and you have a house in miniature, designed for all climates and capable of being used indefinitely far from civilization. The present-day trailer is a hybrid, taking a little something from everybody. The building industry

gives it materials; body builders contribute the art of joining woods; airplane design furnishes ideas for strength with light weight; the automobile industry supplies its knowledge of metals.

Trailer design, although still in the formative stage, has approached a high degree of standardization in form and character of fittings and arrangements. All trailers carry housekeeping devices such as an ice box, stove, sink, water supply. They all are equipped with dual electrical systems: a 6-volt circuit to operate from a battery and a 110-volt system for outside plug-in connection when parked near current. They have countless cabinets and drawers and, of course, accommodations for sleeping.

Strange to say there is yet no close correlation between price and quality in the sense of strength and durability. The correlation between price and size is definite. There are some low priced trailers that are better made than some higher priced ones, the reason being largely that the chassis and shell (sans fittings) can be produced well for a small figure, while the fittings can run into much money depending on the cabinet work and woods used. Appearance,



Essentially for vacation tourists, this trailer uses a combination of metal and fabric in its structure for light weight



A year-'round home on wheels with heat- and sound-insulated panels of aluminum riveted to a metal frame

therefore, is not a reliable indicator of road life.

To obtain maximum comfort in a trailer you must pay 1000 dollars or more for it; but you can be well satisfied for much less. The newest luxury models will boast heating plants, hot and cold water, baths, self-contained electric light plants, and ventilating systems elaborate enough to be termed air conditioning. They will also feature brakes and toilet facilities as standard equipment.

AT the moment there is great controversy within the industry as to what constitutes the best type of construction. All agree that a steel chassis is essential for safety and long life, but there is no agreement as to the best material for the exterior wall panels. Some say metal; others say anything but metal. Among the former are those who believe that the trailer is a sort of offshoot of the automobile; among the latter are producers who think of the trailer more in terms of a house. A third minority group declares that the ultimate material has yet to be developed.

As an outcome of the divergent opinion there is great variety in wall construction. We find plywood, plywood covered with leatherette, hard composition board, soft composition board, thin sheets of galvanized steel backed with plywood, steel backed with a sound deadening and insulating material, and aluminum sheets. Proponents of metal claim greater safety and more durable construction; opponents declare metal unnecessary for strength, excessively hot unless well insulated, and unduly heavy. The final outcome will be determined by the public and its demands.

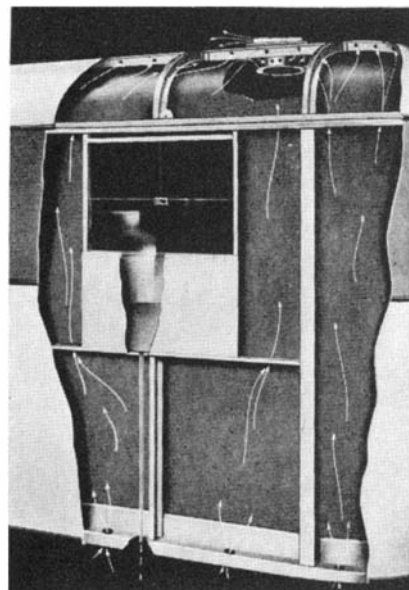
Brought to its present state of perfection, what is the future of the product and of the industry that makes it? Will the trailer of five years hence be the trailer of today save for minor

modifications? Will the industry continue to expand without apparent limits to create a mobile population? What are the trends? These are questions that are puzzling producers, interesting the public, and intriguing the man who wants nothing better than to get in on the ground floor of a "natural."

Character of product and growth of the industry are very closely linked. Ultimate use will be the deciding factor. Will the trailer become primarily a week-end and vacation vehicle or the substitute for a home?

Trailers are being used for pretty nearly everything and by all classes of our population. They have been purchased for vacation travel, for hunting, for homes, and for commercial use. Itinerant workers have taken to them, pensioners and retired citizens have pulled up stakes and departed in them. Salesmen are using trailers to drag their wares around the country.

Of the many current uses, the commercial is the easiest to plot. It has been slowest to get underway, but destined to grow rapidly. Concerns manufacturing refrigerators, stoves, lawn-



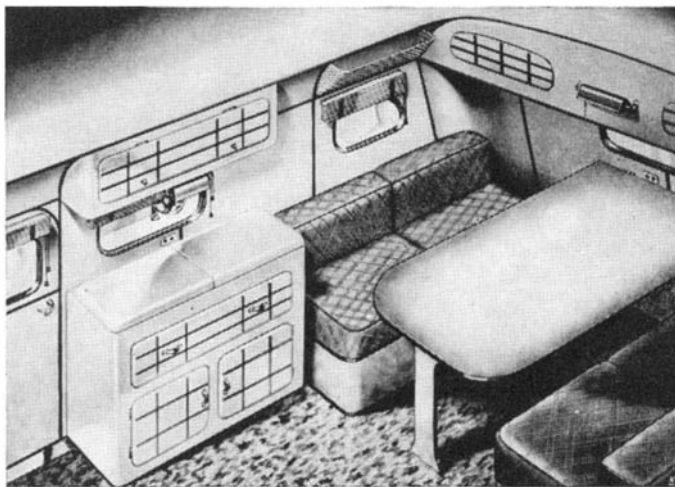
A blower draws air through the double walls, cooling the interior

first-hand experience in trailer living, but we must not forget that there were automobile manufacturers who became nervous when 5,000,000 automobiles got into owners' hands and who planned to retire before the "fad" blew over.

What people now see in the trailer is chiefly a means for getting around the country with maximum choice of how, when, and where, and at a minimum cost, once first cost is absorbed. The appeal is tied securely to sport, leisure, day-dreaming, and economics—above all, economics. The urge, the necessity, to live without paying taxes and rent is behind the sudden expansion of this industry. Without the promise of providing a home at a fraction of the cost of a house, the trailer industry would never have become

the most talked about business in this country. Will home owning continue to be the major stimulus? Let's weigh it.

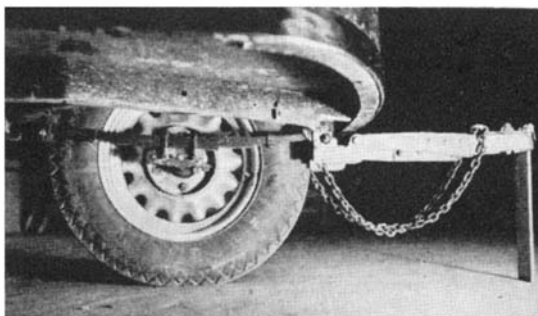
If you will query trailer manufacturers as to where their market lies, you will find a fairly even division between those who believe intermittent vacation use will keep the factory wheels turning and those who believe that year-'round homes are what people want. This split, in itself, heralds a diversity of product to suit both markets. Believing that vacation use does not warrant the outlay of large sums, a product is being developed to give the necessities at minimum cost, while at the other end of the scale are coming more elaborate products aimed to supply everything that could be needed in a modern home, for people



All-metal fixtures are a feature here. The dinette arrangement can be altered to form a very comfortable double bed

mowers, glassware, and a hundred other items have found the trailer a boon for the demonstration and display of their wares on a national scale. More and more companies are taking to it, and trailer fleets are beginning to multiply to insure a back-log of trailer sales.

The ultimate use of trailers by the public is not so easily forecast. Even trailer producers are at a loss to foresee where the flare-up of interest may lead. It may be significant that the majority of producers are skeptical of the idea that the bulk of our citizens will live on wheels. Most of them have a long-term,



A swiveling third wheel at the nose of this trailer takes the weight off the draw-bar and hitch



In this unique tourist trailer coupling, the road shocks are absorbed by a pneumatic casing held by an aluminum frame which is fastened rigidly to the chassis of the tow car. The nose of the trailer pivots on the center of the casing spider, with the weight thrown just forward of the rear axle of the towing automobile

who have no other abode. And with this latter development goes a great deal of experimentation in design to the end that quarters will be less cramped.

The proponents of the home idea claim that no other suitable dwelling can be purchased at anywhere near the cost of a trailer. And this is true. The question remains as to whether present low-cost operation will endure. There are indications that the present advantage of escaping taxes and rent will not last. Not that imposition of taxes might be so onerous as to wipe out all advantage, but that the expansion of trailer use will lead inexorably to some payments which will raise operating costs. This year the question of trailer regulation will come up for consideration in the legislatures of several states, and out of these deliberations may come higher taxes (they are negligible now) and regulations which will force concentration of the trailers in suitably prepared camps.

The net result of legislative developments may serve as a damper upon sales, but it should in no wise prohibit them. The "escape" feature may be subordinated to eliminate mere social irresponsibility, leaving a means of living, the economy of which can be compared with fixed residence upon a more equitable basis. Wherever the earning of a living involves travel, the trailer has and will continue to have a prominent place. For those who have retired from active pursuits, it, too, promises a mode of living. Those who can afford a trailer in addition to a home will be in the market, and if they can't own, they'll be able to rent. But what of the person to whom home ownership is out of reach because of un-

settled employment? Does it offer him a way out?

Trailers have been considered by those whose life work is the study of low-cost, mass housing for the worker and to date they do not see the trailer as affording any solution. They maintain that low cost housing has always been a problem of land economics rather than of building construction, that mobility is not a prime requisite, and that steady employment cannot be aided by it. They maintain that a large mobile population of workers would breed further unsettlement and make the tenure of employment even more uncertain than it is today.

WHETHER or not the housing experts are correct in their interpretation of needs remains to be seen. The public may decide the issue. Sometimes problems are solved by those who barge in from other fields, knowing little or nothing about the obstacles to be overcome. Several enthusiasts for trailer living are struggling to perfect trailers that will overcome the limitations of space, now an inherent drawback, and provide a "packaged" home which will meet the needs for decent living. They vision an extension of municipal or private camps to dot the peripheries of large cities, where electric light, water, and sewage disposal can be had at reasonable charge. These colonies, they maintain, are a logical development because they permit families to live without heavy outlay for land ownership or rent, while enabling the bread-winner to get a hold in a gainful occupation.

The proponents of mass housing with trailers believe that a degree of fixity must go with the mobility if comfort is to be had over a long period of time,

hence their designs tend toward an expandable type. If a trailer is to stay put for months, the owner may not mind a small setting-up operation. And so a new type of trailer is in the making. One current design resembles an orthodox trailer while on the road, but when anchored, the sides swing open to double the floor space. Another design, still on paper, calls for a two-story structure, while a third would have the trailer travel in two sections which could be "buttoned" together when the site is reached.

All of these behind-the-scenes developments make it obvious that the trailer industry is still in its formative stage and, therefore, passing through a period of instability. This is true despite the beginnings of mass-production with all that it implies in standardization. The present product can easily become standardized and still leave room for further development.

The immediate outlook for product development is for trailers with better insulation, adequate toilet facilities, standardized hitches, and more durable construction—in short, toward a normal improvement based upon lessons learned from service. Yearly models will record these advances. In viewing the immediate market, there appear to be no indications of a slackening of pace. Rather, expansion will continue until an equilibrium is reached, or until untoward social, legislative, and economic developments become influencing factors. As to what's to happen in two years or five years? The public will decide this unknowingly and your guess, the trailer manufacturer's guess, and mine, are equally good.

Photographs courtesy of Aerocar Co. of Detroit, Edwards Iron Works, Palace Travel Coach Co., Pierce-Arrow Motor Car Co., York-Hoover Body Co.



Coach trailers in all stages of assembly in a modern trailer factory

SENSE AND NONSENSE IN SENSATIONS

WHERE is *up*?" "That," you say "is as silly a question as one could ask." Not at all. It is very dangerous for some persons to dive into water. Once under the surface they forget where "up" is and are likely to start for the top via China. This condition is caused by a curious disease of the inner ear, where is located a remarkable mechanism which keeps you friends with gravity. Ice and a smooth sidewalk give a most effective demonstration of gravity's force but this little organ in your ear keeps you right side up—with luck.

Its working is beautifully simple. Just imagine a very small rubber balloon filled with thin oil in which are floating little pieces of limestone. Now cover the inside of this balloon with tiny hairs, each of which is attached to a nerve, and you have the "sacculé," as we call this organ. You can see how it acts. Gravity works on the limestone particles. When you are standing erect they rest on the bottom of the sacculé, stimulating the nerves which say that you are upright. Lie on your side and they stimulate other hairs which indicate your position. Dive into water and you have an automatic device which tells you when you are standing on your head, as it were, and where to find the surface, even if you keep your eyes closed.

There is a funny little fish that sheds its skin every now and then. Along with the skin go the contents of the sacculé, so the fish scrapes along the sea bottom filling its sacculé with water and fine sand. Then the skin grows over the sacculé and he is "all set." Observing this, one biologist had a brain wave. He filled the bottom of the fish tank with very fine iron filings, so that the fish got these in the sacculé instead of sand. Then he needed only a magnet to make life miserable for the poor fish. When held over its head the magnet jerked the filings to the sacculé's top. This meant that the fish was wrong side up, so he promptly flopped over on his back. Possibilities were infinite and the fish probably died of a nervous breakdown—a fit test case for the S.P.C.A.

If you are to survive you must be able to handle your body. The sacculé and other structures in your inner ear take

Hunger and Thirst . . . Fatigue and Pain . . . Cold and Warmth . . . Smell . . . Sight and Color Blindness . . . Hearing . . . Our "Intelligence Department"

By G. H. ESTABROOKS
Professor of Psychology at Colgate University

care of balance, which is tremendously important. These mechanisms inform your muscles what is happening and the muscles do the rest. But you've got to know what the muscles are doing, where your arm or your leg is and whether you are standing or sitting.

Again you say, "utterly silly! Of course I always know where my limbs are." By no means! Very important nerves run in from the muscles and joints which give you this information. At times they become paralyzed. For example, let us take the case of locomotor ataxia—syphilis of the spine. This disease always attacks the back of the spinal cord and here are located these nerves from the muscles—the kinaesthetic nerves. The syphilis germ kills them and as a result the individual literally cannot locate his legs. Lay him on his back, blindfold him, then put his leg in any unearthly position and ask him to touch it with his hand. He just can't do it. He also has a peculiar shuffling walk. He can't feel where his feet are, so he has to watch them. Now close his eyes and ask him to stand erect. You can do it easily, for the muscles of your legs keep flashing messages to your balancing apparatus and you just balance. You take it all for granted. But he will sway and fall—it is called Romberg's sign—because his muscles cannot send these messages.

The kinaesthetic fibers run up the cord to the brain, hence any injury to the backbone may very easily put them out of commission. Fractures or wounds, as well as disease, may give these curious results. Generally the legs alone are involved, because the nerves from the arms enter the cord high up. Any injury here generally results in a broken neck and death. In those rare cases where only injury occurs we get a weird inability to control the hands. The individual suddenly loses his power to play

the piano, not because he can't move his fingers just as fast as before but because he can't keep track of them. They literally get lost.

"Let's eat," you say. "Why?" "Because I'm hungry." "And why are you hungry?" "Because I haven't eaten, you idiot." That's a very good reason—certainly good enough for most of us. But there is a much more scientific explanation of hunger. We can remove it with a very hearty meal of air. Hunger is caused by the walls of the stomach rubbing together, or by other movements in these walls. We have you swallow a small rubber balloon with a tube attached. Then we inflate the balloon. Result; no more hunger, because you have a "full stomach." Certainly a cheap meal and one which we would recommend to relief agencies if government money is not forthcoming.

And thirst? Much the same idea. There is a small area in your throat which tells you when you need water. It becomes dry because of insufficient water content in your whole body. Keep the area moist and you will not feel thirsty. People who live in desert areas have discovered this trick. They can walk in comfort under a hot sun and use about one fifth the water you would need. They swallow very little but keep the throat wet.

Now of course you are not fooling your body when you eliminate hunger or thirst by these trick means. These sensations are simply automatic whistles, so to speak, which tell you that the machine needs more fuel. You can turn off the whistle and the machine will still run, but you are drawing on the reserve fuel supply and sooner or later you will pay for it.

Similarly, fatigue is another of these internal sensations which warn us to ease up. It is caused by poisons, which

accumulate in the blood, acting on a center in the brain. Fatigue can be produced artificially. We simply take some blood from a person who is very tired, inject it into your veins and you promptly feel as tired as the blood donor. We can also turn off the sensation by means of hypnotism. Then the individual no longer feels tired but for a time can continue work greatly in excess of the normal performance. But again you are not fooling the body. You have just turned off the warning whistle and may suddenly find the subject in a state of collapse. For these purposes, the body is just a machine and when the fuel runs out, it stops.

SIMILARLY, pain is humanity's greatest blessing. It is nature's warning that part of the machine is either badly worn or broken—the danger signal par excellence. An appendix may give you a pretty bad time of it—but if it were not for the pain involved, you would go gaily along until it ruptured and peritonitis set in. Now we can turn off the signal here as elsewhere: hypnotism again can do it very nicely. Ether, or a dozen other drugs are even more effective, but your doctor is by no means as anxious to stop the pain as you are. It is about the only way he has of locating the engine trouble. Indeed, he would give a great deal at times if you would develop a good ache or two before it was too late. Some of our most dangerous diseases owe their bad reputation to just this trick. They keep under cover and don't give you even a twinge until it's all over. If cancer or tuberculosis, for example, just brought a good toothache in their early stages, we would reach the hospitals in time and thousands of lives would be saved. As it is, when detected, the battle is all too often lost before treatment even begins.

The sense organs we have mentioned thus far are the more obscure. Situated deep within the body, you are very likely to overlook them completely, centering your attention on the more evident senses of hearing, taste, or sight. Nevertheless, the sensations to which they give rise are absolutely necessary to a proper functioning of the body. Pain is peculiar, in that it can be aroused both inside and outside. It is nature's great and pressing danger signal—and danger exists everywhere. You would never know you had a speck in your eye, a tack in your toe or a burn on your finger if it were not for the pain receptors. They warn that something is wrong with the machine and insist on action. You get used to a bad smell very quickly. Taste is the same; also, very few of you have heard the clock ticking in the room for the last hour. But you can't lull pain away. If you have a bad tooth, nature doesn't play; you get no peace until you land in the dentist's chair—and precious lit-

tle of it there, as far as that is concerned.

It is an interesting fact that the feeble-minded are not nearly as sensitive to pain as are normal people, while some types of insanity are characterized by its complete absence. These people will stick needles and knives through various parts of their body with no ill effects other than the danger from infection, which, of course, is great.

The pain receptors outside the body are located in the skin but their distribution is by no means uniform. For example, you cannot prick your finger without getting the sensation of pain. If you even touch your eye ball it hurts, but you can thrust a needle through a fold of skin on your upper arm or back and the chances are that you won't feel it. This is because there are very definite sense organs in the skin and their location does not change. These skin senses involve not only pain, but also pressure and warm and cold spots. Each of these sensations has sense organs just as definite as the eye, even if microscopic.

Pressure spots are located all over the skin, especially at the bases of hairs. In the good old days before you became civilized, slight pressure might mean great danger. The walking of an insect across the skin, placing a hand on a snake or furry animal, would call this sense into activity. The whiskers of a cat or rat are further examples, while of course the "feel" of any object, from a toothpick or your own hat to the handle of your car in the dark, is largely dependent on this sense. All these skin senses yield very curious illusions. For instance, suppose you have a clean bone break in arm. If we bend the arm at this point the patient gets the same sensation as when he bends his elbow. Joint movements are always associated with pressure on the skin, and the sensation is simply carried over to this false joint.

Some 250,000,000 years ago, nature decided on a new model. This was to be temperature conditioned. So she brought out the mammals and birds—so-called warm-blooded animals—which means that the body stays at that constant temperature which is most efficient for the working of the machine. It is a terribly wasteful arrangement because four fifths of all the food you eat goes to keep up the fires—only one fifth to movement. But it gives you one enormous advantage over the reptiles and the fish. Cold or heat, unless extreme, mean practically nothing to you, but at freezing weather, a snake or any other cold-blooded animal simply stops. The machine just won't work, because its temperature falls to that of the air about it. As a result, the great race of dinosaurs, huge reptiles which once ruled the earth, were swept out of existence by these new-model animals, the warm-blooded mammals.

You keep your house constant in tem-

perature by means of a thermostat, but nature has a device which makes this look crude. The sensations of cold and warmth, the so-called "temperature" senses in your skin, are simply very efficient little thermostats installed to keep your machine at its best running temperature. On a hot day they warn you to go into the shade or the water, otherwise the engine will boil. You put your nose out when it is ten below zero and you know that plenty of clothes and fast walking are indicated or else the engine literally will freeze. Your body adjusts itself to the temperature sense so beautifully that you rarely realize what you are doing. An extra jersey in winter or cottons in summer are the more visible signs. Actually you are continually changing your position, drinking this in summer or that in winter, eating more meat and fat at one season, fruit at another, all because the "air conditioning" apparatus is always at work keeping the machine at its best running temperature.

There are two other senses and these intimately associated, namely smell and taste. In reality, you taste very little. The wonderful taste of roast beef, coffee, or pickles is almost entirely a matter of smell. The sense organs of taste are located in the tongue and other parts of the mouth. They can detect only four qualities—sweet, salty, sour, and bitter. Smell has its center at the back of the nose. Anything which approaches or enters the mouth must stimulate this area because of the air currents continually in circulation. You complain that you lose your taste during a bad cold: what really happens is that your nasal passages are blocked and so you lose your smell of the food, which is the most important part of "taste."

YOU can play some interesting tricks on yourself, which very nicely illustrate this dependence of taste on smell. Close your nose with a clothespin, cotton, wool or any other device. Now blindfold yourself, so you can't see what you are eating. Under these conditions you will find that the best roast beef and gravy taste exactly the same as sawdust probably would taste. Mashed potatoes are indistinguishable from mashed turnips, finely ground dog biscuits, or pulverized leather. I should add that it is always best to have a friend whom you can really trust working with you on this experiment, or else your stomach may get a few surprises. Believe it or not, cream and castor oil cannot be distinguished, while I actually saw one boy swallow a tablespoonful of paraffine and ask for more—also for the privilege of murdering his friend when he later found what he had done.

Your eye is, of course, the world's most wonderful camera. The best product of modern science is crude in com-

parison. The eye itself is simply a marvelous apparatus to focus light rays on the plate—the “retina” we call it. Now and then, parts of the camera go wrong. The lens—it goes by the same name in the eye and serves much the same purpose—does not function properly and you become short sighted or far sighted, or its curvature is not perfect and you have astigmatism. Glasses correct these faults. Much more serious is the collection of white matter in the lens when the very serious condition of cataract develops. This calls for heroic measures, so the modern surgeon takes the lens out completely and gives you glasses to compensate.

Sometimes the optic nerve itself dies, and this, of course, is incurable. Certain diseases may lead to blindness—syphilis and tuberculosis are offenders here—while, of course, accidents can do the same. It is interesting to note, however, how difficult it is really to get at the eye. It is situated in a bony socket and these bones can absorb a terrific blow without the eye itself being injured. Pointed weapons are the great danger and, of course, the flying glass from automobile windshields qualifies very nicely under this head. When plans for your eye were drawn up, however, many millions of years ago, even the Model T hadn't made its appearance. So be charitable if nature falls behind a little—consider the football rules.

THE camera plate itself, the retina, is our chief point of interest in the eye. Here are located the real organs of vision, the rods and cones. These have two separate functions. The rods detect movement and changes of brightness, the cones react to color. Strange to say, the lower mammals, such as the cat, dog or bull, are color blind. This is difficult to demonstrate, but it can be done. Then, for some reason or other, when nature got to man, she decided to introduce color vision in her latest model. So now both you and the bull can “see red”—but the bull can't!

But man is a backslider, here as elsewhere. Every now and then he arrives minus this latest device, and we have the color-blind individual. If he is totally color blind, he sees no colors at all. If “red-green” color blind, then he cannot detect these latter. Red-green color blindness is present in at least 5 percent of males but in a much smaller percentage of females.

Your ear gives us a marvelous example of just how clever nature can be in this matter of sense organs. First we have the passage leading to the ear drum. Sound waves striking this membrane start it vibrating and three little bones, very neatly jointed, pick up these vibrations and carry them across the “middle” ear to the “inner” ear. This middle ear is a tiny bone chamber filled

with air. Here nature struck her first major problem—that of varying air pressure. If you go up a mountain or down a mine, the air pressure outside changes, the ear drum gets pushed in or pulled out, can no longer vibrate and you get that curious deaf feeling, best encountered in an elevator. What to do about it? Nature put through a tunnel from the throat to the middle ear. Every time you swallow this opens and equalizes the pressure inside and outside the ear. Unfortunately this tunnel—the eustachian tube—carries the possibilities of infection. Germs from the throat travel up it and attack the middle ear. Mastoid disease is one of the results.

The organ of hearing itself is one of nature's masterpieces. She simply installed a tiny piano keyboard in each inner ear. To be sure, it is microscopic in size and has a few curious features, but the fundamental idea is there just the same. From the end of each string a nerve goes to the brain and in this way you hear. But how to play it?

The board is in a winding chamber filled with a very thin liquid. Vibrations from the air are picked up by the ear drum, relayed across the middle ear by the three little bones aforementioned and passed on to the liquid in the inner ear. The strings vibrate according to the principle of “sympathetic resonance.” You have heard a window pane rattle on playing a certain piano note. Similarly, the strings of a violin or piano will vibrate when they are in perfect tune with a note played on another instrument. They just pick it out of the air. So your ear keyboard picks it out of the liquid in which it is immersed and the various strings vibrate in tune with the vibrations in this liquid. The nerves carry this to the brain, and so you hear.

The sense organs form the intelligence department of the body. It is their duty to keep you posted about what is happening both within and without. At times they can be fooled or will make curious mistakes. Certain diseases will cause you to see anything from streaks of light to snakes. Under hypnosis you can hear Caruso singing in the spirit world or “Big Ben” broadcasting from London—without the radio. Then we have a whole store of trick illusions in the psychological laboratory. With these we can make you swear that lines of the same length are different, that different colors are the same, that hot is cold and that bad smells don't exist.

For all that, the sense organs of the body do a good job—and they should. Your eye, for example, is the direct result of more than 500,000,000 years of evolution—and that is a long time.

In closing, we would like to stress two very interesting facts. Not only do we deal with immense periods in evolution, but also with a highly varying rate in different species. For example,

50,000,000 years ago parrots existed which were practically identical with present-day species. Man is very much a newcomer and, should you meet your ancestor of but 50,000 years back—the so-called Neandertal man—you would certainly never invite him to lunch. Short, squat, hairy, with receding brow, magnificent teeth and immense physical strength, he would probably have much preferred eating you to eating with you, for he was a cannibal, among other things. Some species were born only yesterday and are still rapidly evolving. Others have remained as they are for a billion years, watching the race go by.

This same picture holds in sensation. As evolution advances, we place more and more stress on those sense organs which enable us to analyze the world in which we live, particularly stressing eye and ear. In physical strength, coordination and speed, a cat can literally make a monkey out of a monkey, while if we match a man and a tiger of equal weight the result isn't even worth a good bet, despite the higher intelligence of man or monkey. Physical efficiency is, of course, just as much a matter of kinaesthetic sensation as of muscle tissue. Similarly, in smell man's best is just nothing, compared with a dog's keenness in this sphere.

But here the superiority ends. Man now lives under conditions where careful analysis of a very complex environment is essential. The dog, for example, cannot distinguish different tones, nor can any other animal. A violin sonata is, to him, just noise of varying intensity. He would certainly prefer the jazz orchestra. Nor can he see color, strange as this may seem. The red flag means nothing to the bull, so far as color is concerned, while green or blue would be just as annoying, but this color vision enables man to know his world far better than any animal.

Finally, man specializes on *fine* coordination. The tiger—even the monkey—may surpass him in strength and use of the big muscles, but just watch your best-trained chimpanzee try to thread a needle or use a fork, and you realize that man is his superior just where this superiority is most needed. Our kinaesthetic senses allow us to handle a pen, shoot a gun or grind the valves of a motor—activities which are essential to our life and happiness but which are completely beyond the scope of any lower animal. That makes sense in our world of sensation and gives us the prize, even if the monkey can hang by his left hind leg from the tree tops.

*I*N stating that man—Homo sapiens—is the descendant of Neandertal man, the author follows the school of thought of Dr. Ales Hrdlicka of the United States National Museum. The question is not yet finally decided.—The Editor.



A fine example of a waterfowl marsh area at Red Rock Lakes, Montana

FLOODS AND WILDLIFE

THE disastrous floods that occurred during the spring of 1936 have focused national attention upon the problem of devising methods to control the runoff of water and prevent recurrences of seasonal catastrophes of this sort. The last Congress authorized a gigantic flood-control program and this action has probably been most effective in acquainting the public with the fact that devastating floods are not necessarily to be classified as "acts of God," or inescapable natural calamities which must be endured. Rather, they are often the result of our own mismanagement of a great resource. Since this is so, then it is obvious that flood damage can be prevented or at least greatly reduced by substituting good management for bad and by applying sound and sensible methods to the problem of water conservation and control. The problem primarily is one for our engineers, but all those agencies concerned with the conservation and restoration of our renewable organic resources have, also, a tremendous interest in what may be done. No money for the flood control problem has yet been appropriated but the public's vivid recollection of the terrifying and destructive events of the past year will undoubtedly compel protective action on an extensive scale in the near future.

Wildlife conservationists in particular

Flood Control and Wildlife Management Can Be Correlated . . . Proper Dam Design Creates Wildlife Refuges . . . A Three-in-One Program

By **IRA N. GABRIELSON**

Chief, Bureau of Biological Survey, United States Department of Agriculture

are becoming increasingly interested in this program and its possible effects on wildlife populations. The idea of control meets with their general approval, for floods are disastrous to small ground-inhabiting mammals that find it impossible to escape the rush of rapidly rising waters. When floods come during the bird nesting season, wide-spread destruction of this valuable form of wildlife is the inevitable result. Migratory waterfowl and other marsh-nesting species are especially hard hit by upward fluctuations of water levels during their nesting and rearing seasons in May, June, or early July, while the plants upon which they feed are destroyed or prevented from growing at all in waters subject to frequent violent changes of level.

THEREFORE the flood control program holds a vital interest for those concerned with the increase of the nation's wildlife resources. Such a program will, if wildlife needs are con-

sidered, add materially to these resources, or, if no consideration is given, it will cause concentrated damage of the kind that such resources have been subjected to almost every year in the past.

Official conservation agencies, both Federal and State, are now spending great sums of money in attempting to restore migratory waterfowl and upland game resources. They must spend still more if these efforts are to succeed, and it seems pertinent, therefore, to point out any expedients which may allow the flood-control program to contribute to that end.

Waterfowl need comparatively stabilized water levels for proper environment, while flood control, if dams are built solely for that purpose, might require huge storage capacities which would permit water to be fed out into the streams in a regulated flow over a long period of time. Such dams can serve no useful purposes for migratory waterfowl and their catch basins would often

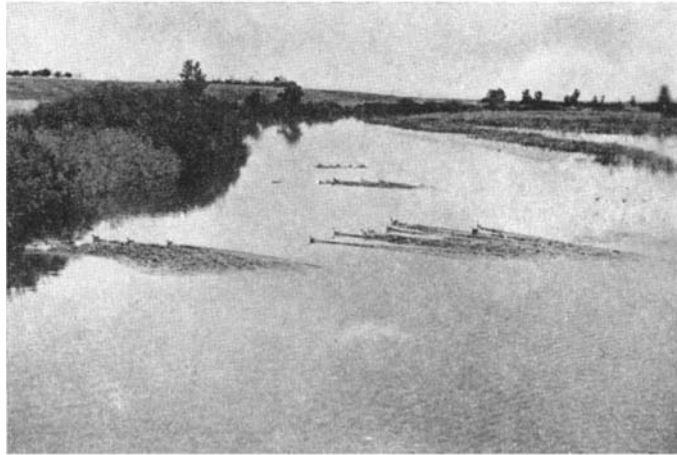
be huge death traps for small game which had taken up its abode therein during the dry season. Seemingly the two purposes are incompatible, but actually there are methods by which the needs of migratory waterfowl and small upland species may be met in some degree without excessive increase in the cost of flood-control dams or a material lessening of their effectiveness.

Huge dams creating great catch basins should be used only where absolutely necessary. From a wildlife standpoint they are the least valuable of various flood control devices.

Stream straightening and channel deepening may help locally, but in many instances they speed up the run-off of flood waters to the detriment of communities lower down the water courses. Incidentally such operations often decrease wildlife cover and food supplies.

THESE methods have been used in the past and undoubtedly they will be used in the future, but wildlife needs will be benefited much more by the use of methods outlined in the next paragraph.

Small dams on the headwaters of streams, creating shallow lakes, small ponds, or marshes, even of a few acres or a few hundred acres where possible, help regulate the run-off before it assumes flood proportions. Several of these on each stream, each with a stabilized level and provided with gates to raise the water temporarily during periods of



Four broods of ducks on the Lower Souris Refuge

excessive run-off, might well replace a single but much larger and more expensive structure farther down the stream. In other words, water may sometimes be more cheaply and effectively controlled in small volume than in huge quantities. Such small dams would have the added advantage of preventing soil erosion and would slow up siltation farther down streams.

Whether large or small dams are required, wildlife administrators realize that the number, location, and size must be worked out by engineers to meet the special problems of each stream. It would seem entirely possible and reasonable that some of the larger dams be built to hold shallow lakes at a stabilized level which could be maintained by the normal flow of the stream. Storage

capacity above that level during flood periods, while somewhat interfering with wildlife and occasionally causing serious loss if it were required during bird-nesting season, could still provide some first class feeding and resting grounds in sections where such areas are now lacking. They would frequently if not always provide fair nesting conditions as well.

A fine example of how large dams may help the wildlife resources is developing now on the Upper Mississippi River Wildlife

Refuge near Winona, Minnesota. Two of the pools created here by the flood control and navigation dams have relatively stabilized water levels. These dams, which might easily have been so designed as to destroy most of the wildlife value of this great area, are actually in-



With the Upper Souris Dam in operation, floods will never again sweep through the city of Minot, North Dakota, as in the photograph at right above

creasing these values. In the shallow portions of these stabilized pools, which lie outside the navigation channel, water plants, both the submerged aquatics and the emergent vegetation favorable to waterfowl and other marsh-loving birds, are establishing themselves in abundance. If these waters are held at their present levels an outstanding waterfowl habitat will have been produced and maintained. It is improving steadily and is at the present time a concrete example of what advance consideration can do for wildlife in the planning of these major structures. In this instance Army Engineers at the request of the Biological Survey altered their designs for the dams to meet the needs of the wildlife refuge.

A somewhat different type of structure exists today on the Upper Souris Migratory Waterfowl Refuge which, while built primarily for storing water to maintain nesting marshes below it on the river, was also designed with the added purpose of providing flood protection to the city of Minot, North Da-



A drainage canal carrying water into the Clear Lake Refuge in California

kota, below it. It creates an artificial lake which at its maximum will be some 28 miles long and 21 feet deep.

Such a lake may be raised a foot or sometimes more without great harm to cover or animal life, provided that the additional flooded land is not covered for an extended period. In very flat terrain such water would spread farther and perhaps do more harm than in lakes with somewhat precipitous banks. In any event the harm is minimized and a stabilized water level provided which will be of great value to wildlife. Temporary deepening of the waters during

flood stages is not good for aquatic vegetation, but dropping the water or drawing it entirely away is much worse.

Dams can be easily designed to maintain minimum water levels and to provide temporary storage above that level sufficient to take care of sudden excessive floods. The Souris Dam mentioned above is of that type. It is equipped with gates which can be opened to carry the full channel flow of the river and a spillway which provides an additional safety factor in excessive quick run-off.

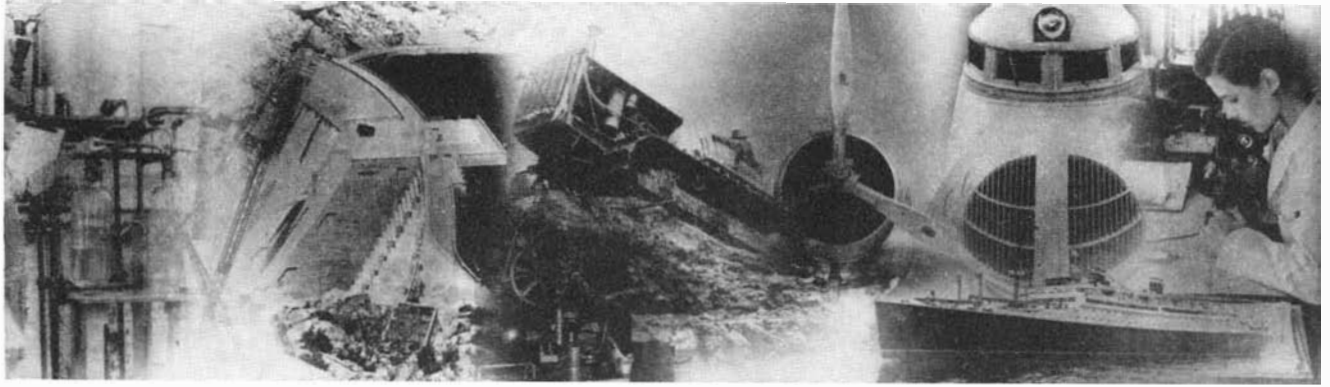
Should a sudden flood develop when the storage capacity was already utiliz-

ed, the spreading of the flood waters over the comparatively vast area of the lake will greatly minimize the effect of any except extraordinarily prolonged run-off. In other words, the lake itself will act as a stabilizing influence.

Wildlife groups would like very much to see consideration given to these types of flood control structures. They believe they will be of great and lasting benefit to the public from the standpoint of preventing soil erosion, conservation of forests and farms by holding advantageous water levels instead of allowing all of the run-off water to hurry out of the country, and that at the same time they will provide much better conditions for wildlife. This latter consideration is of prime importance in the north-eastern states where few places exist in which water storage and conservation for the benefit of migratory waterfowl restoration is possible. The cost of the structures required is too great to justify the work for that purpose alone, but when combined with flood control it becomes much more feasible and practicable. In any event it would seem to be the peak of extravagance and folly to take less than we can get for our flood control money. If, by taking thought, we can prevent this type of water damage and at the same time realize tremendous additional benefits in the way of wildlife restoration and soil conservation and have all three at the price of one, then it would seem to be well worth while to give consideration to the foregoing program.



The Alma Dam on the Upper Mississippi is stabilizing water levels to the benefit of waterfowl



THE SCIENTIFIC AMERICAN DIGEST

Conducted by **F. D. McHUGH**

Contributing Editors

ALEXANDER KLEMIN

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

D. H. KILLEFFER

Chemical Engineer

HUGE "ICE-PACK" SAVES DAM

ENGINEERS on the Grand Coulee Dam project were recently faced with a serious problem. The foundation of this dam is of exceptionally fine massive granite lying 500 feet below a layer of glacier-deposited pulverized earth. Now this earth is comparatively stable when dry, but when moistened or disturbed, either by excavation or by the cutting action of the river, its stability is disturbed and it flows like molten lava.

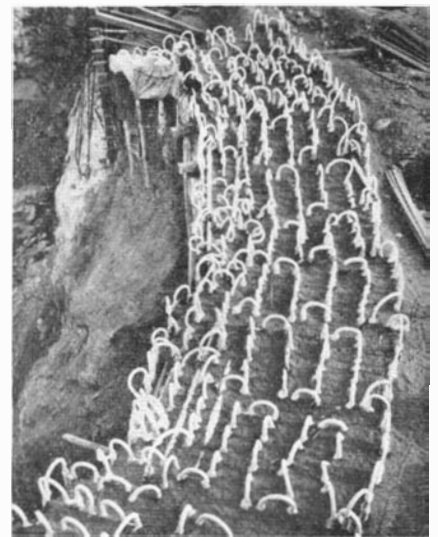
Since excavation was started on this project there have been several "flows" of this earth which encroached upon the work. Some of the flows were stopped by draining off the excess water, others were stopped by shoveling off part of the overburden, a very slow job.

Recently an earth flow resulted in the most serious situation faced since construction began. It started as earth was being removed from a gulch in the bedrock, 120 feet deeper than the average bedrock surface and 117 feet below the low-water sur-

face of the river. It runs parallel to the river and apparently was cut in some past age by the stream. The sides are very nearly vertical and are from 60 to 100 feet apart.

When this gulch was nearly emptied of earth, the great bank above it began to slide into the excavation from the upstream end. It moved at the rate of about two feet an hour and engineers estimated there were more than 200,000 cubic yards of earth in motion. Power shovels at work could not hold their own and were forced to retreat to keep from being buried.

Engineers in charge of the dam decided upon an experiment in which the earth at the base of the slide would be frozen, forming a dam to hold back the remainder of the earth until concrete could be poured to an elevation higher than the sliding earth.



Frost-coated brine-carrying pipes that formed the dam-saving ice pack

Two refrigeration machines were brought to the site. They had a total capacity of more than 80 tons of ice a day. About six miles of pipe were driven into the sliding mass in the form of an arch at the head of the gulch. Brine was forced through these pipes at a low temperature and the earth frozen. The dam thus created has a crest length of 105 feet. It is 25 feet thick and 40 feet high. The major test was placed on this unique structure when the earth had been removed from in front of it. The surface of the foundation rock was smoothed by blasting. Even this did not damage the frozen dam. Flying rocks cut a few pipes in the exposed face of this strange structure, but repairs were made quickly and it did not fail.

GAS FROM COKE

CONVERSION of solid fuel into gas and liquid products is an important factor in modern utilization of fuels. Experiments recently made at the University of Michigan have shown that powdered coke treated with sodium carbonate solution can be completely converted into gas by falling through a tube containing a mixture of steam and oxygen heated to 900 degrees, Centigrade (1650 degrees, Fahrenheit). In the experimental unit, a steel tube two



Photographs from Mirzaoff

View of the frozen section that stopped earth slides at Grand Coulee Dam

inches in diameter and eight feet long served as the furnace. Apparently the presence of a small amount of sodium carbonate on the surface of the coke materially increases the speed of gasification. The process may have important value in the manufactured gas industry.—*D.H.K.*

NEWSPRINT

THE newsprint used yearly in the United States would make a sheet 450 feet wide from the earth to the moon.

WORLD'S FIRST FLOATING CHURCH

GETTING to church has always been a problem on the delta of the Parana River in the Argentine. Church-goers have had to ford many of the streams which thread the delta or miss formal worship. Recently the problem was at least partially solved. The answer, supplied by a practically minded padre and illustrated here,

tween the ages of 35 and 54, the death rate has declined significantly in the past 25 years. Only over the age of 65 has the cancer death rate for white women shown an upward trend.

These figures are from the findings of a survey of cancer deaths among the company's industrial policy holders during the past quarter century.

Even among white males the cancer death rate is not quite a third higher than that of 25 years ago. This increase, it is believed, is due to improved diagnosis, more cases being recognized now as a result of improvements in modern medicine during the past quarter century. These improvements in diagnosis have caused an apparently greater increase in the cancer death rate for men than for women in the 25 years, because in men cancer occurs more often in internal organs where it was not easily accessible for diagnosis.

Bearing out the point that the increase in cancer deaths is more apparent than real, is the fact that the recorded death rates from cancer in accessible places have declined while those from inaccessible cancers have increased.

Other hopeful developments in the cancer situation in the United States are the growth of facilities, both public and private, for treating cancer and the improvement, as a result of special training, of the physician's ability to diagnose and treat cancer effectively.

Also encouraging is the fact that between 1932 and 1935 the American College of Surgeons collected data on 25,000 patients living five or more years after treatment for cancer without recurring signs of the disease.—*Science Service.*

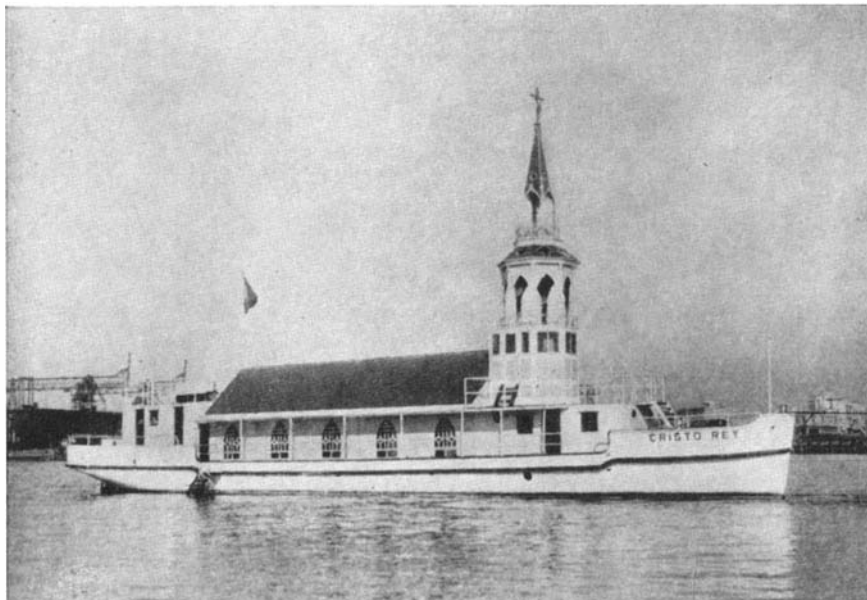
SOYBEAN FLOUR DESTROYS VITAMIN A

FLOUR made of legumes, particularly soybeans, and added to bread to improve the color of the crumb has been found to destroy its vitamin-A content. The color which is removed by soybean flour is carotene, which is oxidized and hence decolorized in the process. Since carotene is the basic substance of vitamin A, its activity is thus destroyed. Similar tests with cod-liver oil have shown that soybean flour will destroy at least 99 percent of its vitamin-A content.—*D.H.K.*

SILENT TROLLEY CARS FOR BROOKLYN

CONGRATULATIONS, heard because they are not drowned out by conventional and unavoidable rumble and clatter of trolley cars, are now forthcoming from residents of Brooklyn, New York, as the first of the hundred new silent type "PCC" cars for the borough are being put in service by the Brooklyn and Queens Transit Corporation. Citizens of all ages, who long ago gave up trying to make themselves heard when a trolley went by, are being agreeably surprised by the new vehicles, evolved by operators and manufacturers after five years of research. The new cars add but a whisper (actually) to the proverbial roar of the city, thanks to the use of rubber in a new way in the construction of the trucks and wheels.

A special study was made of the interior lighting of the cars, and as a result the Brooklyn vehicles are in all probability better lighted than the majority of the homes along the route traversed.



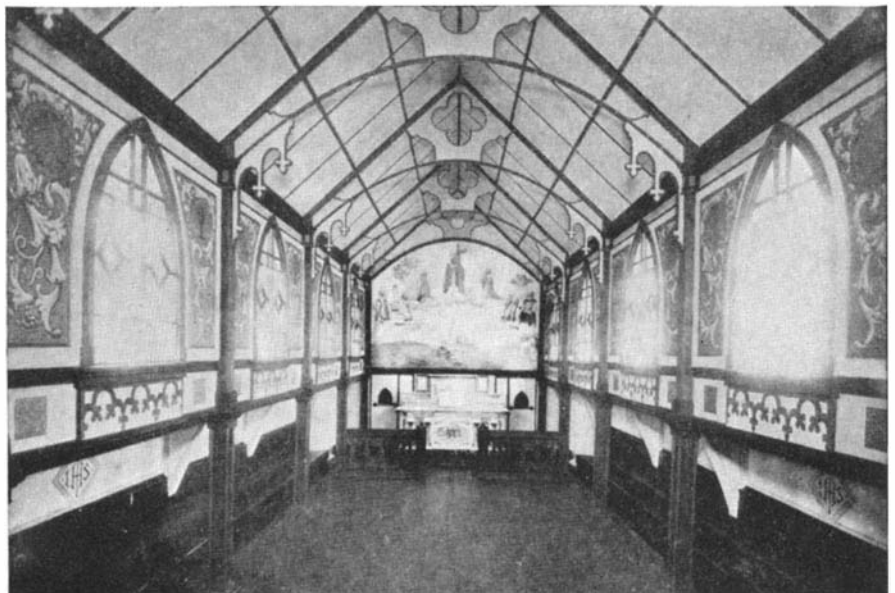
Above: The floating church that brings services to residents of the delta of the Parana River in the Argentine. *Below:* Looking toward the altar in the interior

is the world's first floating church. Now the place of worship, with its steeple, stained glass windows, padre, and altar goes to the congregation!

This floating church, 108 feet long, was built in the Argentine government's Buenos Aires shipyard. The hull is that of an old vessel. It was transformed into a place of worship by the modern Lincoln electric arc process of welding.

CHEERFUL CANCER FIGURES

THOSE who have been worrying over the menace of an increasing cancer death rate can ease their fears and take heart from the optimistic note on cancer struck by recent figures of the Metropolitan Life Insurance Company. The increase in the cancer death rate during recent years is more apparent than real. No more people are dying of cancer now than 25 years ago, but more cancer deaths are being recorded because of better diagnosis. In certain groups, notably white women be-



BICYCLES

SINCE we have been scolded for not including bicycles in our Transportation Issue, we will complete the issue with the surprising fact that bicycle sales for 1935—the automobile era—were greater than at any time since the peak sales of 1899—the horse and buggy era—and when figures are available, 1936 will probably show larger sales than those of 1899.

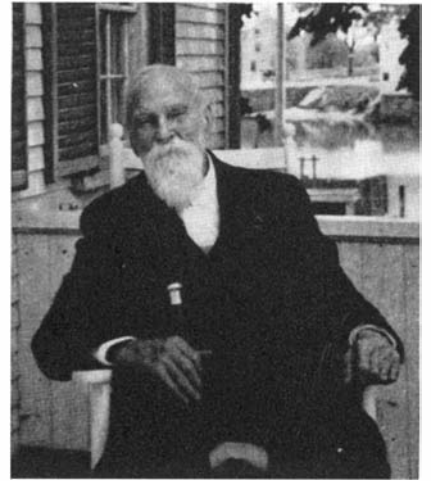
Ventilation was also considered in planning the "PCC" car, and among the attractive features are ducts leading from the motors up through the sides of the car to insure clean air inside.

No discomfort in starting and stopping is experienced by the passengers, because of the increased number of resistance points on the controller. There are 260 notches, or control stages, in the electric

For 80 Years!

ALL told, perhaps a hundred of our readers have been with us regularly for 50 years or more. They've followed in our pages the steady march of science from the "early days." Some of them have written from time to time expressing their belief, as the late Hiram Maxim did, that they *must* be record-holders. Not one of them was!

We pay tribute here to Mr. Oscar Loughton who, without a doubt, is the record-holder. Mr. Loughton, whose home is the Isle of Shoals, off the coast of Maine and New Hampshire but who winters in South Carolina, says he has read *Scientific American* for 80 years! At the age of 98 he is still keenly alive to the spirit of progress that has builded this nation. From his letters, we see in him incarnated the sturdiness of New England; the gentleness of the poet who loves every stone of the land of his nativity, every flower, every bird song; a generous and a



kindly soul. He is a brother of the New England poet, Celia Thaxter.

Thank you, Mr. Loughton, for your long years of loyalty. May the future years deal gently with you.—*The Editor.*



One of Brooklyn's new high-speed, silent trolley cars

operation. A smooth acceleration of from four to four and three-quarters miles per hour per second is obtained—more than twice that of the conventional street car. In five seconds the new vehicle can attain a speed of almost 24 miles per hour, and it can reach 50 miles per hour in less than eleven seconds.

The car can be stopped in about 70 feet when it is going 24 miles per hour, the service braking rate being from four and a quarter to four and three-quarters miles per hour per second, and the emergency rate from eight to nine miles per hour per second.

Three types of brakes are employed, operating in sequence from a single pressure on a foot pedal. A dynamic brake acts on the motors, a magnetic brake on the track, and air brakes on the wheels. The latter completes the stop and holds the car. There is no sudden jar when the car is stopped, but a quick and smooth slowing down, effectively insuring against skidding despite rail conditions. The starting

and stopping rates of the new trolley cars substantially exceed those of the ordinary passenger automobile. A quiet hum is the only audible evidence of increasing speed.

Operation of the new street cars is particularly safe and simple. The motorman employs a foot-brake and a foot-accelerator, and his hands are completely free.

Electric equipment for the hundred Brooklyn cars was designed and built by General Electric. Similar vehicles are also on order for Chicago, Pittsburgh, Baltimore, and Los Angeles.

PULP-MAKING WITH AMMONIA

A NEW method for pulping wood in the process of paper making, substitutes ammonia for dolomite rock as a raw material. Pulp has been made on a large scale by digesting wood chips with sulfite acid liquor made by treating dolomite with water in which sulfur dioxide is dissolved. This process produces the majority of the

pulp from which the better grades of paper are made. In the new process ammonia is used instead of dolomite in the preparation of the sulfite acid liquor. This new method has been tested on a full-plant scale in Norway for several years and the results in producing a high grade pulp, free from ash, in a shorter cooking time at lower temperature than by the older process, have encouraged expansion. The process consumes ammonia now cheaply available by synthesis from the air. Commercial development of the process in Norway is being fostered by Norwegian ammonia producers in co-operation with existing paper pulp interests.—*D.H.K.*

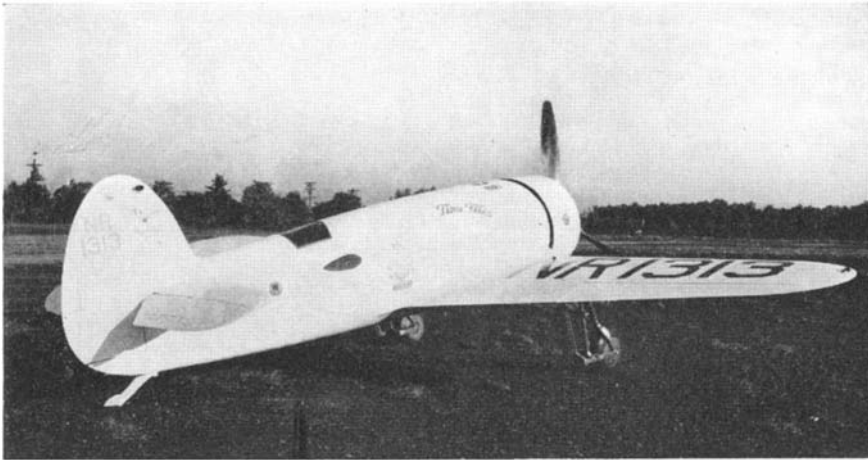
SKUNKS PAY DEARLY FOR THEIR INDEPENDENT ATTITUDE

SKUNKS are traditionally about the most independent animals one is likely to meet. Secure in their formidable means of defense, they stand their ground against all comers and let the other fellow get out of the road. But they are paying dearly for their failure to recognize something more formidable than themselves—the modern automobile, that can rush up on them and annihilate them before they have time to unlimber their gas-warfare artillery. So dead skunks are found on the highways, far out of proportion to their relative abundance among wild animals, according to *Science Service* and the journal *Science*.

On three recent drives in the region around Washington, D. C., totalling about 600 miles, B. H. Wilford and J. F. Wilford counted 22 dead skunks. They saw no other dead animals at all.

MEETING MODERN LUBRICATION NEEDS

"GIVE her another quart of oil," is the motorist's simple answer to the problem of lubricating the small, powerful engine which drives the modern automobile. Yet behind that "quart of oil" is a vast amount of the most painstaking research to provide in it exactly the characteristics necessary to keep the intricate parts of the



Time Flies, Commander Frank Hawks' new ship described below

machine in continuous efficient operation.

Recent rapid developments in automotive engines have greatly complicated the lubricating problem by imposing heavier loads on bearings and by widening the range of temperature over which they operate. Since the function of the lubricant is to form a continuous thin film between the metal surfaces of the bearings, this has necessitated the finding of oils and oil mixtures capable of maintaining lubricating films under the newly severe conditions imposed. In addition to new refining methods designed to remove undesired and objectionable impurities from the oil itself by the action of solvents, modifying agents added in small amounts to the refined oil impart valuable characteristics to it.

The whole cycle of development of lubricating oils today has been compared with that of steel and its alloys. The new super-refining methods using such solvents as dichlor-diethyl ether, furfural, propane, and others are similar in their effects to the modern steel refining methods and the addition of modifying agents to the refined oils corresponds roughly to the alloying of metals.

Among the agents found valuable in increasing the strength of the lubricating film produced by oils are, strangely enough, a variety of chlorine compounds which of themselves are not lubricants in the ordinary sense. Such materials as methyl dichloro-stearate have been found to be particularly valuable.—D. H. K.

“TIME FLIES”

APPROPRIATE is the name—*Time Flies*—of the new ship designed and built by Commander Frank Hawks and Howell Miller, under the sponsorship of the Gruen Watch Company. The new ship, the aerodynamics of which were checked in the wind tunnel at New York University, has a well defined objective—to combine the high speed of a racer with the practicability of a modern light transport plane.

Time Flies is passing its tests brilliantly; equipped with a twin Pratt and Whitney Wasp, developing 1150 horsepower, it is expected to have a cruising speed of 340 miles per hour, and a top speed of 375 miles. The wing span is 31 feet, length overall is 22 feet, and the wing area is 160 square feet. There is a very complete instrument installation including a Sperry Gyropilot; a 230-gallon fuel tank carried forward of the cabin and just aft of the

engine gives long range. The landing gear is fully retractable and the clean and modern lines of the ship are clearly seen in the photograph.

There is one particularly good idea which Frank Hawks, fine pilot and instinctive engineer that he is, has brought forth for the first time in aviation history; the complete elimination of the windshield.

The disappearance of the windshield has of course greatly enhanced the streamlining. The pilot is seated well to the rear. The cabin conforms to the line of the fuselage without a break. How can the pilot see? In flight he has flying vision through top and side windows. For landing and take-off the seat may be raised by a manually operated hydraulic jack and in the raised position the pilot's head is above the line of the fuselage so that there is wide vision ahead and to the sides.

A very simple idea, readily realized. But it was Frank Hawks who had to think of it.—A.K.

BOMBERS HAVE THE EDGE

LIEUTENANT-COLONEL Robert Duncan Brown, of the Coast Artillery, in a recent talk before the Reserve Officers Association, gave it as his opinion that at the present time airplane bombers have the edge over anti-aircraft guns.

It is true that modern guns can hit a

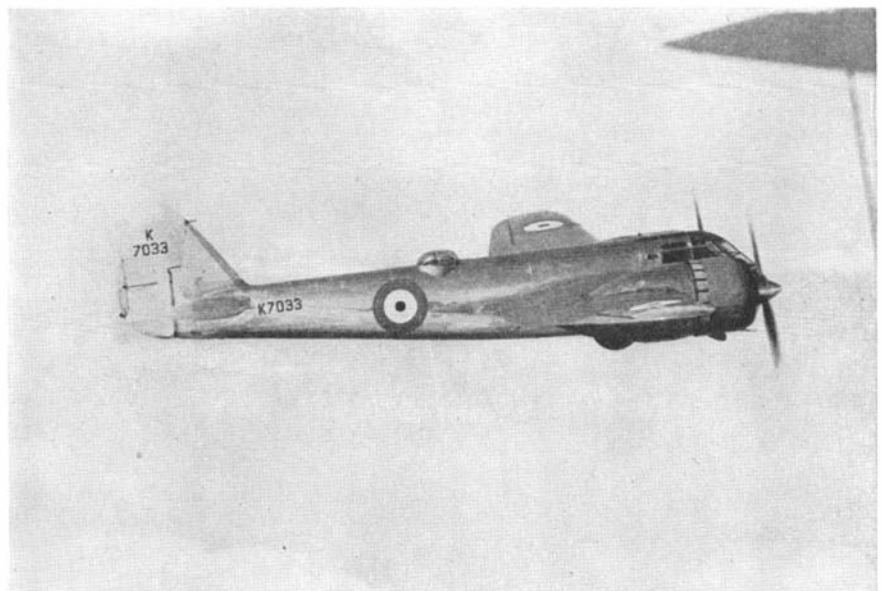
towed target two times out of three, but a target can only be towed at 120 miles per hour, while the bombing plane may fly at 250 miles per hour. Modern searchlights under perfect conditions can penetrate a distance of 25 miles, but are useless in fog. The tremendous speed of modern planes gives them a practical if not theoretical advantage. The Colonel's gunners fixed their searchlights on 13 out of 21 attacking planes, but managed to shoot at only two, even though the spotlighted planes obligingly landed and played dead. Probably the worst problem of anti-aircraft defense is dive bombing. There are only two defenses against dive bombing—hitting the plane before it starts to dive, or putting such a barrage into the “elbow” (the place where the ship points its nose down for the dive) that the pilot is afraid to venture into the maneuver.

On the other hand, bombing in the last two years has made such enormous strides that the bombers can hit their objectives from a height of 17,000 feet with deadly regularity.

There is always a struggle in military tactics between offense and defense. At the present moment attack seems to be definitely in the lead, at least so far as air warfare is concerned.

In view of this situation, it is not out of place to examine a photograph of one of the very latest British bombers, the Bristol-Blenheim twin-engined monoplane, equipped with two Mercury 840 horsepower engines. Its civil forerunner, mounting less powerful engines, attained a speed of 268 miles per hour, so the rumor that British bombers have speeds in excess of 300 miles an hour is probably not far out.

A photograph such as the one shown carries many lessons for the airplane designer. We note that the entire nose and sides of the fuselage is one almost unbroken expanse of glass. The line of the fuselage is a stream-lined sweep from nose to tail, with the rear gunner enclosed in a glass covered cockpit. There has been much controversy whether wings should be high (above the fuselage) or low (below the fuselage). The best position from an aerodynamic point of view is mid-wing—with the wing halfway up the fuselage. Precise-

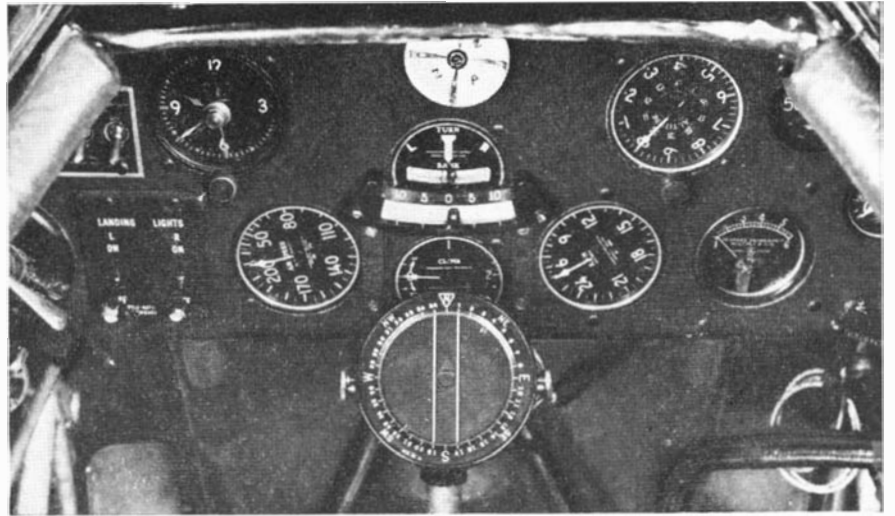


Courtesy of Flight

A modern British bomber, rumored to attain speeds over 300 miles per hour

ly this arrangement is adopted in the Bristol-Blenheim. There are structural difficulties in carrying the wing loads through the fuselage, but these have evidently been surmounted. Another interesting feature is the large proportion of the rudder which projects in front of the hinge to act as a balance. With this balanced portion and the little tab or trimmer at the rear of the control surface, such a rudder is very easily actuated no matter what the speed.

So little information is available on military machines that designers pounce avidly on such photographs as the one reproduced here.—A.K.



Indicating head (center) of direction finder, in place on a plane

The system consists of two electrostatically shielded fixed loops mounted at any convenient location on the airplane. The output of the receiver supplies the necessary energy for operation of the indicator. The streamlined electrostatic shielding of the loops not only assures good reception dur-

ing conditions of snow or ice, but also minimizes drag. The receiver can pick up any frequency between 1500 and 250 kilocycles.

In operation, the transmitter and its direction are represented by a small spot of light on the indicating scale. By setting the outer degree scale of the indicator to correspond to either the magnetic compass or the directional gyro reading, the bearing for the transmitter is given in direct relation to either of these.

The direction finder allows homing on any suitable transmitter with the plane flying straight to the transmitter at the destination. The pilot can also, by setting on a station off the course and watching the visual indicator, know what angle the latter station is making with his course. The pilot tunes in on the check station some minutes before it is at right angles to his flight course, and watches the angle increase from say 70 degrees to 90 degrees, and then increase beyond the 90 degree value. Thus he gets a valuable check of his position. If he wishes to allow for drift, he changes the direction of his craft until the small spot of light shows 10 degrees or whatever drift is to be allowed for.

Excellent results have been obtained in service and the value of the instrument is obvious.—A.K.



Above: The fixed loops of the Dane visual radio direction finder. Below: The rest of the equipment, with the remote control on the left and the indicating head at the extreme right

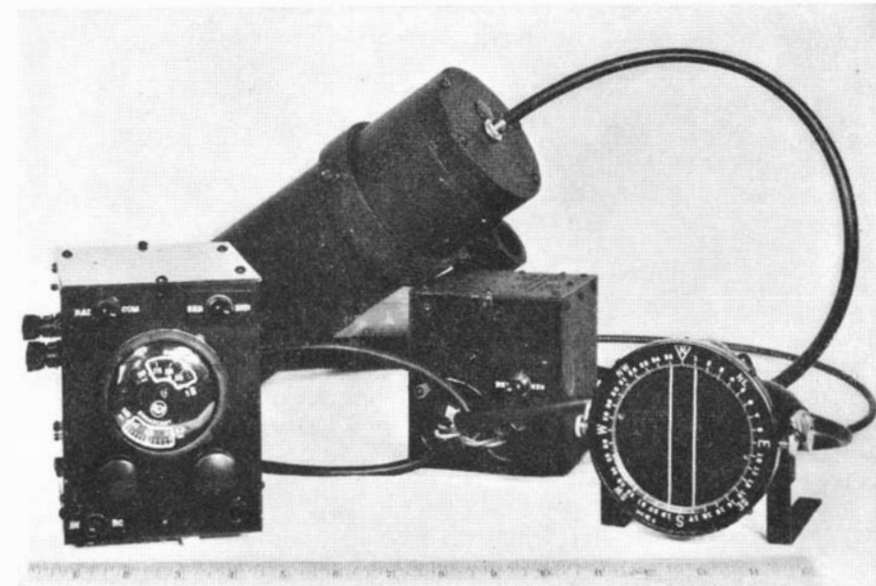
DIESELS

IS there any good reason why almost everyone continues to capitalize the initial letter of the word "Diesel" in speaking of the engine? Many other technical words taken wholly or adapted from men's names have long since ceased to be capitalized—for example, ohm, volt, ampere. Isn't it time that diesel with a little "d" is considered as a generic term rather than a man's name? What do readers think?

VISUAL RADIO DIRECTION FINDER

AN article in *Aero Digest* by the inventor describes the new Dane visual radio direction finder. Radio direction finders now in use can be divided into two classes; those which can be used as homing devices and those which permit bearings to be taken during flight. The operation of the homing device is limited to airports which are equipped with transmitting facilities. The second system constitutes a more accurate system of navigation but involves rotatable loops.

For the Dane visual radio direction finder, it is claimed that absolutely automatic indication in degrees to any known radio transmitter is given, as long as the receiver is tuned in to a particular station. The loop aeri-als are fixed, avoiding the customary difficulties with rotatable loops.



FOREIGN ENTRIES IN AIR RACES

IT is common knowledge that the great success of Michel De Troyat, in a plane sponsored by the French government, was a cause of great disappointment to American contestants in recent races. A correspondent writes in to inquire whether it is fair that our racing plane builders—small groups of adventurous young men, none too well financed—should be exposed to the competition of government-supported foreign interests?

Such foreign participation does seem to be unfair, at first blush. But a race is a race, and unless our National Air Races are open to one and all, so as to provide the keenest possible competition, they will lose all interest and no longer serve to advance the art.

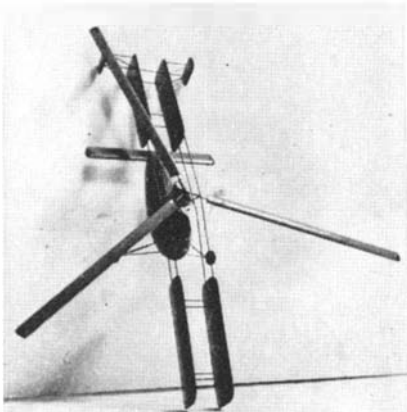
Perhaps the following is the best compromise: Let the great national events such as the Thompson Trophy Race, the Bendix Transcontinental Race, and so on, be open

without any restrictions to all competitors. But let the smaller local races be restricted solely to home talent, with no government sponsorship allowed.

Thus we should have the advantage of world competition in the great events, yet at the same time give the "backyard" constructors a chance to pick up a few cash prizes without which they could not keep going in their exciting but precarious occupation.—A. K.

THE PLATT VERTIGIRO

HAVILAND H. PLATT, an engineer of considerable ability, describes in the *Journal of the Aeronautical Sciences* a direct lift aircraft which he has termed the Vertigiro. To secure great lift for a given power, a large amount of air should be



A model of the Vertigiro

handled by the lifting air screw, and accordingly its diameter and disk area should be large. Another requirement is that the torque or turning moment of the airscrew should be counteracted. Hence, helicopters have generally been built with two airscrews rotating in opposite directions, and for the same disk area two airscrews involve very large and cumbersome overall dimensions. Another expedient has been to use two screws mounted on the same shaft, also rotating in opposite directions. Here the difficulties are less due to interference between the two lifting propellers and where hinged or flexible blades are used it is difficult to secure proper clearances between the flexible blades.

Mr. Platt offers another solution. As indicated by the model, a single airscrew of large diameter (without excessive overall dimensions) is provided, but the reaction torque is provided by large anti-torque vanes placed in the slipstream of the airscrew. These vanes are of biplane construction with appropriate camber to provide side forces and hence a turning moment equal and opposite to that of the propeller.

Propulsion is to be obtained by tilting the rotor forward, so that the same unit contributes to both sustentation and propulsion and there is no intermediate transformation of energy.

Control is to be obtained by tilting the rotor as in the direct control Autogiro, with the anti-torque vanes providing an additional directional control in hovering.

The reduction gearing is adjacent to the rotor, and the blower-cooled engine is placed low in the fuselage with the vertical shaft in line with the rotor axis.

Many ingenious ideas have been incorporated in the Vertigiro and the designer's computations and tests give evidence of high lift combined with high forward speed. It would be interesting to see these conceptions embodied in a full scale machine.—A. K.

AN AMERICAN SIMPLIFIES THE CATAPULT

BOTH the compressed-air catapult and the gunpowder catapult are complicated affairs, but American ingenuity is likely to simplify this process of launching and give it wider use. Thus W. B. Wheatley, Chief Pilot of Consolidated Aircraft, mounted a 1700-pound, two-passenger biplane on an old railroad handcar placed on tracks that sloped somewhat downwardly. Drawn by the propeller alone, and aided by the low friction of the rolling wheels and the downward inclination, the biplane attained a speed of 60 miles an hour—far above its normal take-off speed—after a run of only 300 feet, and jumped into the air without the slightest difficulty though considerably overloaded.

Here are the advantages of this simple device: Take-offs in winter, when water is obstructed with ice and flying fields are obstructed with snow; take-offs with exceptionally heavy loads.

We would not be surprised to see many airports equipped with "catapults" of this simple variety.—A. K.

TYPING BY RADIO

DURING the past year and a half the Bureau of Air Commerce has had in operation between Washington and Baltimore a radio typewriter service. The great possibilities of operating a chain of type-



An experimental radio typewriter

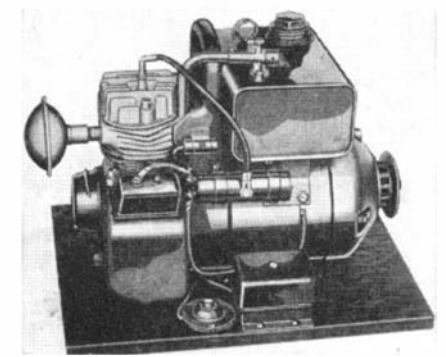
writers by radio are obvious. There are appreciable savings over wired service, of course, but the great advantage is that typewriters can be operated in the airplane itself. Since safety in flying depends so much on the rapid and accurate dissemination of weather reports, and on centralized traffic control, the new system will certainly enhance safety on the airlines.

A radio typewriter system will be installed on the new airway being built between Washington and Nashville. The new installation will provide for ground-to-plane communication by telephone along the air-

ways, and three circuits for operating the typewriters. One of these circuits will be utilized for transport traffic, one for market reports issued by the Department of Agriculture, and the other will be available for experimental purposes by established aeronautical enterprises.—A. K.

PORTABLE POWER PLANT

TO light farmhouses, motor cruisers, summer cottages, camps, sailboats, and so forth, a portable power plant has been developed by the Continental Motors Cor-



57-pound power plant

poration, to sell at a comparatively low price. This plant, called "Tiny Tim," weighs but 57 pounds, is mounted compactly on a wooden base, and is equipped with a handle for carrying. With the battery across the line, a push of the button starts the unit and no further attention is necessary. The six-volt unit lights fourteen 15-watt electric lights and will, at the same time, charge a six-volt battery. With the tank full of gasoline, it is only necessary to start the motor and it will automatically shut itself off when the battery is fully charged.

BELLY LANDINGS

A PILOT for Beechcraft Aircraft, Bill Ong, has made a specialty of "belly landings" in which the landing gear is retracted and the airplane lands on the bottom of the fuselage. The only accessories required for this oft repeated feat are a brake mounted on the propeller to ensure that the propeller is in a horizontal position when the belly landing is made, and two skids, nine inches high, placed below the fuselage and running from the nose to the rear landing gear struts.

With the full drag of the braked propeller and of the skids scraping over the ground the machine comes to a dead stop in a remarkably short space. Owing to the low position of the center of gravity there is not the slightest tendency to nose over.

What of it, one might be tempted to ask? There is an important implication to these experiments. If belly landings of this type are possible, then emergency dead stick landings may be made in the roughest terrain without hazard. What appears to be just a stunt may prove to be a valuable safety measure in emergencies.—A. K.

PROFIT

THE air transport industry has often been accused of subsisting on government subsidies. We can safely say that it has never been subsidized at all. It has,

of course, received payments from the government for carrying airmail, but the government has received far greater payments from the public for this service than it ever turned back to the operators. At the present time the air transport operators are carrying airmail at cheaper rates than ever before, and giving the Post Office excellent service. If they ever make profits it will be not because of payments by the Post Office but because of the larger quantities of air express matter carried, and the larger number of passengers flown. The recent report of Transcontinental and Western Air Express is most encouraging, however. There was a net income of 22.4 cents a share for the quarter ending September 1936, the largest profit ever earned by this company. The operators are not only increasing their revenues but reducing their administrative and general expenses. Much credit is due to Jack Frye, the youthful president of the young corporation.—A.K.

REGISTRATION

MOTOR vehicle registration reached in 1936 an all-time high of 28,424,077 vehicles listed. This was nearly two million higher than the previous peak of 1930.

HARDWOOD FLOORS LAID LIKE CARPET

TODAY you can buy genuine hardwood floors in any one of a variety of woods which, delivered to your home in neat corrugated pasteboard cartons and laid in the proverbial lamb tail's shake, will last a lifetime. And these hardwood floors, Parkay by name, cost little if any more than most good-quality broadlooms—cost actually less than imitation-wood floor coverings. Prefabricated and pre-finished at the factory, they go down on any sub-floor, old or new, with neither nails nor noise and are kept down permanently by a special adhesive, time-tested in laboratories and in actual use.

Briefly, the laying operation is this: First, a layer of adhesive, then a layer of felt, another layer of adhesive, and then the hardwood floor is laid, fitted to every wall



Hardwood flooring in flexible form

projection or indentation, perfectly finished and ready for use as soon as down. The in-between felt makes for greater quietness and a slight suggestion of resilience. Instead of the four or five days of confusion, hammering, and tedious waiting previously involved in laying hardwood floors, Parkay can be installed in the average-size room within four or five hours.

Technically speaking Parkay floors consist of individual four by two and two by



"Carpet-like" wood floor in place

two-inch hardwood blocks of standard 5/16 inch thickness, assembled in basket-weave pattern and held securely together in a semi-pliable grill. For convenience in delivery and laying, Parkay comes in cartons, each containing eight two by six-foot sections.

When buying this flooring, the customer selects the kind and shade of wood best suited to the room to be floored, from samples as easily moved about as specimen strips of carpet. Woods available are light and dark oak and walnut, and the more unusual East Indian teakwood.

SYNTHETIC SILK FROM MULBERRY TREES

NOT content with processes which make rayon from cellulose, two Hungarian investigators have succeeded in making a product more closely resembling natural silk by imitating silkworms more exactly. They use mulberry bark as their raw material, dissolving undesired portions of the bark with alkali and obtaining fibers which can be spun on special machines.—D.H.K.

SCRATCHLESS

THE surface of a headlight reflector is of such a delicate nature that difficulty has always been encountered in the process of polishing it. As a result, many motorists permit the surface to become tarnished or coated with very fine dust, so that the efficiency of the headlight is greatly decreased. Having this in mind, the Winchester Products Company has developed a new polish, composed of an earth pigment in a vehicle of alcohol and ether. It is claimed that if properly used this polish will not scratch the most delicate reflector surface.

In applying this polish a small piece of clean, dry cotton is saturated with the polish

and rubbed lightly but briskly over the entire surface until all tarnish is removed. A light touch is necessary, for otherwise the dirt accumulated on the cotton might scratch the reflector. Its action may be compared with that of pure castile soap, forming an emulsion with the dirt and tarnish. After the polish has dried, it is removed with a larger piece of clean, dry cotton and then the reflector is rubbed briskly with still another piece of cotton.

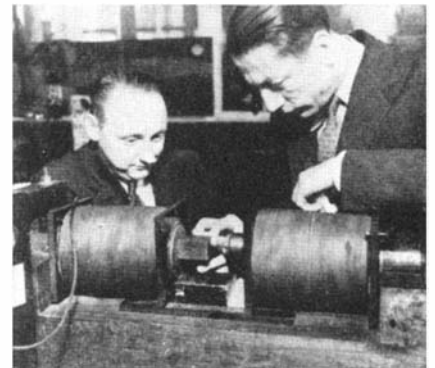
12,500,000 KW.

HIGH current or high voltage—either one or the other is easily obtained. Fifty thousand amperes at five million volts is something to amaze. This, the highest current ever obtained at high voltage, was demonstrated recently in the laboratories of General Electric Company at Pittsfield, Massachusetts.

DELICATE OPERATION WITH POWERFUL MAGNET

A POWERFUL electro-magnet in the General Electric West Lynn works recently aided medical science in a delicate operation to remove seven tiny sharp needles imbedded deeply in the middle finger of the left hand of Arthur Bartlett, employee of the Atlantic Mills Company in Providence. Bartlett's finger was placed in the magnetic field, and after four hours of manipulation, five of the seven needles were taken out.

The needles lodged near the middle joint of the finger while the mill worker was operating a device used in stretching woolen



Steel needles being removed from a finger by a powerful magnetic field

cloth. The hand became infected, and it was the opinion of Dr. E. Franklin Stone, who attended Bartlett, that cutting the finger open would result in a stiffened joint. The ingenious use of the magnet possibly saved Bartlett the use of his finger.

No anesthetic was used, and Bartlett stood the ordeal without pain. Throughout the four hours, he assisted by telling how the needles seemed to be moving under the surface. General Electric engineers also constructed a small compass to aid in the determination.

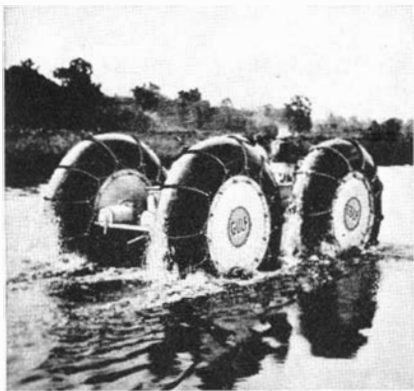
Because of the minute size of the steel needle particles, it was first thought the experiment might not be successful. However, one of the needles came out less than a minute after Bartlett's finger had been placed in the magnetic field. As his finger moved

near the point of the magnet, the mill worker exclaimed, "It's moving! Here it comes!" A second later, a tiny piece of steel came out of the finger and attached itself to the magnet. The magnet will be used again soon in the hope of removing the two remaining needles.

This is the second time that the powerful electro-magnet has been used to aid medical science. Two years ago, it was successfully employed in removing a hypodermic needle imbedded in the hip of a Manchester, New Hampshire, doctor.

MARSH BUGGY

OF the many strange things that have had their beginnings behind the walls of the Gulf Oil Corporation's research laboratory, the oddest is, undoubtedly, the Marsh Buggy. For several months this ingenious merger of automobile, tractor, and boat has been used successfully in the trans-



For water, land, or both

portation of geophysical crews and equipment into the seldom penetrated swamps of Louisiana.

The Marsh Buggy, acclaimed as "the unique automotive contraption of the century," rightfully cannot be classified as either a motor car, a tractor, or a boat. In reality, however, it is all three, for it is equally at home on land, in waist-deep mire, or in water deep enough to float an ocean liner.

The 7500-pound vehicle has an overall length of 22½ feet and is powered by a Ford V-8 engine equipped with an oversized cooling system. At the rear of the motor is a regular passenger car transmission coupled in series with a McCormick Deering tractor gear box.

The front wheels receive their power from chains that pass over sprockets on the back axles. This gives a differential action between the wheels on each side but not between the front and rear. The tractor transmission is provided with two brakes, one to control the wheels on the right, the other to act upon those on the left. Thus, when operated in water, the huge machine can be propelled by all four wheels or by the two on either side.

The forward axle is of conventional design with regular toe-in and caster action and the steering mechanism is similar to that of a motor car. The axle is pivoted in the center in such a manner that either front wheel can rise two feet above its mate without distorting the frame.

The tires of the Gulf Marsh Buggy were designed and fabricated by the Goodyear Tire and Rubber Company and are the

largest ever molded. They are 10 feet high by approximately three feet wide and are mounted on 66-inch rims. The displacement of the balloons is so great that the monstrous vehicle floats with a "draft" of less than two feet.

If one of the tires becomes punctured, a constant pressure can be maintained by starting a compressor which feeds air into the tube. The compressor's output is sufficient to keep the balloons fully inflated until the Marsh Buggy can be returned to the base of operations where the leaky tube can be repaired or replaced. It is interesting to note that the air pressure in the tires never exceeds six pounds per square inch and that the buggy's weight is amply supported with only one pound per square inch pressure in the casings.

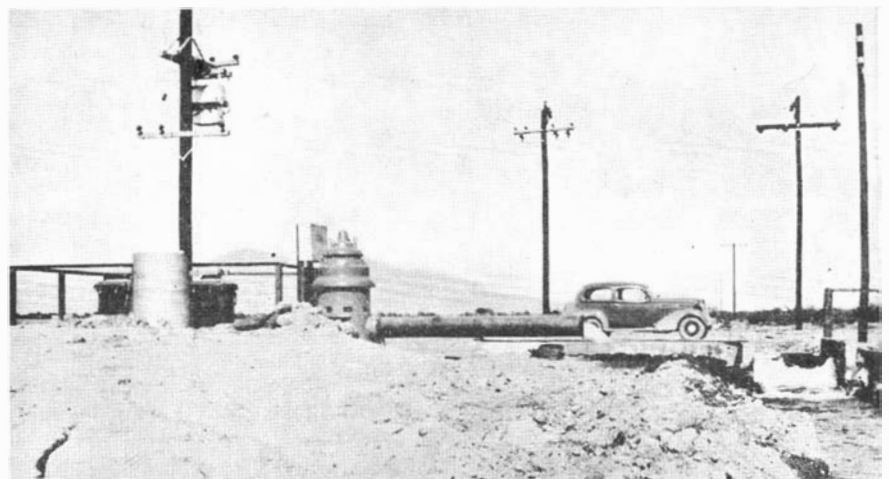
In water or in the marshes traction is obtained by attaching twelve treads to each wheel. These were made from two-inch rubber hose sealed at the ends and provided with an air valve through which they are inflated to a pressure of twenty-five pounds per square inch. Inflation is necessary to keep the links from flattening out under the weight of the monstrous vehicle.

STERILIZATION

IN the 28 states which have laws providing for compulsory or voluntary sterilization of mentally deficient persons, 23,118 sterilization operations had been performed up to last November.

OUTDOOR MOTORS RESTORE ARID ACRES

FIFTEEN 100-horsepower electrified irrigation pumps are converting 10,000 arid acres of the Arizona Farm Products Corporation into fertile farms suitable for raising and harvesting seven-foot high, long-staple cotton in a single season. They lift water from wells 450 feet deep and 20 inches in diameter, the water rising to within 120 feet of the surface with a total lift of approximately 140 feet. Power is supplied by the Salt River Valley Water User's Association to 100-horsepower, 440-volt, 1450 r.p.m. 25-cycle, Westinghouse, hollow-shaft, vertical motors driving vertical Pomona turbine pumps equipped with water-lubricated rubber bearings. Each



Fifteen of these outdoor stations each pump 2500 gallons of water per minute

pump has a capacity of 2500 gallons per minute, delivering a total of 3,600,000 gallons of water and consuming 2004 kilowatt hours per day.

Each pumping station is supplied by a simple outdoor 6600/440-volt substation consisting of three 37½ kv-a. transformers mounted on a concrete foundation, with the necessary outdoor protective devices, safety features, and lightning arresters. The substations average approximately one half mile apart and were constructed at a cost of approximately 2500 dollars each.

The majority of this tract is one large farm with electricity used for cooking and heating.

"YOU'VE CHANGED SOMEHOW"

THE ears get larger, the nose gets longer and broader, and the mouth gets wider as one grows older. The curious age changes in the dimensions of these facial organs, sufficient to change materially the appearance of the individual, have been established by Dr. Ales Hrdlicka, Curator of Physical Anthropology of the Smithsonian Institution, by measurements of thousands of men and women—white "Old Americans," Pueblo and other Indians, Eskimos, and Negroes.

When one meets an old friend after a lapse of years, there is often a vague unfamiliarity about his features which cannot easily be explained. "You've changed somehow, but I can't say just where," is a common remark. Part of the change, it is probable, is due to these altered dimensions of mouth and nose.

Among the white "Old Americans," says Dr. Hrdlicka, "both the nasal breadth and length increase during adult life with age, but the increase in breadth exceeds somewhat that in length. With the ears, conditions are reversed—they increase more in their length. Both the Pueblos and other Indians show similar conditions, and at least as pronounced. The length of the nose and the breadth of the ears increase with age but slightly; the nasal breadth, however, and the ear length increase decidedly."

The effects of age on the mouth, Dr. Hrdlicka points out, are even more marked than those on the nose. "This phenomenon is observed," he says, "in both whites and Indians, also in other races, and in both sexes. It is of a progressive nature from early life onward. There is a continued slight

"SMALL-CAR" FAMILY *Switches* TO BIG NEW 1937 DODGE!

"OUR FAMILY ALWAYS OWNED one of the smaller makes of cars—trading in on the same make whenever we needed a new car," says Herman L. Thieme, Jr., Jamaica, N.Y. "We thought we couldn't afford to do differently. But this year we switched to Dodge. We're getting over 22 miles to the gallon of gas. We not only saved money right from the start, but we know that gas savings alone will make our Dodge cost less to own than the small cars we drove before." Pictured below are Mr. and Mrs. Thieme, and their son and daughter-in-law, Mr. and Mrs. Herman L. Thieme, III.



...Contends Gas Saving Alone Will Make Big Dodge Cost Less To Own!

FROM all over America flashes this news: motorists who always felt that, in buying a new car, they had to "trade-in" on the same make to get the most for their money, are switching to the sensational new 1937 Dodge!

They say they have discovered that this new Dodge—with its new "wind-stream" styling—its astonishing new comfort and safety features—offers such amazing economy in gasoline and oil consumption and in general upkeep that they'll be money ahead from start to finish!

Although new Dodge owners report 18 to 24 miles to the gallon of gas and savings up to 20% on oil, don't lose sight of the fact that Dodge for 1937

offers much more than record-breaking economy!

It's bigger, more beautiful than any Dodge ever built! All sedans accommodate at least six passengers! *Quieter* too! The new Dodge safety all-steel body is anchored to the frame by rubber-insulated "hush-point" mountings that kill road noises and give you the new Dodge "Silenced Ride!"

New improved Chair-Height seats... low, level floor!...new improved weight distribution—these contribute to your greater comfort. And, too, for your greater safety, Dodge gives you an even stronger safety all-steel body...new "high-safety" interiors...and *genuine* hydraulic brakes!

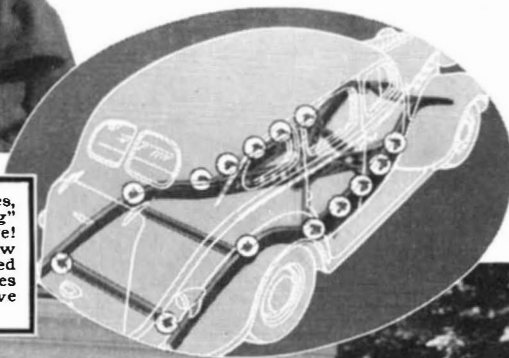
See this new 1937 Dodge! Drive it! You'll be amazed that such a big, luxurious car actually costs just a few dollars more than the lowest-priced cars! And you, too, will agree you can "Switch to Dodge—and save money!"

DODGE

Division of Chrysler Corporation

Dodge dealers invite you to tune in on Major Bowes Amateur Hour, Columbia Network, every Thursday, 9 to 10:00 P. M., Eastern Standard Time. Sponsored by Chrysler Corporation.

NEW "SILENCED RIDE!" Road noises, which cause body "rumble" and "drumming" in many cars, are silenced in the 1937 Dodge! The new Dodge safety all-steel body is now anchored to the frame by rubber-insulated "hush-point" mountings that kill road noises and give you the quietest ride you have ever known!



DELIVERS NOW FOR JUST A FEW DOLLARS MORE THAN THE LOWEST-PRICED CARS. Easy terms gladly arranged to fit your budget, at low cost, through Commercial Credit Company.

Switch TO BIG 1937 DODGE - and Save Money!

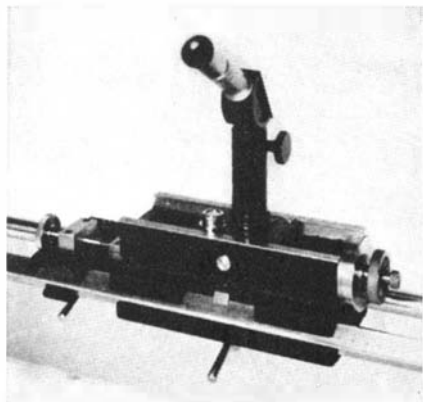
excess in the widening of the mouth through the factor of age over that of stature. Age has more influence on mouth width than has stature. It is the chief modifier of the dimension."

Generally speaking, Dr. Hrdlicka's work confirms the fact that the breadth of the nose increases from north to south, or rather from cold climate to hot climate. The effect of climate on nose dimensions is connected, according to all indications, with different demands of the function of respiration. It is in all probability the main factor which originally produced the various racial types of noses. Once these were fixed through heredity, they tended to be reproduced generation after generation, although the original habitat of the race may have changed.

DENDROHELICONOMETER

THERE is a growing interest in the importance of studying tree rings. A surprisingly large amount of valuable information can be obtained in this way, which is of importance in meteorology, history, and anthropology. A study of the growth rings of trees reveals information about wet and dry years, floods, and forest fires for thousands of years in the past.

The first step in this branch of the science of dendrology is to procure a sample of the wood. Where living trees are involved, special core drills have been devised, which make it possible to remove a plug having



Close-up of the adjustable microscope of the Dendroheliconometer

a sample of all the rings from the outside to the heart of the tree, without seriously damaging the tree.

The second step is the measurement of the width of each growth ring in the tree and it is for this purpose that the Dendroheliconometer was designed.

The instrument is manufactured by the Gaertner Scientific Corporation of Chicago, and was originally designed for the Tennessee Valley Authority of Knoxville, Tennessee. It is used by the T.V.A. to determine flood years of the past with the purpose of correlating them with sun spot activity and other natural phenomena and to develop methods of flood prediction.

The Dendroheliconometer consists essentially of a microscope with fiducial cross-hairs in its field, transported by a precise micrometer screw, with a head graduated to read .01 millimeters directly and permitting easy estimation to .002 millimeters. To measure a ring, after placing the sample in the focus of the microscope, the micrometer screw is adjusted until the cross-hair in

the microscope coincides with one edge of the ring. After reading the micrometer head on the screw, it is rotated to carry the microscope until the cross-hair falls on the other edge of the tree ring and the micrometer head reading taken again. The difference in these two readings gives very accurately the width of the tree ring. The microscope has a magnification variable from 5 to 40 and is equipped with a roof prism. This prism, in addition to inclining the eyepiece, produces in the microscope an upright image instead of the reversed image ordinarily seen in a microscope. This it accomplishes by reflecting the light twice internally from two faces which must make an angle of 90 degrees with each other to an accuracy of a few seconds of arc.

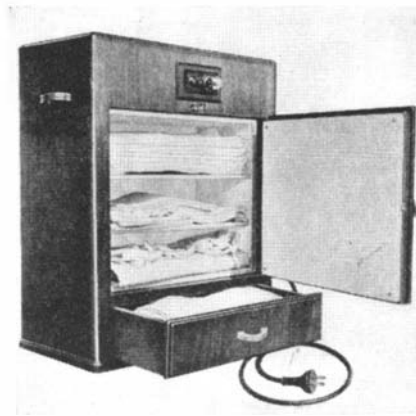
The micrometer screw has 100 millimeters range (about four inches) and the entire micrometer moves on guide rods having a coarse scale, which makes it possible to measure the rings on a specimen 75 centimeters long, corresponding to a tree 4½ feet in diameter, without moving the specimen.

One of the interesting results of studying tree rings is the dating of woods found in ancient ruins. By studying large numbers of living trees, a master scale is made, having a given length for each year, and on this is marked a pattern indicating only unusual years—for very dry years a long mark, and for years of more rainfall, respectively shorter lines—five different lengths being used. If now a similar scale is made for any specimen of wood of unknown date and if this is placed beside the master scale, it can be slid to a position at which the two patterns match and from this position, the date at which the particular specimen of wood was cut down can be definitely and accurately determined. By overlapping of specimens, it is possible to extend the master scales back beyond the beginning of the oldest known living tree, and some scales are now available complete to before the time of Christ.

FOR BABIES ONLY

NAMED to indicate its application of a new principle and use, the new Desertaire all-electric infant's apparel wardrobe-cabinet makes its bow to young mothers and their babies.

Called the "first electric home appliance for babies," Desertaire cabinets are designed to sterilize, heat, and thoroughly dry, and maintain in a dry and heated condition, all of an infant's wearing apparel 24 hours a day. The maintenance of an infant's diapers and other articles of clothing, including minor bedding accessories, such as sheets and cover blankets, in a sterile, electrically-dried and heated, body temper-



Insuring warm, dry clothes for baby

ature condition, is, of course, important from the health standpoint.

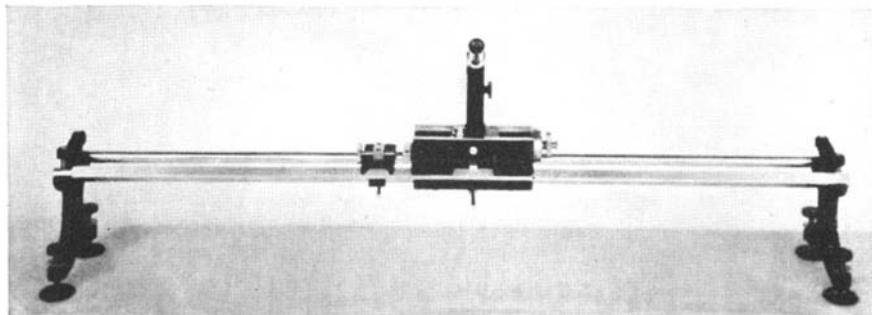
The cabinets, which are finished in walnut as articles of beauty as well as utility, come in two sizes: one, a semi-portable design, suitable for easy removal from room to room or for traveling; the other, a larger size, for nursery use, may also be moved about the home because of rubber-tired wheels. Both incorporate the same features of white metal, steel-shelved interior compartments in which baby's clothes are stacked. Cabinets are equipped with "high" and "low" selector switches, night lights, and in the case of the larger model, with a special electric circulating heater which may be turned on to heat the immediate surroundings while baby is being bathed or changed and which may also be used to take the chill from the room.

SUNDAY EDITION

A SINGLE issue of a large daily metropolitan paper uses more paper than was used in the whole United States in 1800. The Sunday edition requires the product of 240 acres of pulpwood forests.

PROTECTING METAL BEFORE PAINTING

CLEANING iron or steel before painting produces a surface which rusts more easily than the uncleaned metal. To provide extra protection, several processes are widely used to protect the metal with rust-resisting coatings to which paint will readily adhere. One of these, forming a dark red coating of iron phosphate on the metal, can be applied by either dipping or spraying. Another employs an aqueous solution of chromic acid with an activating agent to change the character of the metal surface.



The Dendroheliconometer used for measuring tree rings

**Famous Books at
incredibly
low prices**

**IMPERIAL
EDITIONS**

*Handsome cloth-bound volumes,
beautifully printed.*

WILD FLOWERS

By HOMER D. HOUSE

Formerly \$7.50
NOW
\$4.45 pp

Only by a miracle of publishing economy is this superb book with 364 color plates and 340 pages of text issued at such a low price. Hundreds of wild flowers in all parts of the United States can be identified through the pictures and the descriptions, which were written by the noted authority, Dr. House, State Botanist of New York. 364 magnificent color plates.

**GARDEN
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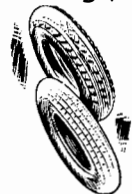
Have you ever worn shoes that fell apart after a month's wear? Wondered why the tires on your car went to pieces so quickly while your neighbor's tires seemed to last forever? Bought an electric shaver, a toaster, or some other household article which proved unsatisfactory? Taken widely advertised remedies for colds, headaches, indigestion and whatnot without knowing whether they were safe or harmful?

THESE and similar experiences are the most exasperating the average consumer faces. Unless a consumer has laboratory facilities for conducting expensive tests on the products he buys, however, he has no way of knowing beforehand which brands will turn out to be good and which will be inferior, misrepresented, or worthless. Advertisements of competing brands naturally conflict—as do the statements of salesmen—for no manufacturer is willing to admit that the other fellow's product is better than his. There is only one way to avoid these mistakes, which in a year's time may cost you several hundred dollars, and that is by relying for your information about goods on the advice of unbiased technicians. Such advice is now available to you at a very nominal cost through Consumers Union of United States.

WHAT IS CONSUMERS UNION? Consumers Union is a strictly non-profit membership organization controlled and supported by over 25,000 consumers throughout the country. Its chief purpose is to supply its members with accurate, unbiased technical information about the comparative value of competing brands of goods. This information—based on laboratory and actual use tests conducted by staff technicians and a large body of able consultants—is published each month in **Consumers Union Reports**, a magazine which tells which shoes wear longest, which tires give the most mileage per dollar, and which brands of most other consumer products are the best value for money spent. Merchandise is rated in these Reports, by brand name, as "Best Buys," "Also Acceptable," and "Not Acceptable." The labor conditions under which products are made are also described. These Reports are available at the low fee of \$3 a year—a fee which also brings you a yearly BUYING GUIDE now in preparation.

Professor Colston E. Warne, of Amherst, is president of Consumers Union. Arthur Kallet, co-author of **100,000,000 Guinea Pigs**, is director, and D. H. Palmer, physicist, is technical supervisor. Among the board of directors and sponsors are many prominent scientists, educators, journalists, and other progressive leaders. Below are summaries of typical reports in recent issues of **Consumers Union Reports**.

Saving \$40 to \$100 on Tires



Equipping your car with one brand of tires instead of another may save you as much as \$40 in each 25,000 driving miles for tires of average size. For the largest sizes, your saving may be \$100. Brand A tires, for example, lasted 27,051 miles in actual road tests and cost only \$8.50 per tire. Brand B, in the same test, lasted only 13,550 miles but cost \$10. For the names of these tires and of 10 others rated as "Best Buys," "Also Acceptable," or "Not Acceptable" read the report in the September issue.

How Much For a Good Pen?



Good, dependable fountain pens are more uncommon than ordinarily supposed. Those that are good are sometimes greatly overpriced. How much should be paid for a good pen? Which brands are best? Are the new cartridge-type pens satisfactory? For the answers see the report on fountain pens in the December issue. Only 3 out of over 20 makes tested are rated as "Best Buys"—11 are "Not Acceptable."

Rebuilt or New?



Tested by engineers for cleaning ability, electric shock hazard, mechanical construction and other factors, 13 of the newest models of vacuum cleaners and 4 rebuilt models are rated in the latest issue of **Consumers Union Reports**. One model selling at \$19.95 is listed as a "Best Buy"—others selling for more than \$80 were found to be only "Acceptable." Near the top of the list is a rebuilt model which proved to be somewhat more effective in cleaning ability than even the newest model of the same machine.

Are Nose Drops Safe?



"During 1937 and the coming years many thousands of children will die of pneumonia. Hundreds—perhaps thousands—of these deaths will have been caused by nose drops." These statements are from a report on nose drops in the December issue of the **Reports**. Naming widely-exploited brands by name, this article warns of the danger of giving children certain types of nose drops for colds, and presents medical evidence to show how many children are being killed by these medicines.

These are just a few examples of the type of information which Consumers Union supplies to its members. If you wish to become a member and receive this information, too, fill out and mail the application blank below. You can begin your membership with any of the issues of the **Reports** listed in the coupon. Simply check the month desired. For an additional 50c the **Reports** will be sent to you in a black cloth, gold-stamped, swivel-lock binder.

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NOTE: An abridged edition of the **Reports** at \$1 a year is also published. For information, please write.

Still another applies a continuous coating of zinc phosphate to the metal by means of an alternating electric current. These processes are standard practice in preparing for painting the metal used in the automobile and refrigerator industries. Their adoption in other industries is increasing since they give longer life to the paint film and better protection for the metal.—D.H.K.

MECHANICAL CALCULATION MOVES ON

SIX answers at the same time, silence, and the ability to handle anything of a repetitive nature up to and including algebraic computations—these are the features of a device based on an entirely new principle in the development of mechanical calculators.

Designed jointly by LeRoi E. Hutchings, the originator of a number of well-known



Six answers at the same time . . .

business devices, and Herbert Austin Brown, the new calculator operates by means of a sliding panel which spots the proper answers from among an array of predetermined calculations in the interior of the machine, which is called the Costometer.

Since most of the actual calculation goes into the preparation of the tables, the keys, cogs, and wheels of the conventional type of machine are eliminated and there is no necessity for mechanical computation of each mathematical step in a problem. The device shortcuts its way directly to the proper solution and may reduce the number of individual manipulations by as much as 99 percent.

The originators state that the device is not intended for use as an all-purpose machine, but is designed to handle calculations of the repetitive type required in the figuring of job cost, payroll, interest and discount, and similar work. An increasing volume of these types of data is becoming necessary in every class of business, the new Social Security laws alone requiring a complete set of reports and figures on some 27,000,000 employees throughout the country.

The multiple-answer feature of the new device will permit the simultaneous solving of Federal and State Old Age Benefit, Federal and State Unemployment taxes, total weekly wage and net wage after deductions, a total of six calculations at the same time. The tabulations in the interior of the machine are specially prepared and arranged to fit the individual needs of the user, and some 5600 sets and combinations

of tabulations can be brought into position under the index panel at the will of the operator.

The pre-determination and arrangement of tables permit the handling of any type of calculation, including combinations of addition or subtraction with multiplication and division, or the solving of complicated algebraic formulas where an extended series of solutions hinges on one or two variables.

MARCHING TREES

THIRTY million years ago the redwoods that are now the pride of California had relatives in Greenland, Siberia, and other northern lands now much too cold for them. Obviously, they marched southward and westward as the glacial ages froze the northern countries.

A "RUBBER STAMP" FOR METALS

AN accompanying illustration shows a new multiple-wheel metal marking machine which has been developed by the Quality Die Company. This may be made with figures of sizes varying from $\frac{1}{16}$ to $\frac{3}{8}$ of an inch, and with from four to eight wheels. Indicators are provided to locate position of marking. Impressions are made by hammer blow. Changing of serial readings is done by hand, one wheel being

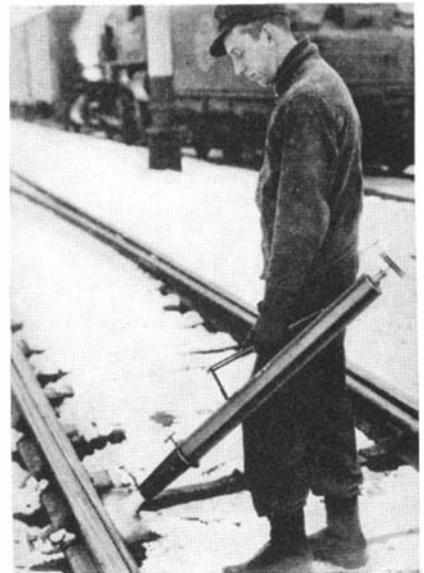


Multiple-wheel "rubber stamp" for metals, to be used with a hammer

turned at a time while the other wheels remain locked; and all wheels remain locked after a serial is selected. Letters and figures will stand up on any material up to 415 Brinell hardness.

TO THAW SWITCHES, BURN WEEDS

DESIGNED to thaw frozen switches, start back fires, or burn weeds, a new type of utility blow torch has been developed by the Turner Brass Works. The blow torch may be carried easily in one hand while a hot blue flame is shot downward at the ground. The torch was originally designed through the co-operation of the United States Forest Service for starting



Portable utility blow torch being used to thaw out a railroad switch

back fires and burning weeds. Many varied uses for the torch have been found by railroad companies, park departments, public utilities, highway departments, farmers, and poultry men.

Fighting fire with fire, or back-firing, may be done effectively in less time with the new torch, it is said. Damp rubbish piles may be dried and burned quickly, and noxious weeds and undergrowth along railroad rights-of-way or highways destroyed. Because of the intense heat of the torch, it is said to be ideally adapted to thawing railroad switches in a quicker and more satisfactory way than by other methods. The torch may also be used for fumigating buildings constructed of fire-resisting materials, as flame in many situations is more effective than disinfectant solutions.

The torch is equipped with a coil burner of the firepot type which develops a wide-spreading, intensely hot blue flame. The burner is protected by a sheet metal shield. The tank is made of heavy seamless brass tubing with cast bronze ends brazed into place. It is equipped with an adjustable handle that can be folded flat when the torch is being transported. A quick-action pump serves as a filler plug. The torch will burn $2\frac{1}{2}$ hours on one filling of gasoline, the tank having a capacity of $\frac{3}{4}$ gallon. Overall length is 41 inches, diameter is three inches, and shipping weight 14 pounds.

FACT, OR FICTION?

FAR be it from the editors of this magazine to state that the item quoted below is true or untrue—you may believe it or not. It is from *Nature* (London) and *Nature* quotes it from the *Medico-Chirurgical Review* of 100 years ago—October 1836; and this, in turn, had quoted it from the French press by which the incident was stated to have taken place at Aunay in the Department of Avalon:

"A very fat woman, aged 74 years, addicted to drinking brandy, lived alone, and one evening returned home as usual, but, as she did not appear among her neighbours the next morning, they knocked at her door. No answer being returned to repeated demands, they summoned the mayor, who

forced the door and exposed a horrible spectacle, accompanied by an extraordinary smell.

“Near the chimney lay a heap of something burnt to cinders, at the end of which was a head, a neck, the upper part of a body, and one arm. At the other end were some of the lower parts, and one leg still retaining a very clean shoe and stocking. No other traces of fire were to be seen, except a blue flame which played along the surface of a long train of grease, or serous liquor, which had been produced by combustion of the body.

“The mayor found it impossible to extinguish this flame, and summoned all the authorities; and, from the state of the apartment and comparison of circumstances, it was concluded among them that previous to going to bed, for which she had evidently been making preparations, the woman had been trying to ignite some embers with her breath. The fire communicating with the body by means of the breath, combustion probably took place.”

While ignition and combustion of a body seems quite possible (arctic birds, very oily, are combustible—human “grease balls,” touched off with the alcohol that is eliminated via the breath may be similarly so), we have no record that such a thing has frequently happened. It would seem that, with many very fatty alcoholics still existent, similar instances would occasionally happen, even today.

MATHEMATICIAN

DAYS of laborious computation by trained mathematicians are no longer necessary at M. I. T., for a new one-ton machine with many complicated levers and gears will, in a single action, solve nine simultaneous equations with nine unknowns.

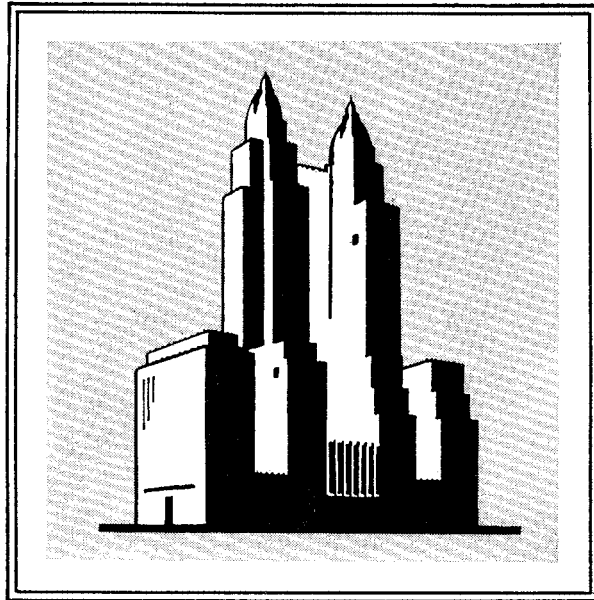
RARE ELEMENTS IMPROVE ALLOYS

COLUMBIUM, one of the relatively rare elements, can be used in small amounts to improve the resistance of stainless steel to corrosion at high temperatures (500 to 800 degrees, Centigrade). Titanium, still considered to be a rare metal although it actually ranks ninth in order among the elements that form the crust of the earth, is similarly effective. At high temperatures, stainless steel, even with a very low carbon content, has a tendency to form a carbide precipitate between the crystal grains of the metal. At these points corrosion begins. The addition of tiny amounts of columbium or titanium apparently prevents this segregation.—D. H. K.

STEAM-ELECTRIC LOCOMOTIVE

ANOTHER page in the rapidly accelerated history of modern railroading will be turned early this year with the appearance on the Erie, Pennsylvania, test tracks of the General Electric Company of a new steam-electric locomotive which is being built for the Union Pacific Railroad.

This new passenger unit will carry a condensing steam turbine generating plant



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ing points of mixtures of glycerol with methanol and water have been determined and the way shown to overcome both the scarcity of glycerol, which does not boil away, and the evaporation of methanol from the radiator. Using a mixture of equal parts by weight of methanol and glycerol and blending this mixture with water, protection against freezing is obtained as shown in the following table:

Percent by weight of methanol-glycerol mixture in water	Freezing point, degrees Fahrenheit
10%	+25°
20%	+14°
30%	— 1°
40%	—20°
50%	—45°

In such a mixture the rate of evaporation of methanol is materially reduced and the effectiveness of the glycerol is increased. The proportions given here are by weight and not by volume.—D.H.K.

RESEARCH ON TIRE CHAINS

AN Industrial Fellowship that is investigating broadly the durability of automotive tire chains has been founded at Mellon Institute of Industrial Research by The McKay Company of Pittsburgh, Pennsylvania, which manufactures commercial chains of all types. This Fellowship, which began operation on September 15, 1936, has for its objective the production of better chains, particularly for the motorist. A comprehensive program of basic research is being carried on, including studies of the design, materials, processes of manufacture, and testing of chains.

CHROMIUM AND ITS ALLOYS

TODAY, according to W. J. Priestley of the Electro Metallurgical Company, we have many different commercial grades of so-called "corrosion resisting" and "rustless" or "stainless" steels containing from 1 to 35 percent chromium. A list of the elements that are used for modifying the properties of straight chromium steels include nickel, silicon, manganese, molybdenum, copper, tungsten, columbium, titanium, nitrogen, aluminum, sulfur, selenium, zirconium, and vanadium.

Steels containing up to 3.5 percent chromium are known as "mild alloy steels" and their use was developed to replace simple carbon steels because of their greater strength and resistance to atmospheric corrosion. Among steels containing 3.5 to 9 percent chromium are the well known 4 to 6 percent chromium steels which were originally developed as a compromise in quality and cost between the higher chromium stainless steels and plain carbon steel. They are finding general use in the petroleum refining industry where good service is obtained in oil still tubes.

With carbon under 0.12 percent and chromium raised to 16 to 20 percent, we have a steel which possesses excellent corrosion and oxidation resistance without special heat treatment. The addition of 1 or 2 percent of nickel hardens and raises the strength of this steel when heat treated, making it suitable for aircraft construction.

When chromium is increased to over 20 percent we have an alloy that offers good resistance to oxidation up to 2000 degrees, Fahrenheit. Nitrogen is sometimes added to

feeding electric power to traction motors. Radically different in design from any locomotive now in service—of either steam or electric type—it will eliminate two of the colorful characteristics of the steam-railroading days: the side-rod drive and the water tower. Electric power will drive traction motors constructed on the usual electric locomotive design, and the turbine will operate condensers using the same water over and over, with small additions to make up for leakage. The problem of picking up water is thus largely done away with, and clean distilled water will insure long life and permit long runs without boiler repairs.

The many desirable constructional features of the modern high-speed electric locomotive will be incorporated in the design. Because of fundamental differences it is expected that the new locomotive will show a tremendous reduction in fuel consumption and a correspondingly low maintenance.

The new unit will be a double-cab locomotive, rated at 5000 horsepower. The two cabs can be operated together in the same manner as with electric locomotives. It will haul 1000-ton trains such as the Union-Pacific *Challenger* or the *Los Angeles Limited* over the Los Angeles-Omaha route.

Streamlined, practically smokeless, and provided with equipment for air conditioning, the new locomotive will be modern in every respect. The builders promise speeds of 110 miles per hour on level track. Sufficient fuel oil for a long journey will be carried, and the number of stops for fuel will

be greatly reduced. Because of this greater availability, an increased mileage per year is expected to develop.

As with the electric locomotive, a finely graduated scheme of control will permit smooth and easy handling, rapid acceleration, and effective braking.

A new, highly efficient type of steam boiler has been built, and tests give ample assurance of power to meet the exacting requirements of the locomotive. The high steam pressure and use of condensers are in line with the latest practice in modern power plant construction.

The boiler will use fuel oil similar to that employed by other locomotives on railroads today, but the method of combustion will be more accurately controlled to obtain the maximum amount of power from a given quantity of fuel. The almost perfect combustion will insure practically smokeless operation.

MIXTURES AS ANTI-FREEZES

SHORTAGES this winter of some of the better known anti-freezes used in automobiles lend particular interest to the possibility of using mixtures instead of pure materials. An unexpectedly large demand for ethylene glycol and a shortage of glycerol, presumably caused by use in synthetic resins of large quantities of this by-product of soap making, have created a scarcity of both of these valuable materials. In a recently completed study at Worcester Polytechnic Institute the freez-

this grade of steel to retard grain growth when it is held for a long time at high temperatures. For ordinary use, nitrogen will reduce the grain size and make the metal more shock resisting.

A new alloy has been developed which contains 35 percent chromium and 7 percent aluminum which is good for continuous service at 2300 degrees, Fahrenheit.

The group of 17 to 20 percent chromium and 7 to 10 percent nickel steels represent the best known and most widely used stainless and corrosion-resistant steels. Their popularity is due to their ease of fabrication and good physical properties at high and low temperatures, combined with their excellent resistance to oxidation at high temperatures and with many different kinds of corroding media.

They cannot be hardened by heat treatment, but, by cold working, their ultimate strength can be raised to over 200,000 pounds per square inch with suitable ductility, which makes them satisfactory for light-weight structures requiring great strength, such as aircraft, superstructure of ships, and high speed trains.

Alloys containing from 13 to 20 percent chromium and 60 to 80 percent nickel are used in the food and dairy industries. They have good resistance to oxidation up to 2000 degrees, Fahrenheit, and are also used for electrical resistor material for high-temperature service. It has been demonstrated that the addition of chromium to nickel makes it free from tarnishing and corrosion under the very conditions for which nickel itself is unsuited.

DONKEY MILK

ACCORDING to an Indian scientific journal, donkey's milk is one and a half times as digestible as the milk of cows. It is therefore used in many countries for feeding children and invalids.

**PRESERVE NUT MEATS
By HOT WATER**

A NEW home method for keeping nut meats fresh—using a water bath canner such as many housewives use to process fruits—is announced by the United States Department of Agriculture.

Many families who make a winter industry of preparing shelled nuts for sale or home use, often take a loss when warm weather causes the oil in the nuts to become rancid. Commercial concerns avoid this staleness or rancidity, caused by light and heat in combination with air, by vacuum-packing the nut meats.

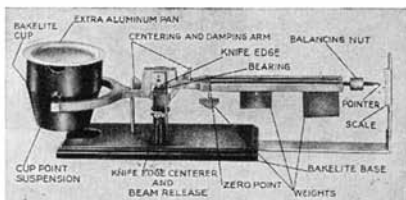
The only equipment needed for vacuum-packing nut meats at home, says R. C. Wright, of the Bureau of Plant Industry, who developed the method, is glass fruit jars to hold the nuts and the water bath canner to exhaust the air from the jars. He says:

"Fill glass jars with nut meats and adjust the glass lids and rubbers but do not tighten them. Set the jars in a water bath canner—either a clothes boiler or a big kettle with a rack on the bottom. Use enough water to reach almost to the top of the jars. Keep the water boiling

(Please turn to page 130)

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THE AMATEUR TELESCOPE MAKER

Conducted by ALBERT G. INGALLS

SUPPLEMENTARY, in a way, to the long article by Captain C. S. McDowell in the November number, describing the 200" telescope plans, are the new drawings, Figures 1 and 2, made by Russell W. Porter and kindly furnished for this department by Captain McDowell. Figure 1 shows the oil pads, but Figure 2 is probably the more interesting. In his article Captain McDowell described the declination axis as follows: "The declination axis of the telescope is formed by two trunnions mounted on ball bearings in the 10' 6" diameter tubular yoke girders and connected to the tube by means of flexible spoke gimbals. Flexibility of connection between the yoke and the tube is required in order to avoid imposing strains on the tube due to slight inaccuracies in mounting that may occur during assembly and due to deflection of parts. The gimbals on either side of the tube consist of two alloy steel flanges, one attached to the declination axis trunnion and the other to the tube, joined by 144 three-fourths inch diameter spokes. These spokes are so arranged that their extensions intersect at one point on the declination axis, thus forming a fulcrum. The gimbal spokes permit slight rotation of the tube about these fulcrums, at the same time restraining it against any other motions. There are six additional spokes connecting the gimbal flanges, arranged in a plane perpendicular to the declination axis, to resist the torque required to drive the tube in declination."

Some readers experienced difficulty in visualizing the plan from a verbal description, such as just given, hence the drawing in Figure 2 was made. You are looking at the hollow declination axis in the center, which extends to the left from the large framework of the tube (on the right); and at the left you are gazing down the deep well afforded by the interior of one of the two big yokes: couder mirror is at the right, diagonal and an astronomer at left—and the bird cage made by the spokes is near the center. It hardly seems possible that any one will adequately grasp the hugeness of this telescope until he has actually climbed on, in and over it a few times; it is like trying to imagine a billion dollars (or, for most amateurs, a mere million! Or why stop there?).

HAVE you a wife? If so, is she a "Telescope Widow"? No doubt she is. No doubt you often become absorbed in practical or theoretical optics and forget to come to your meals, go to bed or perhaps, thinking of ways to solve problems of obstinate mirrors, you start to change your clothes for a meal and find you have undressed and got into bed at 6 P.M., as this writer once did. Telescope Widow Number One lives in Pasadena, California, and she

has a sense of humor. She used to live in Vermont, and while there she coined that accurately descriptive term for the lot of us, abbreviated as "T.N.," meaning "Telescope Nut." 'Tis said that the clock building amateurs call themselves "Clock Maniacs," and in aviation certain enthusiasts for the

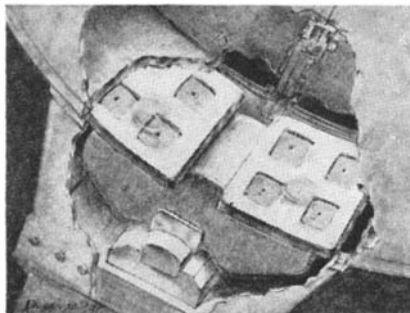


Figure 1: Oil pad for the 200"

lighter-than-air kind are known as "Balloonatics." Well—anyway—here is an item from the *Pasadena Post*, describing the flower show of the Pasadena Flower Show Association, which "T.W." No. 1 sent to us; show it to your wife if you own one—she will understand. "For awhile yesterday Association officials had a mystery," the clipping runs. "A woman at the gate requested they inquire at the police station if her husband had been injured in an automobile accident. He had gone to park the car and she had waited an hour and a half for him. Inquiry failed to disclose the whereabouts of her husband, Russell W. Porter. She decided to wait another half hour. At the expiration of this period, Mrs. Porter went looking for the car and discovered him in it, reading a book, having forgotten about the flower show."

The only mystery now remaining is the title of that book. Was it Conrady's optics, "A.T.M.," or one of those old "Pluck and Luck's" we used to read in the days before last year's mail order catalogs were customarily kept where we used to read "Pluck and Luck"? Verily, optics provides a wonderful alibi for the addict.

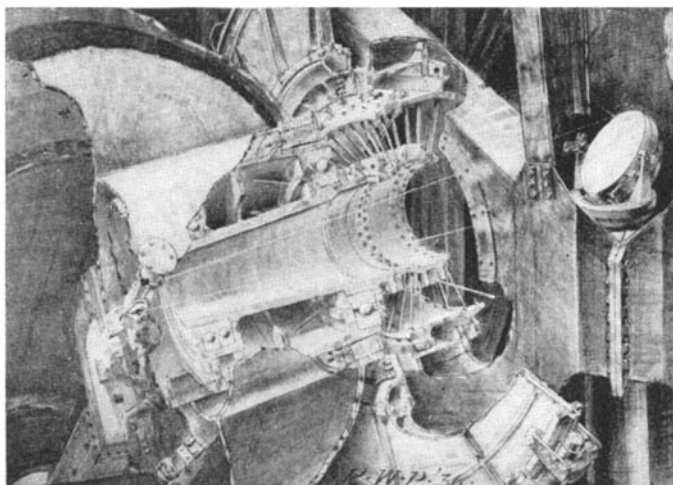


Figure 2: Cutaway drawing of declination trunnion of 200"

CORNING is now making 20" Pyrex disks of two kinds—solid ones and 20" replicas of the 200" disk, the latter naturally costing more than the former (harder to make). A number of amateurs have indicated their hopes of obtaining disks of this size; we know of one, for example, whose wife, by the time you read this, will have given him one for Christmas (wives please note). It is no longer correct form to raise the eyebrows more than part way when a telescope maker tackles a job of that size; in fact, who dares set the limit for the amateur? There is some added odor of romance or glamor surrounding the ribbed or non-solid disks, since they are copies of the big 200" disk, and there would be even more odor thereof if some amateur would go the whole hawg and build a tenth-scale replica of the 200" telescope, mounting and everything. So far as we know, nobody has yet started to do this.

C. R. TINSLEY, 3017 Wheeler Street, Berkeley, California, has been working one of the 20" replicas of the 200"—ribbed type—and here is his account of the job:

"To us, Mr. O. A. Gage of the Corning Glass Works had written: 'Your disk is the first one that has been made and sold commercially.' It was a proud day for us and our staff as we gathered around the packing case and the beautiful thing was exposed to view—a perfect 20" replica of the great 200" disk now being ground at Pasadena. With its pearly, alabaster, semi-translucent ribs, it looked for all the world like a gigantic wedding cake (Figure 3).

"The virgin disk had a 3½" hole through the center and, due to its having been cast in a ceramic mold, had a slightly pebbled, frosty surface. The working surface increased in thickness toward the center in such a way that the concave, finished face should be of equal thickness throughout. The glass weighed 45 pounds and it would have been entirely feasible to grind and polish it by hand in the usual amateur manner. The writer, however, believes that nothing can be done by hand which cannot be done better by machinery (yes, even parabolizing!).

"The first job was to grind both faces flat. This was done on a revolving, cast iron turntable (Figure 4), 24" in diameter and run at 300 r.p.m. This apparatus is driven by a ⅓ H.P. motor. The disk was laid on the table between guides which held it somewhat off center. A location was found in which the mirror automatically revolved as the turntable passed under it, and we could stand back and enjoy the job. No. 80 Crystolon was used, and the time consumed was about two hours. The back was finished with No. 240 Alundum. The machine which was to be used for grinding and polishing required that the disk be ground truly circular and have smooth edges. This was ac-

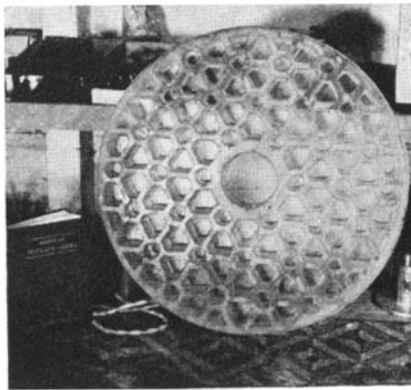


Figure 3: Tenth-scale replica

complished by fitting a wooden plug in the central hole (Figure 4), through which a shaft was fitted and the whole mounted on edge on crude bearings above the turntable. Arrangements were made to lower it gradually as the edging proceeded. Again No. 80 did the job; followed fine grinding with No. 240. Time, about 1 hour.

"The machine (Figure 5) used for grinding and polishing has been a development of several years' experience. There is no mechanism for revolving the mirror, other than the drag of the turntable below. All motions of the machine are adjustable as to speed and the table, in this case, was set at 1.5 r.p.m. The mirror sets freely on the table and is pushed first from one side and then from the other. For the present job this was done at 20 stroke cycles per minute. The pushers are low down near the working surface and, unless weights are used, there is no force that could affect the shape of the glass other than gravity. During the pushing movements, the mirror does not revolve with the table but at the change of direction there is a momentary freedom of movement, at which time the mirror revolves by about 1/4" of its circumference. The pushers are hinged so that they follow the glass as it assumes a rocking motion on the convex tool. The motion is imparted to the pushers through an upright walking-beam leading to the mechanism below. The motor used is 1/2 HP (1/4 HP for smaller glasses). The pulleys and belts are V type. Length of stroke is governed through an adjustable crank.

"The tool used was 1 1/4" plate glass and the abrasive, during rough grinding, was fed through the hole in the mirror. Except to note progress, it was unnecessary to remove the mirror from the tool at any time. No. 36 Crystolon was used and, as the glass sludge accumulated, an overdose of water caused perfect purging *without washing out the abrasive*. Pyrex, ground on plate glass, *practically never grabs*, though we used care not to let the abrasive become too thin. The face thickness, though ample, was not sufficient to permit wearing away any of the edge. We were therefore compelled to use long strokes and hog out the center first, spreading the curvature toward the edge later with shorter strokes.

"Just before rough grinding was finished, a 3 1/2" disk was cut from a 4 1/4" Pyrex port hole and this disk was ground to approximately the same concavity as the mirror. The tool was cleaned and oiled (to prevent plaster from sticking) and, with the mirror and plug resting on the tool, plaster of Paris was filled in behind the plug. After a very few strokes, mirror and plug coin-



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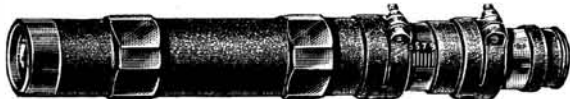
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cided. Thereafter it was necessary to lift the mirror when new abrasive was applied.

“When the focal length seemed correct, the whole was brought to a sphere by using 30 pounds of extra weight on top of the mirror. This brings up a matter which is understood by too few. Concaving action is a function of *gravity alone*, while extra weight merely causes more wear *equally distributed* over the entire surface. While a one-third stroke will theoretically produce



Figure 4: Edging the 20" disk

a sphere, weight alone will do a better job. If the weight is large, in proportion to the tipping due to gravity, the glass will come to a sphere almost regardless of length of stroke. Unfortunately, this principle cannot be applied so readily to a plastic polishing tool, but for solids it works perfectly.

“The grinding had consumed 102 hours, including time out for measurements, adjustments, etc. The fine grinding, including the 600, had all been done with *thirty pounds’* extra weight on top of the glass. We believe it due to the use of this weight that on the first Ronchi test, at the end of 500 strokes, the entire mirror gave a bright reflection, and at no time was it possible to say that any part was polishing faster than another. Nor was the mirror ever out of control from start to finish, the final parabolization being the farthest departure from the sphere.

“We anticipated considerable difficulty in forming our pitch tool, and probably would not have been disappointed had we followed established procedure. The total concavity was $5/16''$ and the sides of the tool were as steep as a toboggan slide. We are always ready to try anything at least once and so on this occasion we indulged in radicalism de luxe. The tool was turned bottom side up, with its flat surface exposed, and carefully leveled. A paper fence was tied around it in the usual manner. Then the surface of the tool and the paper fence were liberally smeared with glycerine. In melting the pitch for the tool, care was taken to pour while yet a small solid remained unmelted. This insured the pitch being near the solidifying temperature. When we were ready to pour, it was noticed that surface tension had caused the glycerine to recede from several spots on the tool, leaving its surface dry. A few strokes with the finger cured this and the pitch was poured at once. As soon as the $3/16''$ sheet could hold its shape at the edge, the paper fence was removed and a long spatula carefully slipped around between the soft pitch and the flat tool face. The pitch slab was quickly slid off on a

broad, flat board and the tool turned face up after wiping off the glycerine. The tool was then applied face down to the top side of the pitch slab but not allowed to press. The whole combination was then turned right side up and the board removed. The pitch slab at once settled down on the tool and was wiped free from glycerine on its top side. The HCF was laid on top, the rouged mirror was added, 150 pounds’ weight was applied over all and, in exactly one hour from the start of operations, polishing began.

“It will be objected that in the two transfers of the pitch distortions in thickness were bound to be set up; also that adding $5/16''$ to the top of the tool would offer a different radius of curvature than that of the tool or mirror. The only answer I can make is that, in practice, the darned thing worked perfectly. I have since made a $9''$ lap by the same method and shall probably use it exclusively in future.

“Pressing presented some problems. The tool, originally $1\frac{1}{4}''$ plate, was now barely $\frac{7}{8}''$ thick and found subject to flexure; hence no cold pressing could be used. Upon heating the tool, the curvature was so steep that the pitch sagged in the middle and formed a flat top before pressure could be applied. Finally, the HCF was stripped off and the mirror smeared with turpentine. The mirror was then worked on the bare pitch, as in grinding, the turps being wiped off and renewed as fast as it began to become tacky. When the pitch exactly fitted the mirror at all points, new HCF was applied, and the results exceeded any previous experience in pressing. This process was used three times during polishing operations. At no time during the job did the curvature depart from the sphere by an amount nearly so great as the final parabolization. The HCF was never scarified but hosed clean from time to time. Scarification merely prevents the rouge from collecting

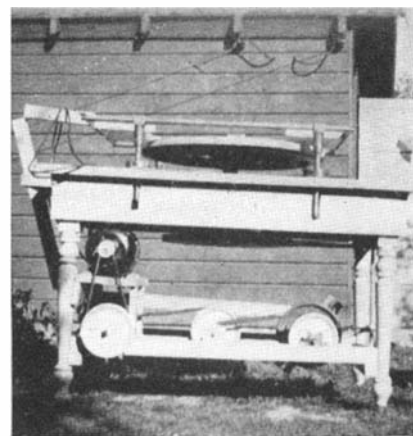


Figure 5: The machine

at undesirable points and, if the lap is cleaned frequently, is not needed.

“I would like to offer a word about turned down edge. Since learning the importance of keeping the edge of the polisher wet, we have scarcely seen such a thing. We believe that 95 percent of all turned down edges—at least, those not inherited from fine grinding—are caused by dry-edged polishers. Consider for a moment that *all* polishing operations tend gradually to deepen the center of the curve. A dry edge of polisher absolutely ceases to polish. The result is that the part of the polisher that is



Figure 6: A sturdy and rugged mounting, made by James E. Myers, 1519 Olin Avenue, Omaha, Nebraska. The drive is of special interest (the extra "shaft" is only a pipe in the fence in the rear)

wet continues to deepen the mirror, while the dry edge of the glass does not change its curvature. This leaves a shelf at the edge of the mirror, which is turned down with reference to the deeper center. This does not apply to the outer 1/32". That same slight amount appears at the edge of a Cassegrain plug and is not worth considering. Finish your mirror with as little bevel as possible, and bevel it 1/32" when done. Our replica will have 20 1/2" clear aperture after such beveling operation.

"Parabolization was effected by trimming out the standard rose tool and continuing the machine operation at 1/3 stroke. Results could not be improved by hand.

"Total time for polishing, 73 hours; for parabolization, 3 hours."

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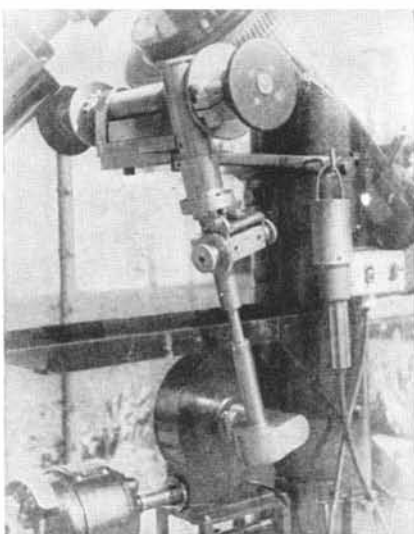
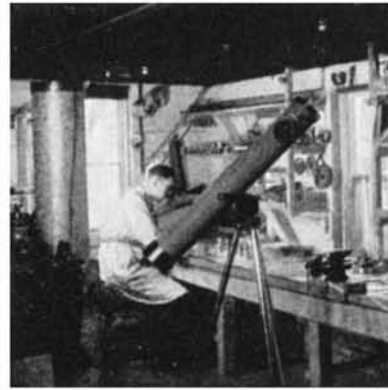


Figure 7: A close-up view of the substantial drive shown in Figure 6



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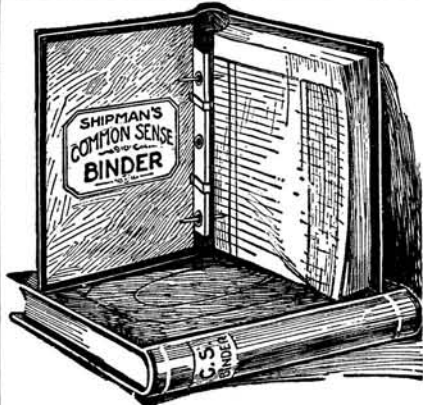
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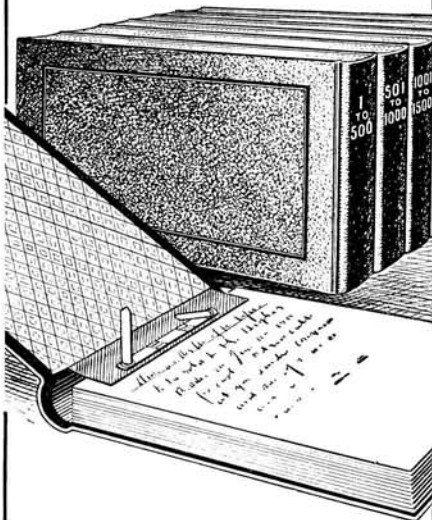


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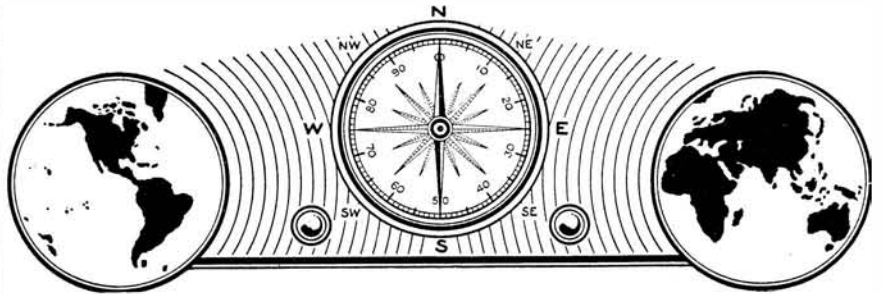
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WEAK-SIGNAL RECEPTION

MOST modern receivers are equipped with automatic volume control for the purpose of maintaining a relatively constant volume output on all stations and to equalize fading signals. Since the basis of the control action rests in reducing the radio-frequency gain or amplification of the receiver as signals increase in strength, it is obvious that, with no other provisions, any signal will automatically tend to reduce the overall sensitivity of the receiver.

Under such conditions the owner is deprived of the use of a certain degree of sensitivity the receiver would otherwise have. And it is this "last ounce" of sensitivity that is often required to bring a weak signal up to a point where it is distinguishable.

This drawback is eliminated in some receivers by the use of a delayed automatic volume control action. Circuit values are so adjusted that the automatic volume control does not function unless the received signal is above a predetermined level. The radio-frequency amplifiers in the set therefore run "wide open" if the signal is weak; thus no sensitivity is sacrificed.

But the fact remains that many receivers do not have delayed automatic volume control. In some sets the loss in sensitivity may be quite small, but in other sets the inherent

amplification may be reduced to such an extent that the receiver is incapable of picking up weak signals.

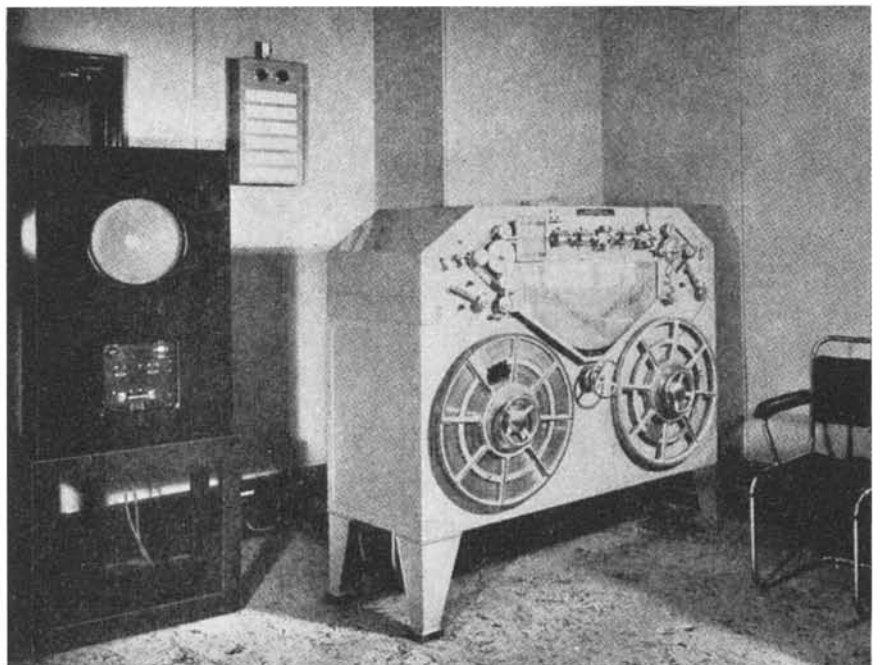
This fault may be removed by installing a simple toggle switch that will cut out the automatic volume control action while hunting for distant stations. Control action can be immediately restored by flipping the switch in the opposite direction.

The installation of such a switch is not a complicated procedure. Any radio service man can do the job in short order.

BRITISH RECORDING

THE G-string short-wave stations of the British Broadcasting Corporation are equipped to make instantaneous recordings, in "newsreel" fashion, of special events of import to the Empire. This is something as yet untried in this country, although we accomplish much the same result through "pick-up" broadcasting.

The BBC employs Marconi-Stille Recording Machines, one of which is shown in the accompanying illustration. The programs or special events are recorded magnetically on a steel tape which winds off one reel and on to another. When the tape is "played back," the magnetic variations in the tape produce minute electrical currents in a pick-up coil. These currents are amplified and passed on to the broadcast transmitter.



Courtesy British Broadcasting Company

Magnetic recorder used for Empire transmissions of "spot" news

Such recordings are not permanent, but are retained in the tape for a number of hours. When the recording is no longer of service, it is "wiped off" the tape by an electro-magnetic process. The tape may then be used for other recordings.

NEW VENEZUELAN STATION

PERMISSION has been granted by the Venezuelan Ministry of Communications to Nicolas Vale Quintero, of Maracaibo, Venezuela, to establish and operate a commercial radio broadcasting station in that city.

The new station will be situated five kilometers from the center of the city, and will operate with a power of 250 watts, on a frequency of 1120 kilocycles (standard broadcast band) and 6350 kilocycles (49-meter short-wave broadcast band). The call letters will be YVIRG and YVIRH for long and short wave respectively.

FOREIGN AMATEUR PHONES

ALTHOUGH the 20-meter (14 megacycles) amateur radiophone band is excellent for long-distance communication throughout the year, it is of particular interest to the short-wave listener at this time.

East Indian and Australian stations may be heard in the early mornings; between 8 P.M. and midnight, depending on the length of time the band stays "open," stations in South America, South Africa, and the Hawaiian Islands come through with fairly good strength.

Foreign stations, other than those located in U. S. Possessions, operate outside of the American amateur radiophone band; that

is, just below 14.15 megacycles and just above 14.25 megacycles. The majority of the Hawaiian stations operate close to the high-frequency edge of the band, or 14.25 megacycles.

These foreign stations are audible for only short periods of time and usually fade into the background in less than an hour. The trick, then, is to listen at the proper times. At present the Hawaiians are coming through between 10 and 11 P.M., but as winter progresses they will be heard earlier in the evening.

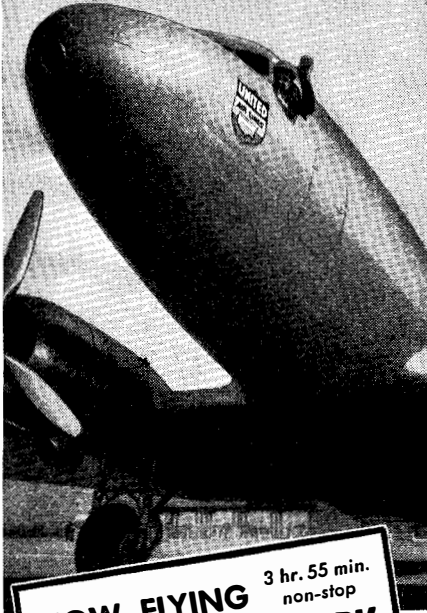
By far the easiest method of locating such stations is to "pace" the amateurs in the American phone band. These fellows work with their ears wide open and they are experienced in spotting foreign stations. When you hear them calling such a station, pick up the letters and then tune to the high or the low side of the band. As likely as not you'll be successful in picking up the foreign station as readily as the American amateur.

U. S. SHORT-WAVE BROADCASTERS

THE recent Federal Communications Commission regulations with regard to the power and frequency stability of American short-wave broadcast stations has resulted in the closing down of some transmitters. The stations remaining are on regular schedules and are worth your attention. The international programs, not heard on the standard band chain stations, are particularly interesting.

A list of the principal U. S. short-wave broadcast stations, compiled by the Radio Manufacturers Association, is included in this month's column. The schedules and frequencies are complete and up-to-date.

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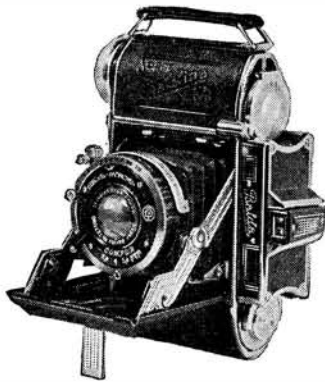
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SCHEDULE OF PRINCIPAL U. S. SHORT-WAVE STATIONS
In Eastern Standard Time

			KCS	M
W1XK (NBC) Boston	Daily	6:30 a.m.- 1:00 a.m.	9,570	31.3
	Sundays	8:00 a.m.- 1:00 a.m.	"	"
W1XAL Boston	Sundays	5:00 p.m.- 7:00 p.m.	6,040	49.6
	Mondays and Fridays Mon., Tues., Wed., Thurs. and Fri. Saturdays	7:00 p.m.- 9:00 p.m.		
W9XAA Chicago	Sundays	6:00 p.m.- 6:30 p.m.	11,790	25.4
	"	4:00 p.m.- 6:30 p.m.	"	"
	Sundays	7:00 a.m.- 3:35 p.m.	11,830	25.3
	Mon. to Sat. inclusive	4:00 p.m.- 6:30 p.m.	6,080	49.3
W9XF (NBC) Chicago	"	5:30 a.m.- 7:00 a.m.	6,080	49.3
	"	7:45 a.m.- 3:45 p.m.	11,830	25.3
	"	4:00 p.m.- 11:00 p.m.	6,080	49.3
	"	"	"	"
W8XAL Cincinnati	Daily (except Sundays)	6:30 a.m.- 8:00 p.m.	6,060	49.5
	Sundays	8:00 a.m.- 8:00 p.m.	"	"
W2XE (CBS) New York	Daily	11:00 p.m.- 2:00 a.m.	"	"
	"	7:30 a.m.- 1:00 p.m.	21,520	13.9
	"	1:00 p.m.- 5:00 p.m.	15,270	19.6
	"	5:00 p.m.- 10:00 p.m.	11,830	25.3
W3XAL (NBC) New York	"	10:00 p.m.- 11:00 p.m.	6,120	49.0
	"	9:00 a.m.- 5:00 p.m.	17,780	16.8
W3XAU (CBS) Philadelphia	"	6:00 p.m.- 11:00 p.m.	6,100	48.8
	Daily (except Sundays)	12:00 noon- 8:00 p.m.	9,590	31.2
	Sundays	12:00 noon- 7:00 p.m.	9,590	31.2
W8XK (NBC) Pittsburgh	Daily	8:00 p.m.- 11:00 p.m.	6,060	49.5
	"	7:00 a.m.- 9:00 a.m.	21,540	13.9
	"	9:00 a.m.- 7:00 p.m.	15,210	19.7
	"	7:00 p.m.- 10:00 p.m.	11,870	25.2
W2XAD (NBC) Schenectady	"	10:00 p.m.- sign off	6,140	48.8
	Daily (except Sun. & Mon.)	9:55 a.m.- 3:45 p.m.	15,330	19.5
	Sundays	10:00 a.m.- 4:00 p.m.	"	"
W2XAF (NBC) Schenectady	Mondays	9:55 a.m.- 4:30 p.m.	"	"
	Daily (except Mondays)	4:00 p.m.- midnight	9,530	31.4
	Mondays	3:30 p.m.- midnight	"	"

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CAMERA ANGLES

Conducted by JACOB DESCHIN

INVENTORY TIME

THIS is a good time of year in which to do some careful weeding in your negative garden. If you take your hobby seriously, you doubtless are finding that you are constantly improving your technique and feeling less and less satisfied with your earlier efforts. Look through your negatives carefully and see how many of them are still worth keeping, considering the higher standards you have set for your work.

Unless you are a very exceptional photographer, you will find quite a number with which you once were passably satisfied but which today you hold in disdain. Some of these negatives may be valuable to you for other than purely artistic reasons and you cannot be blamed if you will want to keep these, if only for a "little while longer." The others, however, may easily be thrown away and good riddance. You want your negative file to hold only those which you would not hesitate to show to a fellow-hobbyist. If the others are so poor that you find it painful to look at them yourself, waste no time in eliminating them as quickly as possible. Try it and see how much better you feel.

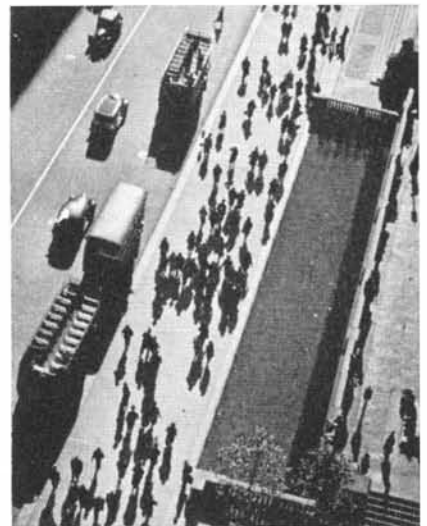
DIAGONALS

THE diagonal type of composition appeals to many workers who seek to introduce original ideas into their picture-taking. They like its liveliness and vivacity, its devil-may-care atmosphere. The conventional triangular arrangement that is held to be the ideal composition is perfect, but let's do things a little differently now and then; let's try it this way and that way and if we get something pleasing to us let's enjoy it even if it isn't exactly according to Hoyle.

This diagonal form does not necessarily have to involve distortion of the subject nor even call for an angle shot; some very fine portraits have been made which have employed the diagonal line, one beautiful example of this that comes to mind being that of a girl, in which the head is in the upper

right hand part of the picture space and a shoulder in the lower left hand part, the two being related by an invisible diagonal line.

The distinctive characteristic about the diagonal composition is that the picture in which it is employed seems to come alive; it is alert, active, full of movement. Now, if we can get this spirit into our pictures what does it matter if some die-hards, pur-



"Pedestrian Shadows"

ists, or whatever they call those people who refuse to go along with the new times and the new spirit, object to these new-fangled notions? The diagonal line is, of course, not new, and has always been employed, but the point we make here is that we should exploit it in a more striking way than is ordinarily attempted. Two such possibilities we offer in our illustrations, "Twin Towers" and "Pedestrian Shadows." In the former we get the impression that these "skyscrapers" live up to their name, that they are not just inanimate mountains of stone and steel but vibrant with modernity, conscious of and reflecting the life that is going on within and about them.

In "Pedestrian Shadows" we feel the rhythm of many lines running parallel from the lower left hand corner to the upper right hand corner and yet escaping monotony by reason of the varied shapes and the two short diagonal lines of the stone fences that run counter to the principal lines in the picture. The active forms of the people walking up or down the avenue and the shadows cast by their persons, the rounded-off forms of the buses and automobiles all contribute essential touches to the general atmosphere of continuous movement.

Buildings, street scenes, and portraits seem to offer the best subjects for the diagonal picture, but since photography is full



"Twin Towers"

of surprises it is possible that we may run across a happy composition of this type in almost any subject. If we cannot get into position for the diagonal composition we want, it is often possible to correct this viewpoint under the enlarger. Thus, while "Twin Towers" was snapped in the position it was printed, "Pedestrian Shadows" had to be maneuvered into the diagonal by lifting the enlarger housing higher than would ordinarily be required and then moving the easel about until the desired result was obtained.

Incidentally, while we are on the subject of essaying new fields and breaking away from old traditions when we find these no longer fit the mood of our times, let us recommend that finest of exercises for the serious worker: the still-life. There is no better way to become thoroughly familiar with the various compositional forms or to evolve new ways of putting them to work. A table, a few knick-knacks or pieces of fruit, simple lighting equipment, and a camera equipped for ground glass focusing, although the direct view finder can, with a little extra trouble in focusing, be made to serve, are all the tools you will need.

TIMING CLOCKS

TWO inexpensive darkroom timers, one of which sets off an alarm at the end of a predetermined time interval, are now available in photographic stores. One is the Rexo Interval Timer, which provides for intervals from one minute up to 60, an alarm going off at the pre-set time, and the other the Luxor Photo Timer, which is a double-duty clock, serving both to tell the time of day and the time of exposure for printing or developing purposes. The latter has a full-sweep second hand and smaller hour and minute hands. Both timers have large, open-face dials four inches in diameter.

"BARGAIN HUNTERS"

THE wealth of pictorial material available to the picture-taking wanderer about the streets is again illustrated in the "Bargain Hunters," which was snapped while this department was on its way to the office one morning. An "economy sale" was in progress and the rush of customers to the counters created a succession of picture



"Bargain Hunters"

opportunities that could not be ignored even at the risk of reaching the office late. No posing, no pre-arranged lighting, nothing but life in the living.

"MYSTERY CRYSTALS"

WE have a puzzle for our readers this month. Let us say at once, without further ado, that the subject-matter in "Mystery Crystals" is nothing but the accumulation of spilled developer and hypo



"Mystery Crystals"

solution which had collected on a slightly grooved board and had carelessly been allowed to stay there for several days. Crystallization occurred with the result you see. It took a short focus lens, cross lighting, and precarious placing of the camera to get this picture and two or three others, but as a picture of an unusual darkroom mystery it seemed worth while recording.

DIRECT COPY FILM

A METHOD of making copies of negatives, without the necessity of going through the intermediate step of first making a positive, is now made available in Agfa Direct Copy Film, which takes practical advantage of the "solarization" principle to achieve its effect. It is also useful for making positives and transparencies and in these cases, too, the duplication is direct; a negative from a negative or a positive from

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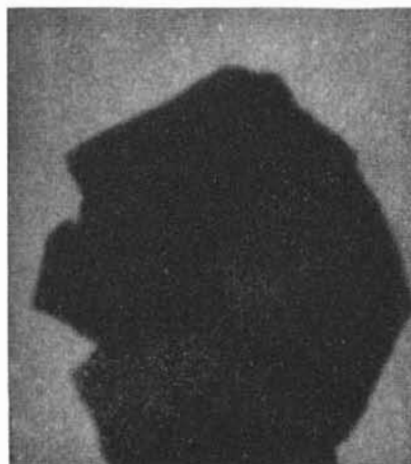
The usual darkroom light used for contact printing is employed in handling this direct copy film and development and fixing is in conventional solutions. The film sizes available range from 4 by 5 inches to 20 by 24 inches, including the popular 5 by 7 and 8 by 10 inches.

VIEW CAMERA

A VERSATILE 5 by 7 view camera intended for the professional but just as useful to the serious amateur who prefers the leisurely convenience and other advantages offered by the view type camera, has recently been introduced by Agfa Ansco under the name of the Universal Junior View Camera. The camera is sold, as all view cameras are, without the lens and in its design are incorporated many modern features, such as the new tilting front action with rising and falling front movement; horizontal and vertical back swings; reversible ground glass back and rack and pinion focusing. The bellows extension permits of the use of lenses varying in focal length from 3½ to 13½ inches. Despite these advanced features, the camera is priced very reasonably, the cost including a carrying case, an extra lens board, and a double film holder.

NEWSPAPER SHADOWS

TAKE a sheet of newspaper, crumple it loosely and throw its shadow on a plain, light-toned background, preferably using a spotlight for sharp shadow edges. At first you may not see anything that looks like sense, but turn the crumpled bundle this way and that and perhaps eventually you may get something like the results shown here in "My Land!" and "Somethin' Fierce." The peculiarity of this method of killing time is that you may get nothing at all for



"Somethin' Fierce"

The Best Books For Amateur Photographers

New Ways in Photography, by Jacob Deschin. Eminently practical from every point of view, this new book contains nothing of theory and nothing that the advanced amateur photographer will not find valuable in one way or another. It covers the whole range of amateur photography, discussing such things as trick photography, photomurals, retouching, infra-red, and a number of other sub-divisions that will not be found elsewhere in as clear and concise a manner. \$2.90.

Monsters & Madonnas, by William Mortensen. This is a book of methods for the artist-photographer, who glories in producing a finished print that contains more than was recorded on the original negative. The book includes a number of beautiful photographs ranging from portraits through nudes to the grotesque. \$4.15.

Practical Amateur Photography, by William S. Davis. Deals with the whole subject from the origin and growth of photography to the latest types and uses of cameras. 264 pages, illustrated. \$2.40.

Press Photography, by James C. Kincaid. Amateur photographers may in some instances do well to ape the procedure of the press photographer. This book tells the whole story of the interesting work done by these men and contains many fine examples of their work. \$3.20.

Infra-Red Photography, by S. O. Rawlings. A treatise on the use of photographic plates and films sensitive to infra-red. Exposure and processing are fully covered; formulas are given for sensitizing. \$1.65.

The American Annual of Photography—1937—Volume Fifty-One. The cream of the year's photography, a series of articles on various phases of photography, and a miscellany of formulas and hints for the amateur photographer. \$1.65.

Elementary Photography, by Neblette, Brehm, and Priest. You can learn much of the fundamentals of photography from this little book even though you have little or no knowledge of physics and chemistry. \$1.15.

Photographic Enlarging, by Franklin I. Jordan. A complete treatise on enlarging, discussing not only the necessary equipment but all of the darkroom processing dodges which may be employed. \$3.70.

Pictorial Lighting, by William Mortensen. Complete control of lighting is an absolute "must" for successful photography. This book tells clearly how to obtain such control. \$2.15.

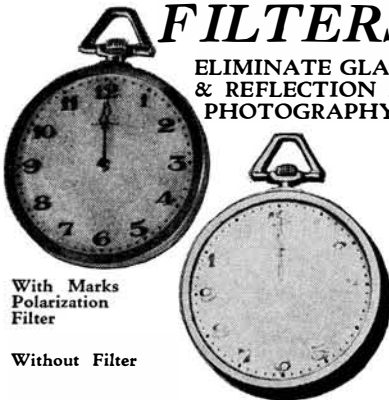
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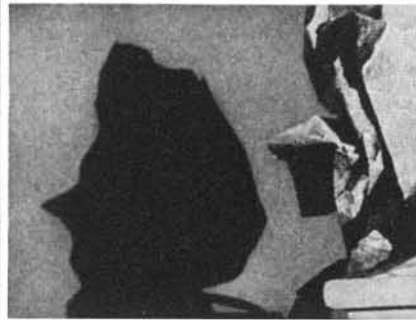


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"My Land!"

quite a while so that after 15 or 20 minutes of this exercise you may suddenly reach a point when you find yourself slowly but surely losing your mind. But to give up at this point would be fatal, since it is just here that you will really be getting into the swing of the thing.

In photographing the final goofy result you will very likely have to include both the newspaper and the shadow, but there is nothing to prevent your cutting out the newspaper part of the negative when you come to make the enlargement.

The intriguing thing about this whole business is that you cannot predetermine the result. Almost anything is likely to appear, perhaps just when you have decided to give up. If the crumpled sheet you have been "modeling" seems to produce no results at all, just discard it and take a fresh sheet. It's all a matter of luck, but you are bound to get something if you approach the thing good-humoredly. At the worst, it's one way of spending a rainy afternoon indoors or whiling away a dull hour or so.

TIMING PRINTS AUTOMATICALLY

ONE of the handiest devices to appear on the market in recent months is an automatic time switch that eliminates watching the clock when making prints and enlargements by automatically switching off the printing light when a pre-set number of seconds has elapsed. It is known as the Simmon Automatic Time Switch and may be connected either to an A.C. or D.C. outlet. The enlarger or printer cord is plugged into the socket at the back of the switch case, a focusing switch turned on to frame and focus the image and then turned off when ready to make the exposure, after which an indicator is turned to the number of seconds required for the exposure. When the exposure switch is released the printing light goes on and stays on for the exact duration of the exposure, when it automatically is turned off. The advantages of this device are, of course, obvious to all darkroom workers, two of the most important being that dodging is greatly facilitated since the clock does not have to be watched and the attention may, as it should, be entirely concentrated on the work of dodging, and exact matching of tone values assured where a number of prints are made from a single negative.

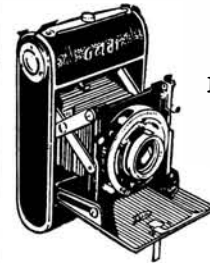
The Simmon Automatic Time Switch is also recommended for making automatically-timed camera exposures from 1 to 60 seconds when working with Photoflood bulbs. The time switch is connected to the circuit carrying the bulbs and the control knob set for the exposure time required. The camera shutter is opened on "time" and the

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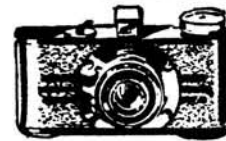
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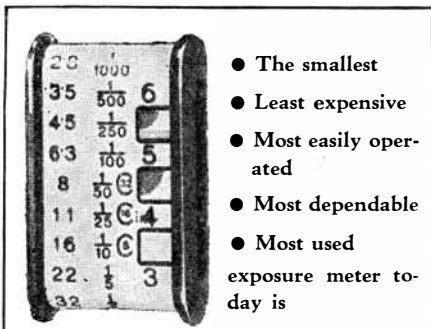
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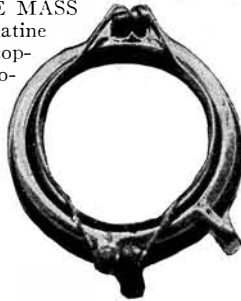
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exposure switch released to time the bulbs rather than the camera shutter. This procedure is familiar to those who have used the non-synchronizing type of flash bulb reflector, the shutter being closed, of course, immediately after the lights are switched off. It is advised that the bulb units should be limited to two No. 1 or one No. 2 Photo-flood bulbs.

HUNG AGAIN

"THE Artist at Work" is one of five of this department's pictures hung during the entire month of December in a national exhibition of the work of American photographers at the University Gallery of the University of Minnesota. We are es-



"The Artist at Work"

pecially partial to this particular picture and this occasion seemed like a swell opportunity for getting it by the powers that be and showing it to our friends. Modesty aside and speaking objectively, if this is possible, we like this picture for several reasons: the dark mass at the right, the leisurely concentration of the "artist" at her work of arranging the dress, the easy, unforced pose of the shoe-less window dresser and the soft, general illumination against which the subject is semi-silhouetted. The picture is a candid shot taken at night while in casual search for likely picture material.

NEW ADHESIVE TAPE

A NEW adhesive tape coated on one side only and having a crepey paper-like base and vulcanized rubber back is now being recommended by supply dealers for use in masking and passe-partout binding, as well as for a variety of other purposes allied with photography. On the market under the name Papertak, it is supplied in a variety of colors, including blue, yellow, brown, green, and red as well as black and white, and in widths of one quarter, three eighths, one half, three quarters and one inch, and in rolls 10, 30, and 60 yards long. Its sponsors claim that it will not curl, resists heat and water, cannot be penetrated by paint, varnish, or lacquer and leaves no surface marks when removed.

ANOTHER MARKET

A PAYING outlet for your writing as well as picture-taking talents is now in the course of getting under way in Chicago in the form of a new magazine devoted chiefly to photography. It is being launched by the Ziff-Davis Publishing Company, 608 South Dearborn Street, Chicago, whose B. G. Davis is inviting suggestions from prospective contributors. Mr. Davis announces

that the requirements of the new magazine will be for non-fiction articles dealing with still photography and cinematography as well as color work and that these "must be of a technical or semi-technical nature, written in fairly simple language."

"Squibs can vary from 100 to 500 words, articles from 1000 to 3500 words," Mr. Davis's announcement continues. "Ghost written articles from important photographers will be very useful. Articles, of course, should include illustrations wherever possible.

"We will also be in the market for a limited number of good or unusual photographs of all types, including color photographs. Home construction articles dealing with cameras, enlargements, dark room activities, etc., will be needed."

So if you have something worth while to say, either with words or pictures, don't waste it on the desert air but write Mr. Davis about it and let him send you a check for your trouble. Mr. Davis writes he "will be glad to confer with any contributor in advance regarding proposed articles."

FEROTOTYPE CLEANSER

BRIGHT, non-curling glossy prints may now be obtained through the use of a new solution for cleaning and lubricating enamel or chromium ferro tins. Ferolene, its trade name, merely calls for mixing a small quantity of it in a pint of water after which a sponge soaked in the mixture is passed over the tins and the washed prints pressed over them in the usual manner without the necessity of first drying the tins.

SHOOT THE RED CAPS

WHEN next you have occasion to visit New York City, do not overlook the pictorial possibilities of Pennsylvania Station. At certain hours of the day, depending on the time of year, sunlight comes stream-



"Red Caps"

ing through the upper windows and down the stairways, illuminating all subjects descending the stairways or standing or walking within a rectangular area measuring 12 or 15 feet by 20 or 30 feet. Prospective passengers coming down the stairs are beautifully "back-lighted" and other subjects present themselves in a very attractive setting, but your best opportunities will be in snapping the Red Caps at their daily routine of carrying baggage from taxi to

For Your Boy or Girl

PRIVATE INITIATIVE In Education may offer the solution

A Handbook of Private Schools, 20th Edition; \$6, 1152 Pages, 250 Illustrations, 15 Maps. Critically Describes or Lists 4000 Private Schools. 21st Edition in preparation for May Publication.

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Thousands of Parents Choose Schools from it: "Between the red-&-gold cover many an undecided parent seeks an educational niche," *Time*. "Much value in helping me find the right boarding school for my daughters," *Mrs. T. B. Lewis*, *Freehold, N. J.* "A perfect gold mine for information," *Mrs. C. S. Green*, *Trenton, N. J.*

Colleges and Universities use it in the offices of their Presidents, Deans, Directors of Admissions, Registrars, Librarians: "I know of no other single source that provides comparable information," *Arnold K. Henry*, *U. of Pa.* "Greatly intrigued by the introduction," *Pres. Laurens Seelye*, *St. Lawrence University*.

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Table of Contents*

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train and back again. Their stiff caps catch the light beams and their swinging arms and alert movements are silhouetted against the generous illumination. Candid-shooting gets a real break in a setting of this kind and either the range-finder or the reflex type of camera will be found ideally useful.

ANOTHER WORD FOR THE HORSE

SOMETIME ago we voiced the suggestion that the city horse going about his daily work in city and town is worth some photographic attention. Permit us to do so again,



"Horse in the Rain"

if only in order to have an excuse to show you the accompanying picture. There was a slight drizzle when this shot was made but we found that by standing in a nearby store doorway we were able to cover just the amount of material we needed, except for too much foreground, which was easily eliminated in the enlargement. The shot was made at F:2 and by steadying oneself against the store window we were able to give a 1/5th second exposure.

LIGHT FOR COLOR

A FLOOD bulb lasting five hours and specially designed to provide a filtered light in order to do away with the need for using a filter when exposing Dufaycolor film, is the Wonderlite Dufaycolor Filter Flood. The glass of the new lamp is colored to approximate the effect of the Dufay standard 1A filter. The manufacturers claim that "the color rendition should be faithful during the entire useful life of the lamp."

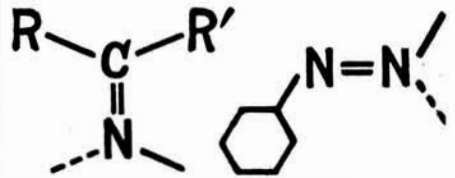
The manufacturers caution prospective users that, when employing the Weston or any other photo-electric meter in determining exposure, the meter reading should be multiplied by four, since the effect of the bluish-white light of the Filter Flood on the meter is only about one fourth the effect of white light.

It is suggested that the Filter Flood may also be used with supersensitive panchromatic film in portraiture, its special virtues in this connection being that it reduces eye strain and glare and throws less heat on the subject. The general advice is to use a factor of two to four, depending on the color of the wall, screen, or picture setting, the multiplying factor being determined through experience.

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THE SCIENTIFIC AMERICAN DIGEST

(Continued from page 117)

for 15 or 20 minutes. Then seal the jars and leave them in the water until it begins to cool. Store the jars in a dark room or cover to keep them from the light. Thus processed, nut meats will keep fresh even during hot weather."

COLORED INSECTICIDES FOR APHIDS

THAT the color of the insecticide used may have a definite effect upon the number of insects attracted to the host plant has been demonstrated in tests made at the State Experiment Station at Geneva, New York, and reported upon recently by J. B. Moore.

The experiments were carried on with aphids on potatoes because it had been observed that aphids tend to increase in numbers on plants sprayed with bordeaux, explained Mr. Moore. By the aid of delicate instruments it was possible to test the light responses of aphids to sprayed and unsprayed potato leaves. From the results obtained it has been concluded that the aphids are attracted to the sprayed plants because of the increased intensity of light reflected from the sprayed surfaces.

Extending his studies to aphids on cabbage, Mr. Moore found that the infestation on plants dusted with a lead arsenate-lime mixture could be reduced below that on untreated plants by dyeing the dusts used. Black dust was the most effective in reducing the infestation.

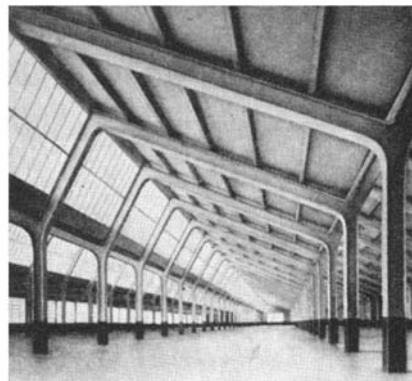
It is believed that the results obtained in these experiments might well lead to modifications of present spraying and dusting practices on crops infested with aphids by using dyed materials to insure a reduction in the light intensity reflected from the treated surfaces.

BROADER FACTORY AISLES

A NEW design for single-story industrial buildings, providing broader factory aisles, unobstructed head-room to full ceiling height, and maximum uniform daylight throughout, has been developed by The Austin Company, industrial engineers and builders, through the use of welded rigid frame construction.

Entirely stripped of cross members and trusses which cast spider-web shadows across most factory areas today, the new type has a continuous rigid saw-tooth frame formed by the welding of rolled beam sections which permit economical construction of aisles up to 50 feet in width. It is particularly adaptable to requirements of machine shops, precision parts production, and the textile, food, and printing industries, where air-conditioning is a factor of increased importance.

"Application of the latest engineering practice will permit the attainment of simple functional lines in plants of the future," Albert S. Low, vice president and chief engineer of the Austin organization, states. "By taking advantage of a system which utilizes the controlled elastic deformation of structural steel in a building of the saw-



Welded-frame building construction makes possible broader aisles

tooth type, it will be possible to eliminate all passing shadows caused by transitory sunlight and to insure more efficient and uniform artificial illumination at night.

"With broader aisles available, and clear, unobstructed head room from floor to roof, men responsible for production will have the maximum opportunity to develop efficient and flexible operating layouts for the future. Straight line operations in any of several directions will be possible."

TIN KILLS DRY-GOODS ODOR

THE odor characteristic of dry-goods stores may become merely a memory as a result of a new use found for tin. Compounds of tin, such as stannous oleate, stearate, or benzoate, when added to the extent of 0.1 percent to the oils used in finishing textiles, prevent the rancidity which imparts undesirable odor to the finished goods. This use of tin compounds as anti-oxidants in textile oils minimizes the odor of new cloth.—D. H. K.

RESEARCH IN MUSCLE FLIGHT

THE Germans have been pioneers in gliding flight, beginning with the great Otto Lilienthal. Now they are undertaking very seriously the study of flight by man-power alone, or *muskelflug* as they term it. A prize has been established for the first real flight by man-power, as distinct from gliding or soaring, and the rules of the contest provide that all starting devices such as rubber bands, and so on, are to be taken aloft. In writing these rules, one of the most difficult problems was to evaluate how much power a man really can produce—it is on the correct evaluation of such power that everything depends.

Information on man-power seems to be vague and conflicting, so with true German thoroughness an Institute for Muscle Flight was established in Frankfurt, with correct measurement of leg and arm power as one of its first tasks.

Some curious apparatus has been developed for this highly scientific research. The subject sits in an adjustable seat and works with his feet on pedals moving in circular arcs, with one foot alternately ahead of the other. With his arms he manipulates cranks in similar fashion. Through gearing and a chain drive the power is transmitted to a Prony brake. The turning moment of the brake is carefully measured on a balance scale; a tachometer measures the

revolutions per minute. The engineer pulls out his slide rule and calculates the man-power developed, on the same principles that he calculates the power during test of an internal combustion engine.

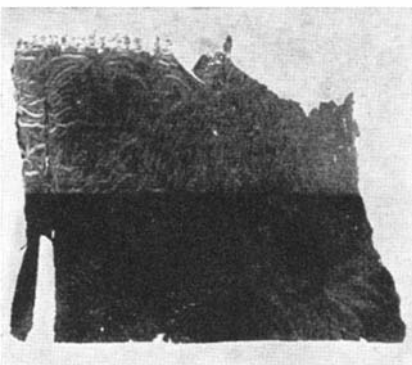
Information to date leads to the belief that man will be a weak prime mover and will develop considerably less than one horsepower even in a frantic burst of a minute's duration—but we shall see. Of course, the Institute will concern itself equally with aerodynamic problems.—A.K.

WELD OF .000006-INCH FOIL

STRIPS of two alloys, Copnic and Chromel, were welded together and rolled to a thickness of six millionths of an inch recently in the laboratories of the General Electric Company. Even when magnified 250 times, the weld in the ultra-thin bimetallic foil can be distinguished only by the difference in color between the two alloys.

Gold has been beaten to four millionths of an inch, and aluminum has been thinned by the same treatment to ten millionths of an inch; but this is the first time two alloys have been welded together and then reduced to such a thin section by rolling.

The six millionths of an inch thickness was achieved by placing the welded strips of the two alloys—the one of copper and



A perfect weld of two pieces of alloy foil rolled to .000006 inch

nickel and the other of chromium and nickel—between pieces of steel and reducing the combination as a unit by passing it between rolls. The final product of the rolling process is as delicate as gold leaf and must be handled with equal care.

The two alloys might have been lap welded after being rolled, according to engineers in charge of the work, but such a procedure would not have given the same clean appearance and uniform characteristics. Rolling is the only method known by which such extreme and uniform thinness can be obtained in metals.

RAINFALL REGISTRATION

ANEW instrument for the registration of rainfall, described by the Swedish meteorological expert, J. W. Sandstrom as the finest yet devised, has been invented by a doorkeeper at Swedish Meteorological Hydrographical Institution. It is characterized by its light weight—only 18 kilograms (40 pounds) against 60 kilograms (132 pounds) of other instruments—the great accuracy of the readings, and the fact that it registers for a week at a time without requiring any attention. The doorkeeper, Fabian Nilsson,

had observed that self-registering rainfall instruments were not efficient and accurate, and pondered over the problem for several years. At last he found the solution and made his first instrument. Now there are several in operation in Stockholm and other parts of Sweden.—Holger Lundbergh.

NEW VITAMIN-ANALYSIS METHOD

LIGHT given off by a vitamin, strong enough for newspaper reading, was the unique phenomenon witnessed by doctors attending the American Medical Association's annual session. It was observed during the first demonstration of a vital, new short-cut method of calculating the content in foods of lactoflavin, one of the vitamins essential in the diet to promote growth and sustain life.

The new method of analysis is based upon the discovery of the fact that lactoflavin throws off an intense golden yellow, fluorescent glow when it is exposed in a completely darkened room to "black light," the invisible ultra-violet rays of the spectrum.

For the past 13 years Dr. Supplee and his associates in the biological and chemical laboratories of The Borden Company, in Bainbridge, N. Y., have been working to isolate and study the unknown factors in milk. Whole milk has long been known to contain all of the health-giving vitamins but there has been much mystery concerning many of its minute constituents, of which lactoflavin is one. Lactoflavin is a water-soluble vitamin formerly classified as a part of vitamin B or G.

"Understanding of what constitutes a healthful diet is broadened whenever a vitamin is isolated, purified and brought under scientific control," Dr. Supplee asserted. "Accordingly, our efforts have long been directed toward the development of methods of isolating and producing lactoflavin, which is so vital to mankind. Our success was recently accelerated by the discovery of the unique fluorescent property of the vitamin."

Lactoflavin is the fifth vitamin to be isolated chemically, the others being vitamins A, B, C, and D. The potential source of supply of lactoflavin is almost unlimited. In milk, lactoflavin has been found to be in the proportion of between 1½ to 2 parts per million, with approximately the same proportions existing in liver, yeast, milk solids, and whey. This may appear to be a very small proportion of vitamin material but these vitamin agents are effective in minute quantities.

HOW AIRCRAFT ENGINE VIBRATION IS ELIMINATED

IN a paper presented before the S.A.E., John M. Tyler discussed the vital problem of vibration in aircraft engines. No matter how well balanced an aircraft engine may be, there is always one source of irregularity which cannot be eliminated; namely, the torque or turning moment of the engine. Even with 14 cylinders, there are bound to be irregular torque impulses. The engineer knows that he cannot eliminate this irregularity and takes the following precautions:

The engine is rubber-mounted so that the vibrations are dissipated by friction, and

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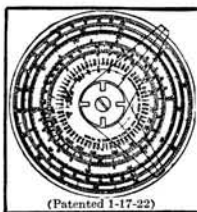
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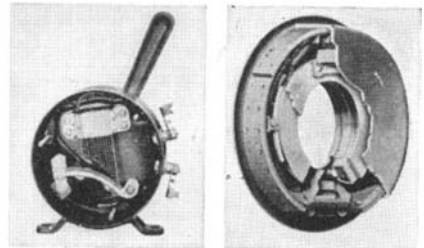
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the rubber mounting is made relatively flexible so that the natural period of swing or oscillation is much longer than the period of the torque impulses. In other words, resonance is avoided. Similar principles of mounting are followed in the automobile engine.

The avoidance of excess vibration is mainly the avoidance of resonance. Resonance is a well nigh universal phenomenon: A child working a swing uses the principle of resonance; soldiers break step when crossing a bridge so that their steps may not be in resonance with the natural period of the bridge; it was the resonant whirling of its propeller shafts which made passengers on one of the world's largest ocean liners uncomfortable on its first trip.—
A. K.

fers power from one part of the wheel to the other.

The electric brakes act instantly, without time lag. The controller delivers current to all wheels simultaneously, and the stopping action begins at once. The driver has complete control over the amount of braking power with a minimum of effort. "Grabbing" and "locking" are eliminated as there is always a slight slipping action between armature and magnet. "Jack-knifing," due



Left: The rheostat controller for trailer brakes. Right: Cut-away view of brake, showing the mechanism

THIRSTY ORCHARDS

If a mature orchard receives its needed four acre-inches of rainfall each month, it would be equivalent to 108,000 gallons of water to the acre monthly or 3600 gallons daily, says the Bureau of Plant Industry. Counting an average of 35 trees to the acre, each tree should have a little more than 100 gallons of water daily.

BRAKE THE TRAILER NOW

ANSWERING problems and peculiarities arising in the trailer field, Warner Electric Brake Manufacturing Company has announced development of a new electric power brake for coach and commercial trailers.

The brake, operating on as little current from the storage battery as a tail light, involves several new principles. From a trailer standpoint, one of the chief advantages is that only one electric wire is needed as connection between the power car and the trailer, permitting free movement of the coupling in turning. Electric brakes have a further advantage in speed and ease of operation and apply a powerful braking force which is under complete control of the driver.

When the driver depresses the foot pedal (or moves the hand lever) a simple controller, acting like a rheostat arm, sends electric current from the battery to an electro-magnet in the brake. This magnet, circular in shape, can revolve in either direction within a limited arc. The current energizes the magnet and causes it to cling to an armature disk mounted inside the brake drum. The armature revolves with the drum and is kept in constant contact with the magnet by means of flat springs. The farther the foot pedal is depressed, the greater is the amount of current that reaches the magnet and the tighter the magnet clings to the armature. This attraction of the magnet to the armature causes the magnet to start turning with the armature. As the magnet turns, it engages a cam lever which, in turn, expands the brake band evenly against the brake drum in the conventional way.

From a mechanical standpoint, the brake construction is simple. No complicated wiring is required—just a single wire leading to each wheel. The electro-magnetic clutch which is built into the brake trans-

to the towed vehicle skidding in one direction and the power car in another until the trailer ends up against the running board or other projecting parts of the power car, is prevented because there is no time lag between application and operation.

Current is fed equally to all brakes at the same time. Bands are expanded against the drums evenly, and as brakes on both trailer and power car function simultaneously, "pull" and side-sway are eliminated.

Weather conditions cannot affect the power of the brakes. The electric current consumed is so small that connections between power car and trailer will not short-circuit even if the bare terminal is submerged in water.

If the power car is standing still and the current turned on there is no action of the brakes. Let the wheel revolve in the slightest degree, however, and the braking power is actuated. The magnetic clutch goes into action only when the wheels are revolving.

ENCOURAGEMENT

THE pessimism of specialists in the field of heredity has painted heretofore only too gloomy a picture of the probable future of the offspring of the mentally ill. Against such a dark background, a new bright spot of knowledge shines with a heartening glow.

Mental disease is all too familiar to most of us. It is so common that few among us are now able to say that no relative or friend is unfortunate enough to need hospitalization for this pathetic type of illness. In fact, it has been estimated that one out of 22 persons in the United States may expect to become mentally ill some time during the course of his lifetime.

It is cheering to read in a recent issue of *Mental Hygiene* that the children of a parent with dementia praecox—a disease generally conceded to be at least partly of hereditary origin—have themselves an excellent chance of being normal.

In a follow-up study, Dr. Myrtille M. Canavan, pathologist to the Massachusetts Department of Mental Disorders, and Rosamond Clark, of Boston, were able to locate 117 out of 381 children of dementia praecox patients studied 10 years earlier. Only 8 of these children had ever been committed

for treatment for a mental disease so far as the investigators could find, and it may be assumed that such news would be most readily discovered. Nine were dead.

Of the 108 still living, 58 or more than half were apparently entirely normal. They had never come to the attention of hospitals, courts, guardians, truant officers, or others dealing with the incompetent. Here is the story of that other 50 who deviated from the "normal":

Epileptic, 9; insane, 3; feeble-minded, 8; backward, 6; nervous, 3; physically diseased, 3; cases of conduct disorder, 27. All but three of these "deviates" suffered from the handicap of the loss of the mother from the home, because in 47 cases it was the mother who was mentally ill.

Compare this story with that of a group of 581 children of non-psychotic parents used as a control for the investigation. In this group 2 were insane, 10 feeble-minded, 12 backward, 12 nervous, and 101 physically diseased.

Apparently the conclusion to be drawn is this: The child of a parent with dementia praecox does not have quite as good a chance of becoming a normal adult as does the child with healthy parents. But it is much more probable that he will be completely healthy and normal than it is that he will need hospitalization for mental disease during the early years of his life.—*Science Service.*

DON'T BREATHE DUST

PNEMOCONIOSIS has been in the news recently because of the claims that, at a job in West Virginia, many workers developed pulmonary diseases because of the inhalation of dust produced on the job. This problem, one which has long troubled re-



Dust cannot get through this mask

search workers in the fields of mining, quarrying, and engineering particularly, has been the inspiration for numerous inventions to prevent production of dust or to prevent its inhalation by workers. In the latter category is a newly created respirator which has the advantages of comfort, light weight, and compactness, to say nothing of its high efficiency and easy breathing ability.

As shown in the accompanying illustration, the Dupor plate respirator fits tightly to a nose of any shape, with a face cloth which may or may not be used for comfort. Two large filter pads permit easy breathing through both the nose and the mouth. These filter pads may or may not be impregnated.

One of the most important improvements is that there are no clamping or holding devices.

The filter pads have been tested by the U. S. Bureau of Mines and approved for Type A Dusts, No. BM-2111, which are the pneumoconiosis producing dusts that it is so desirable to avoid.

UTOPIAN MORSEL

THE succulent tender steaks of the skilled chef may soon become commonplace home fare, lacking only the overture of the grimacing waiter and the finale of the overgrown check. Methods of tenderizing tough meat are being investigated and eventual success seems indicated by results already obtained.

The tenderness of the smart restaurant's excellent beef has been obtained by hanging, by the natural ageing of incipient decay. Patrons would probably refuse such meat if it were delivered by the butcher on demand for specially fine steak for a holiday dinner. Its appearance uncooked is not necessarily appetizing, yet the hanging of beef and game is as old as the art of the master chef. It is perhaps unfortunate that the procedure is not readily adaptable to modern retail distribution and use.

The natives of certain tropical areas, where high temperatures make such hanging or storage impossible, are known to use other tenderizing methods. They wrap freshly killed jungle game in the leaves of the papaya plant for a few hours before cooking. The papaya contains fluids that soften or digest the proteins of the meat—in brief, proteolytic enzymes—and so their enzyme-treated meat is tender when cooked. It is materials of the same type as these papaya enzymes that are being considered in certain modern food laboratories; pepsin and trypsin, for example, have much the same action, although both affect taste adversely. Enzymes are natural products and certain of them are distributed by pharmacists as aids to digestion.

A recent patent covers the treatment of beef and other meat at the stock yards, by forcing the tenderizing fluid into the vascular system of the freshly killed stock. It is indicated that the toughest old range steer can thus be made tender. The best beef draws a premium as much for its tenderness as for its flavor; recent government blindfold tests have even revealed difficulty in distinguishing between beef, lamb, and pork. Nice questions are thus raised for food inspection authorities who will realize that many interests may be affected by any endeavor to market tenderized low-priced meat. McGraw-Hill's *Food Industries* notes a new food softener from Japan. The bottled powder, said to be made from a proteolytic enzyme, softens albuminous food within a few minutes without changing flavor or color. One packing company ages beef in a third the time ordinarily required, at the same time eliminating the customary spoilage loss. This is accomplished merely by appreciably raising the temperature and humidity of the ageing room, and preventing the otherwise heavy surface deterioration by irradiating the meat's surface with a fungicidal ultra-violet lamp offered by Westinghouse for this purpose.

Already one product said to be an extract of papaya is being offered for sale to restaurants and hotels as producing tender steaks

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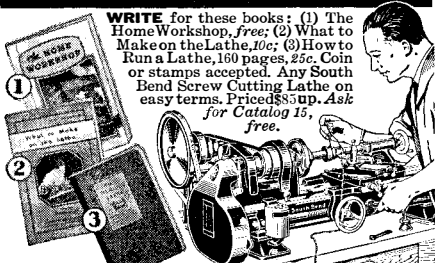
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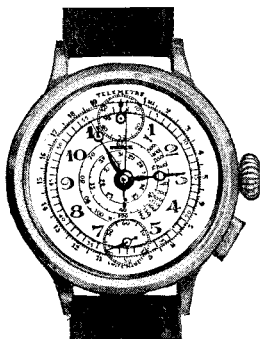
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from cheap cuts at a cost of a cent or two. The liquid is painted on the meat five or ten minutes before cooking, and it is reported that the treated steak may be cut with a fork. Whatever the merit or success of products or methods now available, there is every prospect that in due time even cheap meat will be tender.—*Industrial Bulletin* of Arthur D. Little, Inc.

MILLIONS IN THE AIR

THE air is full of tiny insects and other living matter that have been swept high above the earth by air currents, according to *Nature Magazine*. Numerous flights of airplanes carrying traps for collecting insects in Louisiana revealed that a column of air one mile square extending from 50 feet to 14,000 feet above the ground contains on an average for all seasons about 25,000,000 insects, the range being from 12,000,000 in January to 36,000,000 in May.

BETTER ELECTROPLATING OF ALLOYS

A NEW method of electroplating alloys more accurately and conveniently has been patented by Kersten and Young of the University of Cincinnati. The method, which uses an insoluble anode, has been applied to the electroplating of nickel-iron alloys from a bath kept saturated with

in composition over a long period of plating from the same solution but the composition of the alloy can be varied by appropriate changes in current density and composition of the bath. The process offers a convenient method of electroplating permalloy on electric wires.—D. H. K.

FERTILIZING FROM THE AIR

A RATHER new kind of farming—with fertilizer applied to the atmosphere instead of the soil—has been tried on a miniature scale at the Smithsonian Institution with marked success. Wheat plants were grown by Dr. Earl S. Johnston of the Division of Radiation and Organisms in atmosphere containing about four times the amount of carbon dioxide found in normal air.

It is from carbon dioxide, taken from the atmosphere, and water, that plants build up their substance through the process of photo-synthesis, which takes place in light. On clear summer days, sunlight is intense enough to increase the rate of photo-synthesis were this process not retarded by the limited amount of carbon dioxide available in normal air. With wheat in an atmosphere enriched with carbon dioxide, Dr. Johnston reports, the weight of straw, the number and weight of heads, and the number of grains were increased, in comparison with plants grown in ordinary air.

The Smithsonian wheat fields were only four square feet in area. They were enclosed on four sides with glass, leaving the tops open. Within this glass enclosure, around the growing plants, a fairly constant stream of carbon dioxide was kept in circulation.

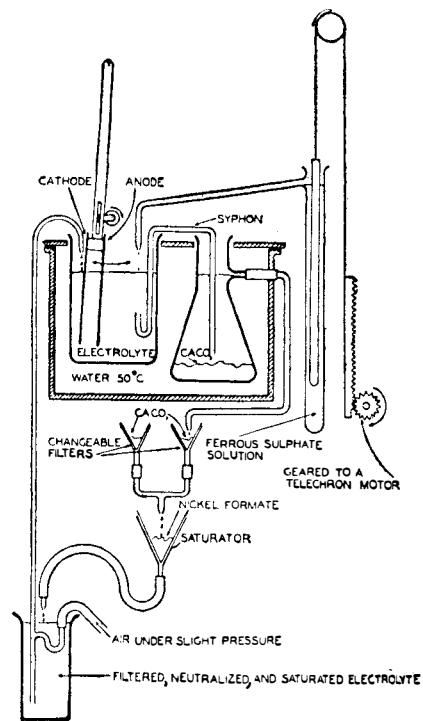
Dr. Johnston says in his report: "The practical application of this type of fertilization in field experiments and the supply of carbon dioxide in sufficient amounts for practical field work are still unsolved problems, in spite of the work that has been done. While experiments in which carbon dioxide is used as an aerial fertilizer are of importance scientifically, the practical application of this type of fertilizer in commercial work is far from satisfactory, although its application to greenhouse culture appears to be most promising."

Because of the problem of confining the gas over large areas in open fields, he points out, there is at present little practical application of his results to open-air farming.

HOW IT FEELS TO FALL

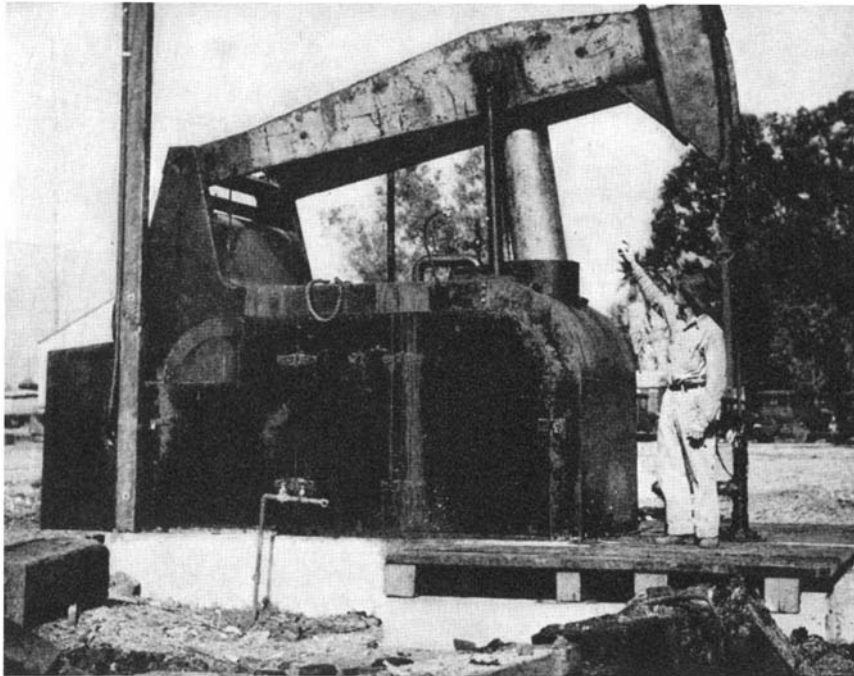
AN excellent and scientific account of a free falls (that is, falls prior to opening of a parachute) is given by Captain Harry G. Armstrong, M. D. of the Army Medical Corps in the *Journal of the American Medical Association*. Captain Armstrong allowed himself to fall for 11 seconds over a distance of 1200 feet before opening his chute.

His report of his reactions is distinctly encouraging. "Throughout the free fall, all conscious mental processes seemed normal. As soon as the airplane was cleared, fear and excitement disappeared. Consciousness was unclouded and ideation was rapid, precise, penetrating, and clear. There was no nausea or vertigo, although I am quite susceptible to both from any swinging or tumbling motion or disorientation. There



Apparatus for electroplating alloys

nickel formate to which ferrous sulfate solution is added continuously. The acid formed by the process of electrolysis is continuously neutralized by passing the solution over calcium carbonate. The new process produces an alloy of uniform composition which was difficult to secure by older methods. The inventors state that the process is limited to those cases where one of the materials can be plated from a saturated solution, where the solutions do not react disadvantageously with each other, and where a suitable neutralizing substance can be used. The plate shows trifling variations



Photograph from Mirzoeff

Possibly less picturesque in appearance than some of the more familiar oil-field equipment, but certainly more efficient, is this newly developed hydraulic-electric pumping unit used for heavy-duty service in Los Angeles oil fields. Not only does it have greater capacity, but it is practically silent in operation

was none of the empty or 'gone' feeling in the abdomen so common in elevators or airplanes. Breathing was even, regular, and undisturbed."

No doubt this will encourage many of our readers to try a parachute jump at the very earliest possible opportunity!—A.K.

STUTTER INTENTIONALLY TO STOP STUTTERING

IF you stutter, learn to stutter well. Once you have become an expert stut-terer, you will find you can speak without stuttering. This is the advice given by Prof. Herbert Koepp-Baker of Pennsylvania State College to stuttering students, says *Science Service*. He announced that this rigorous program of self-discipline has proved successful in helping stutters and stammerers overcome their speech difficulties.

The stuttering-on-purpose method is only one part of a broad program for correct-ing speech defects which is available to students at the college and to persons in other communities throughout Pennsylv-ania. The program also includes tests for right- or left-handedness and gradual train-ing of the stutterer to use the hand nature intended him to use, as shown by the tests.

DROUGHTS DON'T LAST FOREVER

THE great farming and grazing area of the north central United States last summer was near the bottom depth of what appears to be a 46-year precipitation cycle in some way associated with cyclic variations in the radiation output of the sun. This is indicated by records of the water levels of the Great Lakes since 1837.

The 1934 and 1936 droughts constitute what is perhaps the most striking evidence to date of the validity of the now celebrated

23-year weather cycle, the discovery of which was announced three years ago by Dr. Charles G. Abbot, Secretary of the Smithsonian Institution, after intensive analysis of world weather records and other climatic data. The discovery announced by Dr. Abbot was, in brief, as follows:

Temperature and precipitation variations at any particular place on the earth's sur-face have a marked tendency to repeat them-selves every 23 years, which is double the 11½-year sunspot cycle well known to astronomers. This actually has happened in the north central United States, the water level records show, in the four 23-year periods since 1837. The general contours of the curves of the water-level variations for each of the 23-year intervals are very similar.

It so happens, however, that the most extreme variations repeat at 46-year inter-vals, or double the 23-year cycle, in that particular area.

In 1837-38, as is shown best by the chart of Lake Huron published by Dr. Abbot, the level was very high, indicating an abundant rainfall all over the drainage area of this body of water. There was a steady decline from that point, the climax being reached about 1848. Rainfall then increased steadily for approximately five years, after which there was a minor decline and another up-ward swing, continuing until the end of the 23-year period in 1859.

The next cycle included the years from 1860 to 1882, inclusive. Its features were approximately the same as to time, but the extremes of drought and precipitation were much less marked. The depth of the dry weather came in about 1872, but apparently was not sufficient to cause much excitement.

The next cycle was that from 1883 to 1905. The extremes were much more marked. The general pattern very closely duplicated that of the 1837-1859 cycle. The depth of the drought was reached about the years 1898-99. Records show that this drought

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was almost as bad as that of 1848—a striking confirmation of the 46-year cycle theory.

The period from 1906 to 1928, inclusive, shows a curve very similar in its general pattern to that of the 1860-1882 period. The present 23-year interval started in 1929. According to the 46-year cycle hypothesis the region should have been getting drier and drier ever since. It has. If the cycle continues true to form the low point should be reached some time between 1938-1940, followed by a rapid upswing.

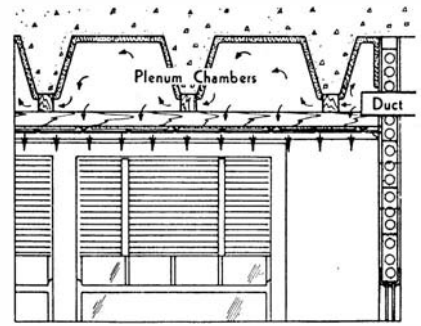
The cycle hypothesis, Dr. Abbot says, gives no support to pessimists who predict that the great drought area will be converted into a permanent desert. There is every reason to believe that history will repeat itself and that the depths of the present drought will be exceeded, at the most a few years hence, by peaks of precipitation.

ACOUSTICS AND VENTILATION

THE rapid development of air conditioning has created new problems of distribution, many of which are not easily solved with the present types of duct systems and ventilating grilles. When air conditioned rooms must also be acoustically treated, the situation increases in complexity.

A new system of air distribution which solves, with one type of construction, the dual problem of air circulation without drafts and the quieting of occupational room noises, has been devised by the C. F. Burgess Laboratories, Inc.

This system comprises a perforated ceiling made of a suitable architectural surface installed slightly below the normal ceiling level of the room. Between the perforated sheet and the room ceiling is a sound-absorbing material that is installed with suffi-



Side elevation showing plenum chambers and Acousti-Vent ceiling

cient clearance so that a space is provided between this sound-absorbing material and the ceiling. This space provides a plenum chamber into which air is introduced through ducts from the ventilating fan. A uniform, low static pressure is maintained in this plenum chamber and suitable means are provided to cause the air to pass to the underside of the sound-absorbing material without passing through it, and thence through the myriads of small openings in the perforated sub-ceiling into the room.

Air flows imperceptibly and uniformly through the perforated ceiling into every part of the room, affording accurate temperature control. Tests indicate that there is no appreciable temperature variation throughout the room. Due to the large ceiling area and the low air velocity at every point, the Acousti-Vent system makes possible a rapid change of heated or cooled air without drafts, a feat not possible when air is forced into a room at concentrated points through conventional duct systems.

The second major feature of the Acousti-Vent system is its high efficiency as a sound absorbent. Room noises, upon reaching the perforated metal ceiling, seep through the small perforations and encounter the resilient sound-absorbing material placed behind the perforations. These sound waves are instantly absorbed, causing a marked reduction in the noise level of the room. In addition to absorbing room noises, Burgess Acousti-Vent also absorbs the noises of the ventilating system.

COPPER IMPROVES LEAD

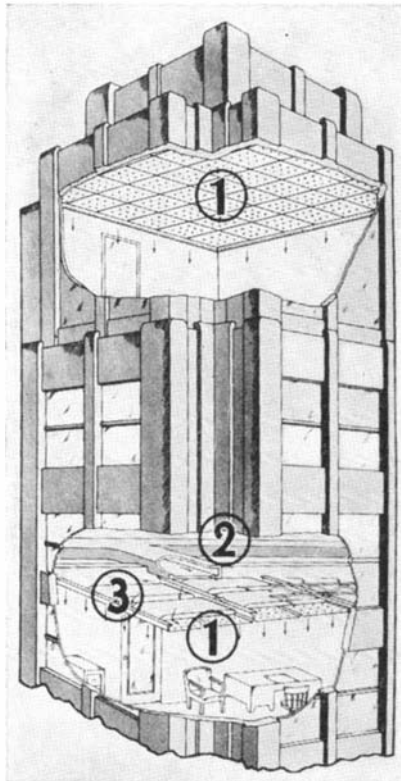
ADDING 0.06 percent of copper to common lead improves its physical characteristics and its resistance to general corrosion.—D. H. K.

NO CHANCE?

HORATIO ALGER made a name for himself by writing books about something that is peculiarly American—the fact that every man in this country has a chance to win fame and fortune no matter what his start in life. In recent years, however, a lot of malcontents and demagogues have been taking advantage of the depression to insist that all that is changed.

The facts are that the depression slowed up the speed with which everybody was getting ahead. But something that happened in West Virginia the other day shows that the country of which Horatio Alger wrote still exists.

Twenty-two years ago, a lad of 15 went to work at the bottom of the ladder in the Carnegie Steel Company plant at Sharon, Pa. He served in the World War as an



A typical installation of Acousti-Vent. (1) Perforated ceiling. (2) Air duct. (3) Sound absorbing pads

aviator, and afterward for a time traveled around as a "barnstorming" stunt flier.

Later, this same lad, then a young man, worked as a mechanic, a riveter, and a salesman. In 1925, he joined the Weirton Steel Company as a salesman. In January, 1929, he became assistant sales manager; in May, 1931, he was appointed assistant to the President, and in July, 1934, he was elected a vice-president.

The other day, the Weirton Steel Company elected that same man as its President—T. E. Millsop. He probably is, at 37, the youngest high executive in the steel industry.

His start from scratch, and his rise to the presidency of one of the biggest steel companies in the land is just one of thousands of similar cases. But the malcontents and demagogues cannot afford to admit it for such an admission would make their arguments look as silly as they are.—*Industry.*

HARDENED COPPER

A COPPER alloy containing about 2 percent of chromium when properly heat-treated has a highly increased strength and hardness, yet retains 80 to 90 percent of the heat conductivity of pure copper.—*D.H.K.*

AERATING, SEPARATING FOUNDRY SAND

ANNOUNCEMENT of a new foundry sand preparation unit, to be known as the "Sep-Aerator" because it performs automatically the two-fold function of (1), properly aerating and mixing the sand before delivery to molder's hoppers, and, (2), separating from the sand, such shot metal, pebbles, and small refuse as may not have been caught by screen or magnetic pulley, has been made by Link-Belt Company. This separating feature is of particular value in non-ferrous foundries, where it is not possible to remove metallic shot by magnetic attraction.

The operating principle is illustrated in one of our drawings, which also shows that the unit is one of few parts—a power-driven paddle-type beater, with sand and refuse collecting and discharging media, all enclosed within a steel housing, which is fitted with an air-release pipe and other suitable means for preventing any blast of air along

the belt conveyor which receives and carries the aerated sand away from underneath the machine, to the respective molder's storage hoppers.

The position of the beater shaft—with its paddles which throw material according to weight—can be adjusted horizontally as required to give proper control of direction of the sand stream. After the beater shaft has been correctly located, the flow-regulating plate is adjusted to split the stream of sand and refuse at the desired point.

INSECTS LIVE FOODLESS FOR A YEAR

INSECTS can live incredibly long periods without food, according to the American Institute of Sanitation, New York City. In an experiment to determine the endurance powers of insects, an entomologist kept bedbugs alive and fairly active for one year without any food whatsoever, reports the institute.

"This remarkable vitality probably explains the great prevalence of bedbugs, or red rovers as they are sometimes called," continued the institute. "In unoccupied houses the insects can exist for months. It would be no great feat for one to creep into a church pew on Sunday, for example, and then journey to a new home a week or two later, fasting during the interval.

"Not only do bedbugs have great fasting powers, but they are probably the most traveled of all the wingless household pests. Many a neat housewife is amazed at the occasional invasions of her home. Yet investigations of entomologists have disclosed that the insects easily enter the home in the laundry, packages from the store, and on the clothing of members of the family. Favorite gathering places for bedbugs are theaters, especially those with upholstered seats. All the large hotels are forced to maintain staffs to keep the pests under control. Sleeping cars on railroads are regularly treated to combat the insects.

"No home is immune from invasion of the pests, but no neat housewife need board them for long," continues the institute. "Modern science has perfected efficient powders, sprays, and liquids to combat red rovers. If such weapons are used both as a preventive and a cure, the careful housewife need have little fear of the pests.

"Although called bedbugs, they do not



DO YOU THINK IN CIRCLES ?

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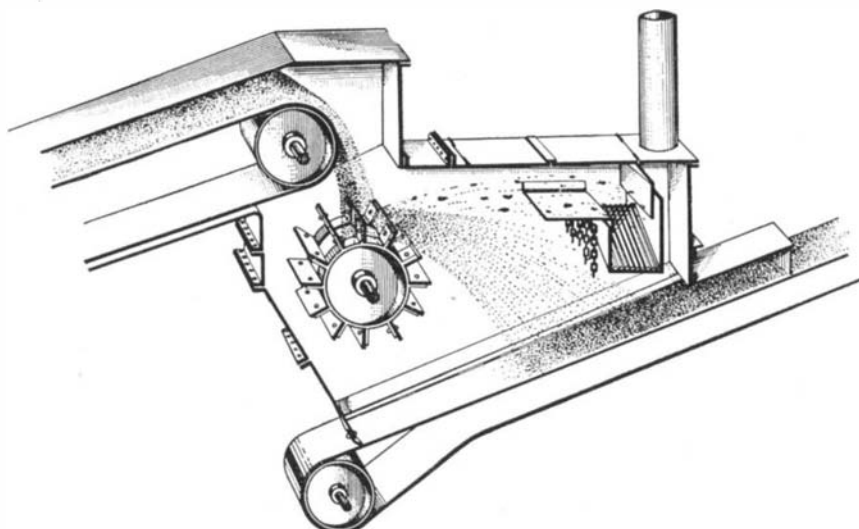
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all live in beds. Very frequently the largest nests will be found under loose edges of wall paper, under the molding, behind pictures, and in cracks in the floor. Such hide-outs should receive attention when fighting the pests."

A CAPTIVE BALLOON NETWORK

IT IS impossible, unfortunately, to avoid giving prominence to military aeronautics, with rumors of wars so frequent and persistent. Now that bombers seem to be in the ascendancy, both the British and the French are seeking every possible means of protecting their cities, and both nations are investigating the possibility of a defensive network of cables to be suspended from captive balloons. Such a network would consist of some 30 cables, strung a few yards apart and held aloft by captive balloons. Cables would also be strung one under the other, forming a species of wall in the air. Of course, the chance of the enemy running into the cables is small, but it would give the pilots something else to worry about, and force them to fly at higher altitudes. We seem to remember that a similar device was under consideration by the British during the World War.—A.K.

LONG-WEARING BEARING METAL

A NEW alloy automobile bearing which will outlast the best babbitt metal bearings now in use three to one times was announced at the opening session of the National Metal Congress. The new long-wearing alloy, according to *Science Service*, is a mixture of cadmium, silver, and copper. It was described by C. F. Smart, metallurgist of the Pontiac Motor Company. Used as bearing material in motor cars, the alloy outlasted babbitt bearings three to one under the most severe driving test conditions. Two things only check immediate adoption of the new alloy, Mr. Smart indicated.

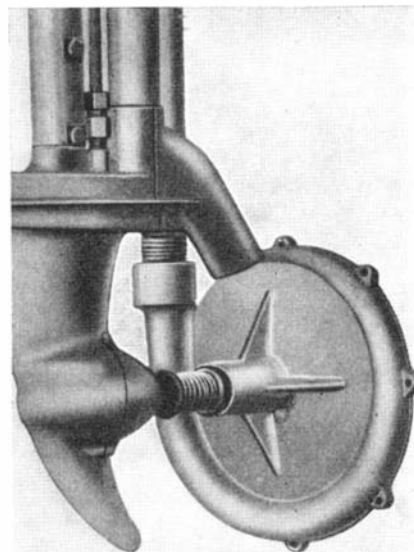
Since the alloy contains silver and cadmium, its price changes with the prices of these metals. Cadmium, which sold for years at 55 cents a pound, has now jumped to a

dollar a pound because of the demand for the metal in bearings. Future technological developments and a reduction of the use of cadmium in a number of plating processes are expected to lower the price of the metal in the future.

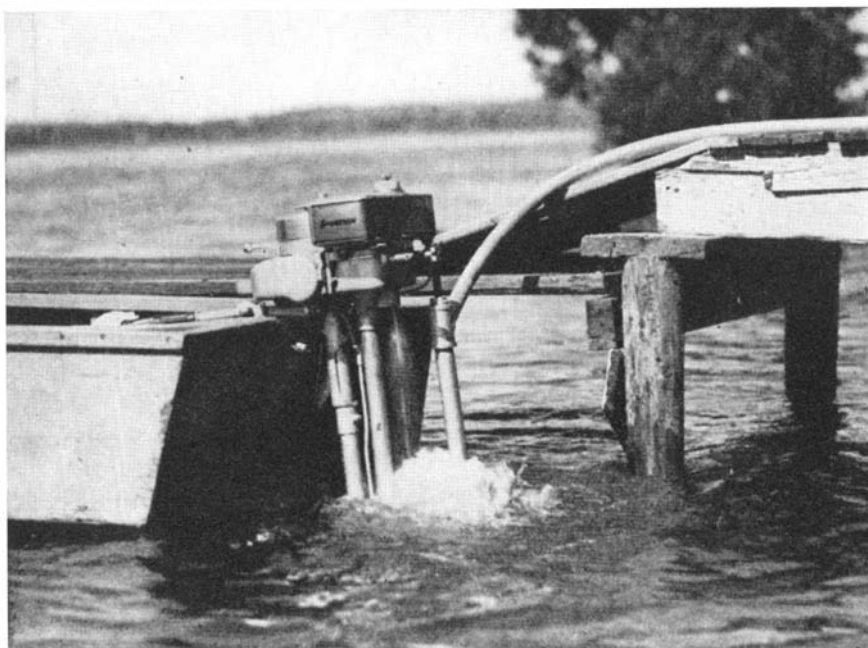
A second factor preventing immediate use is corrosion caused by organic acids in lubricants. Excellent co-operation is now under way, indicated Mr. Smart, between the petroleum and automobile industries to iron out this difficulty.

OUTBOARD MOTOR DRIVES A PUMP

ATTACHED in a jiffy to the propeller shaft of an outboard motor, a compact, foolproof, centrifugal pump supplies cottage, garden, lawn, and so on, with an adequate water supply. The smallest single-cylinder outboards supply a full stream through a single hose as much as 250 feet long. Small twin motors will handle two streams. An old barrel, elevated for a grav-



Above: Pump attached to the lower unit of an outboard motor. Below: The motor, attached to the stern of a boat, pumping water ashore



ity supply system, can be filled rapidly and provides excellent fire protection.

Converting the outboard for temporary pumping enables the owner to salvage the "extra life" of the engine while it is not in boating use. The cost of these pumps is low.

POLYMOLECULAR FILMS AND A NEW APPARATUS

REMARKABLE characteristics of oil films in water are revealed by a newly developed apparatus of high accuracy. This has been used by Harkins and Myers of the University of Chicago to trace for the first time how a film one molecule thick, or about 1/30,000,000 of an inch in thickness, can be changed into a liquid in bulk.

Certain oils of vegetable or animal origin spread on a clear water surface to a film one molecule thick, while a pure mineral oil will not spread at all. A small amount of vegetable or animal oil, added to a pure mineral oil, causes the oil to adhere much better to steel and thus improves greatly the lubricating characteristics of the oil.

Such mixtures have a wide use in the lubrication of automobiles. It is just such mixtures which have been found to give rise to films more than one molecule thick: that is, to polymolecular films.

That such films can exist is contrary to the theories held by workers in surface chemistry, but that they are easily formed is now proved.

One ounce of certain vegetable oils will spread over and cover completely three and one half acres of water surface with a lightly packed oil film one molecule thick. The molecules are held together in the film by their attraction for each other, or by cohesion.

If the oil molecules are shorter, they attract each other less and also vibrate more

rapidly and the result is that one ounce of oil will now cover completely eight acres. This is called the expanded state of the film.

In the tightly packed film the molecules stand upright like the people in a tightly packed crowd: in the expanded state the molecules lean over and occupy more room. Other types of molecules lie flat on the surface, so that in a tightly packed film one ounce of oil covers 15 acres, and in an expanded state will cover about 20 acres of water.

The characteristics of films are of great importance in connection with the manufacture of paints and of laminated glass, in color printing, in the flotation of ores, and in many other industries, and especially in biology and medicine.

SMOOTH BELT JOINTS

A NEW non-metallic belt lacing, Tek-Lace, gives the safety, efficiency, and durability of endless belting, plus the convenience, low cost, and ease of application of ordinary belt fastenings. It is used for fastening flat belts or V-belts.

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

MINERAL RESOURCES OF THE REGION AROUND BOULDER DAM. An appraisal of the mineral resources of the region with respect to their probable availability as the basis of industries that would consume power generated at Boulder Dam. United States Geological Survey Bulletin 871. Superintendent of Documents, Washington, D. C.—45 cents (coin).

BULLETIN OF THE TEXAS ARCHEOLOGICAL AND PALEONTOLOGICAL SOCIETY. Eighth annual bulletin of an association of amateur archeologists which has earned a place close to the borders of professional work. Illustrated, 200-page paper-covered book describing finds in Texas. Dr. Cyrus N. Ray, Box 594, Abilene, Texas.—\$3.00.

TAKING PICTURES AT NIGHT will serve to guide the amateur photographer in the use of proper exposure for outdoor scenes after dark and for theater photography. Several excellent examples are given, together with information as to how the photographs were taken. American Photographic Publishing Co., 428 Newbury Street, Boston, Massachusetts.—40c postpaid.

ARTESIAN WATER IN THE FLORIDA PENINSULA (Water-Supply Paper 773-C, U. S. Geological Survey), by V. T. Stringfield. Readers desiring to understand the geology and hydrology surrounding the proposed Florida ship canal will find it here—without any reference, however, to the canal question. Superintendent of Documents, Washington, D. C., 20 cents, cash.

THE NEW ARC WELDING TECHNIQUE describes in text and photographs various types of arc welding equipment and accessories, together with specific applications. It gives a technical description of the new type of welding control. Write for Bulletin 237A, Scientific American, 24 West 40th Street, New York City.—3 cents.

THE SHORTAGE OF WATERFOWL, by Ellsworth D. Lumley, is Publication No. 58 of the Conservation Series issued by The Emergency Conservation Committee: This eighteen-page pamphlet is devoted to a discussion of the problem in an attempt to come to a satisfactory solution, to suggest possible methods of saving our waterfowl, and to understand the true meaning of sportsman-

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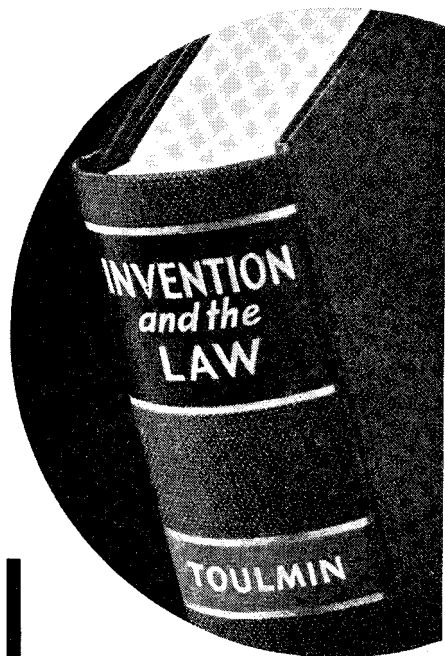
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THIS NEW BOOK is a practical manual on patentable invention, for engineers, executives, attorneys and the interested layman.

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THE BRITISH RAILWAYS, by Alex. Newlands, is a book of 134 pages with stiff board covers that tells in considerable detail the story of transportation from the days of the pre-historic highways—mere paths—through the Roman roads and canals, to the railways of today and tomorrow. *Longmans, Green and Co., 114 Fifth Avenue, New York City.*—\$3.15 postpaid.

KITCHEN TEMPERATURES, by Anne Pierce, tells the story of controlled heat and cold and their contribution to kitchen efficiency and comfort. It also gives many hints as to the proper arrangement and use of kitchen equipment. *The Temperature Research Foundation of Kelvinator Corporation, 420 Lexington Avenue, N. Y. C.*—*Gratis.*

EXCLUDING BIRDS FROM RESERVOIRS AND FISHPONDS deals with a problem that betsets everyone who endeavors to raise fish in either large or small outdoor ponds. Illustrated with photographs and drawings. *Superintendent of Documents, Government Printing Office, Washington, D. C.*—5 cents.

THE ORIENTAL INSTITUTE OF THE UNIVERSITY OF CHICAGO is an illustrated handbook describing the scope, purpose, and history, as well as the field work of a noted archeological institution which maintains several expeditions in the Near East.—*The Oriental Institute, University of Chicago, Chicago, Ill.*—35 cents.

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PICTOGRAPHS AND PETROGLYPHS OF THE HIGH WESTERN PLAINS, by Prof. E. B. Renaud. A book concerning Indian pictographs, their nature, meaning, age, location, and so on, in the regions of Colorado, Wyoming, South Dakota, and New Mexico, written as an answer to many requests for

general information on this subject. *Department of Anthropology, University of Denver, Denver, Colorado.*—75 cents.

SUBGRADE DRAINAGE FOR MODERN ROADWAYS deals with the necessity for and methods of obtaining a dry, stable subgrade. A number of photographs and comprehensive drawings illustrate the 32 pages of text. *Armco Culvert Manufacturers Association, Middletown, Ohio.*—*Gratis.*

A HISTORY OF THE NEW YORK STATE COLLEGE OF FORESTRY AT SYRACUSE UNIVERSITY, in 176 pages plus a map of New York State, outlines in detail the history and present activities of the college. *The New York State College of Forestry, Syracuse University, Syracuse, New York.*—\$1.00.

TRAPSHOOTING HINTS gives information of value to shotgun shooters who are striving to improve their scores. 32 pages of suggestions by experts. *E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware.*—*Gratis.*

HOMES OF ENDURING BEAUTY BY WEATHER-BEST deals specifically with the use of stained shingles for homes. Shingles, when properly stained, have excellent weathering qualities and keep their pleasing appearance even after long years of use. The booklet gives many illustrations of shingled homes and describes several stains and opaque coatings for exterior use. *Write for Bulletin 237C, Scientific American, 24 West 40th Street, New York City.*—3 cents.

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RAIL SERVICE AND ITS COST is an eight-page pamphlet specifically addressed to farmers who have a definite interest in cheaper transportation for their products. *Association of American Railroads, Transportation Building, Washington, D. C.*—*Gratis.*

LEGAL HIGH-LIGHTS

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

By **ORSON D. MUNN, Litt.B., LL.B., Sc.D.**

New York Bar
Editor, Scientific American

WHOSE NAME?

YOUR right to use your own name is not without legal limitations. Thus if your name has been used as a trade name or as a trade mark for an article of commerce and has become well known as such (for example, Waterman and his famous ink), you can not use your name on a competing product without taking reasonable precautions to disassociate your product from your illustrious protonym.

A hat manufacturer whose hat bears a name which has become indelibly associated with men's hats, recently brought suit against a competitor having the same surname but a different given name. The competitor used his full name, that is, given name, surname and middle initial, in association with his product. However, the Court said that the surname had become so well known to the public in the manufacture and sale of hats that it had acquired a secondary meaning and that it was necessary for the competitor, who was a newcomer in the field, to distinguish his product from the original seller of hats bearing that surname. The mere use of the given name and middle initial of the competitor was held to be insufficient to properly distinguish his product. In reaching this conclusion the Court made the following statement:

"We do not understand that the right to use one's own name is absolute unless fraud is consciously planned. A newcomer whose name will cause the public to confuse his product with that of an established competitor may be required 'to take reasonable precautions to prevent the mistake.'"

PAPER PATENTS

THE patent statutes of the United States do not discriminate in any way between those patents which go into commercial use and those which, for one reason or another, are never commercially exploited. It is the policy of the patent laws of many countries to penalize patentees who do not exploit their inventions. Thus some countries have provisions whereby a compulsory license can be secured if a patented invention is not exploited within the country within a fixed time limit. Other countries have provisions whereby a patent may become forfeited or may be cancelled if it is not commercially exploited.

The policy of penalizing a patentee who does not exploit his invention has not been incorporated in the United States patent statutes. As a practical matter, however, the Courts, in suits for patent infringement, distinguish between those patents which have met with commercial success and so-called paper patents (that is, patents which

have never been commercially utilized). In a recent case in the Circuit Court of Appeals for the Third Circuit, the attitude of the Courts towards paper patents was clearly stated as follows:

"It (the patent) is now over nine years old and is still a mere paper patent. It is accordingly entitled only to a strict construction confining its scope to the particular device disclosed."

The policy of the Courts is to construe strictly those patents which have not gone into use and, on the other hand, to give a more liberal interpretation to those patents which have met with great commercial success. This attitude is both fair and logical because it is reasonable to assume that those patents which have met with commercial success are based on inventions of great merit, while those which have not gone into commercial use in all probability relate to inventions that have considerably lesser merit.

PRICE FIXING

THE American law has been traditionally opposed to any attempts to fix the selling price of articles of commerce. Accordingly, the recent unanimous decision of the United States Supreme Court upholding the so-called fair trade or price fixing law of the State of Illinois is of great importance.

The Illinois statute purports to legalize contracts for the sale or resale of commodities identified by the trade mark, brand, or name of the producer or owner, notwithstanding that such contracts provide that the buyer should resell at a price stipulated by the vendor, and that the vendee of such a commodity in turn shall require, upon the sale to another, that the purchaser agree to resell at a price that is fixed by the vendor.

The statute further provides that willfully and knowingly advertising, offering for sale, or selling of any commodity at less than the stipulated price, is an act of unfair competition.

The decision of the Supreme Court was rendered in two suits for unfair competition, in which it was alleged that retail liquor stores had sold commodities identified by the trade mark of the producer at prices lower than those stipulated by the producer. The retail liquor dealers contended that the Illinois statute was in violation of the Fourteenth Amendment of the United States Constitution. The Supreme Court rejected this argument and sustained the statute.

About one year ago the New York State Court of Appeals decided that certain provisions of a similar fair trade law in the State of New York were unconstitutional.

It will be very interesting to see whether the New York State Courts change their attitude in view of the decision of the Supreme Court.

One point which has not been definitely decided by the Supreme Court decision is the validity of contracts made under such fair trade statutes which attempt to fix the resale price of trade marked articles sold in interstate commerce. Price fixing contracts affecting interstate commerce have heretofore been held to be in violation of the Sherman Anti-Trust Law. The State Legislatures can not, of course, legislate with regard to interstate commerce. Regardless of this, however, statutes such as this should prove to be an effective instrument in eliminating price cutting and in stabilizing prices.

FLEXIBLE 17 YEARS

A PATENT purports to confer upon the patentee the exclusive right for 17 years to manufacture, use, and sell the article, machine, or method covered by the patent. The owner of the patent, however, may inadvertently curtail the effective life of the patent. Thus where the owner of a patent fails to take action against an infringer and tacitly permits him to infringe the patent for many years and build up a large business in the patented product, he can not enforce the patent against that infringer.

In a case involving patents relating to shoe manufacture, the owner of the patents failed to take action against the infringer for a period of over eight years and knowingly permitted him to build up a large business based on the patented invention. Because of this delay the Court refused to grant relief to the owner of the patents, stating:

"For a period of eight years defendant and its predecessor were lulled into security by plaintiff's failure to sue. Plaintiff has failed to give satisfactory explanation of its inaction. At this late date after defendant's investment it is inequitable that defendant should be called to account."

A ROSE BY ANY OTHER NAME

CAN any one secure a legally protected monopoly on an odor? Hardly. However, in suits for unfair competition one of the elements which the Court may take into consideration in deciding whether a manufacturer has too closely simulated the merchandise and packaging of a competitor is the similarity in odor of the competing products.

In a recent case in the United States District Court for the District of New Jersey, a manufacturer of a rather well known hair tonic alleged that a competitor was unfairly competing with him in selling a product which simulated his hair tonic too closely. In reaching a decision the Court stated that it was necessary, among other things, to take into consideration the respective odors of the competing hair tonics. In this connection the Court stated as follows:

"Plaintiff's right to relief depends upon a combination of factors in which color, odor, bottle, and label play a part, and they must be so combined by a competitor as to mislead the average person before this Court will grant equitable relief."

Books SELECTED BY THE EDITORS

THE ART OF CONVERSATION

By Milton Wright

WHILE there are many who don't get ahead because they talk too much, millions feel inferior because they are inarticulate, or are inarticulate because they feel inferior. The author of this helpful book, a former member of the staff of this magazine, is a perfect conversationalist, and he tells others in a practical way how to learn to appear equally intelligent. "Getting Started," "Just the Two of You," "When the Talk is General," "Developing Repartee," "How to Tell a Story," "Learning to be Tactful"—these are some of the aspects of the art of conversation he deals with. No doubt this book would help some of the dumb-struck to break the jinx of their troubles and cause the full current of their lives to flow ahead.—\$2.65 postpaid.—A. G. I.

ENGINEERING AERODYNAMICS (Revised Edition)

By Lieutenant Commander Walter
Stuart Diehl

WHEN "Engineering Aerodynamics" appeared in its first edition it immediately became the standard source of reference for practicing aeronautical engineers and students alike. The revised edition undoubtedly will have the same successful reception. A vast, almost overwhelming body of aerodynamic knowledge has become available as a result of wind tunnel studies and airplane construction. Commander Diehl's task for many years in the Bureau of Aerodynamics has been to reduce such knowledge to the practical service of design engineers and his book renders the same service admirably to a far wider circle. The reader is not burdened with abstruse theories (although fundamental principles are clearly set forth) but given the most up to date, complete and reliable information on applied aerodynamics in such form as to make it immediately utilizable. An altogether admirable text, which is further enhanced by numerous references and a fine index.—\$7.25 postpaid.—A. K.

PICTORIAL LIGHTING

By William Mortensen

IT has been a long step from the original uncontrolled light of the sun used by the first photographers to the intense and controllable lighting of the present day. In this volume are presented the

fundamentals of controlled lighting for the photographer and numerous photographs and drawings showing how to achieve certain effects.—\$2.15 postpaid.—A. P. P.

THE NEW MAGICIAN'S MANUAL

By Walter B. Gibson

IF YOU are one of those people who would like to shoot "the life of the party" for monopolizing the attention of everyone, do all you can to prevent him from getting a copy of this excellent book. It would make him too insufferably clever. Better yet—get a copy yourself and beat him at his own game. This manual is a unique guide to parlor magic, containing complete and easily followed instructions for over 100 mystifying tricks. Furthermore, it contains the actual apparatus (in a bound-in envelope) required to do these tricks. In addition, there are programs and routines for the budding magician and samples of patter for those who are tongue-tied.—\$3.25 postpaid.—F. D. M.

THE RENAISSANCE OF PHYSICS

By Karl K. Darrow, Ph.D., Research
Physicist, Bell Telephone Laboratories

DARROW'S abilities as a popular writer are widely recognized. His is an unusually lucid style. In this book he discusses atomic physics: structure of the atom, mystery of waves and corpuscles, transmutation, victory over the elements, and the unity of nature. Readers who find that some of the popular attempts to render these subjects perfectly simple are a bit empty will like this book better, for it has quite a lot of substance to it.—\$3.15 postpaid.—A. G. I.

THE RIDDLE OF WOMAN

By Dr. Joseph Tenenbaum

THIS is a scientific book but it manages to include plenty of things that make interesting reading on their own account—if you get what is meant! But it is not one of the many extant "dirt" books which are deliberately labeled "scientific" only in order to get by various censors, including the one in the purchaser's mind. The office speaker-out-of-turn calls it "a scientific book that isn't soporific." Here are some of the chapter heads: Woman's Sex Psychology; Sex Urge in Woman; The Wife; The Bride; The Unmarried Wife; The Divorced Wife; The Widow; The Vir-

gin; The Spinster; The Psychology of Woman; The Angel, Gossip, Criminal; Witch; The Beautiful Woman; The Prostitute. Total, 465 pages. The author's point of view is somewhat more cynical, realistic, and pragmatic than idealistic and emotional or traditional. But, even after reading the whole book, this reviewer still doesn't understand women.—\$3.70 postpaid.—A. G. I.

SECRET WRITING

By Henry Lysing

NO more can be said about this book than that it provides for code addicts a vast array of cryptograms, codes, and other methods of concealing the actual meaning of written words. 118 pages of compact information.—\$1.15 postpaid.—A. P. P.

RICH LAND, POOR LAND

By Stuart Chase

A STUDY of waste in the natural resources of America, which has been well received by most scientists who deal with this field of work, even though some aspects of it involve planned economy, the TVA and other things concerning which 26,000,000 of us sometimes disagree with 16,000,000 of us. Whether we agree on these factors, all do agree that our soil is our fundamental source of wealth, and that we shall be fools if we let it go to ruin. Mainly this book is a study of basics regarding which most of us will agree to agree.—\$2.65 postpaid.—A. G. I.

HOW TO WRITE A MOVIE

By Arthur L. Gale, Editor of "Movie
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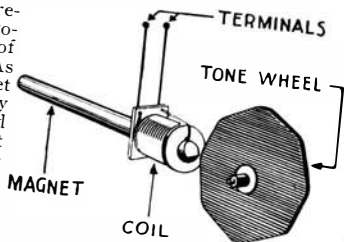
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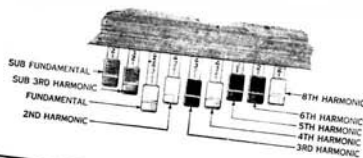
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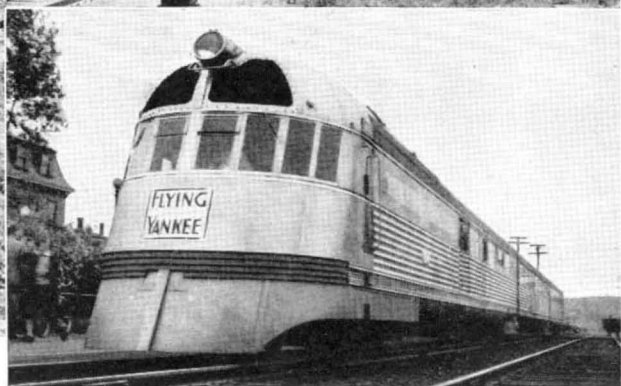
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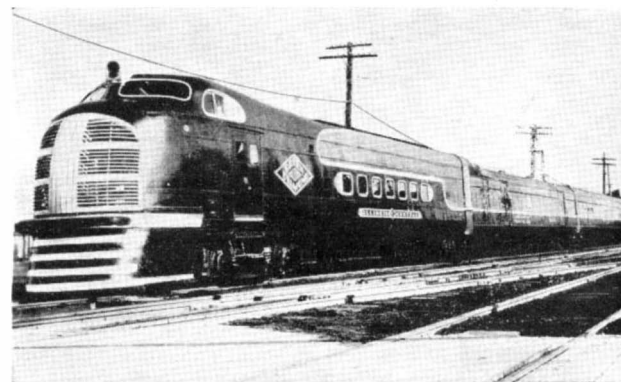
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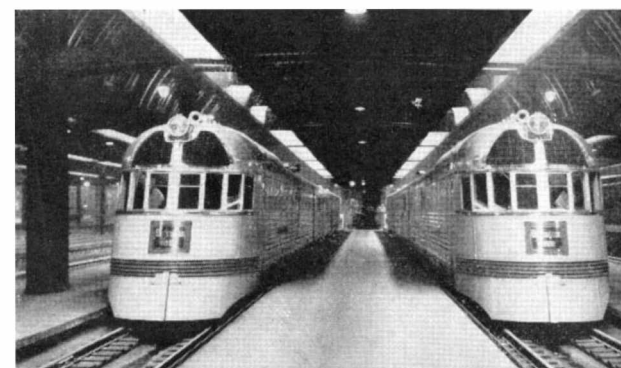
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