New Ideas—The Life of Industry

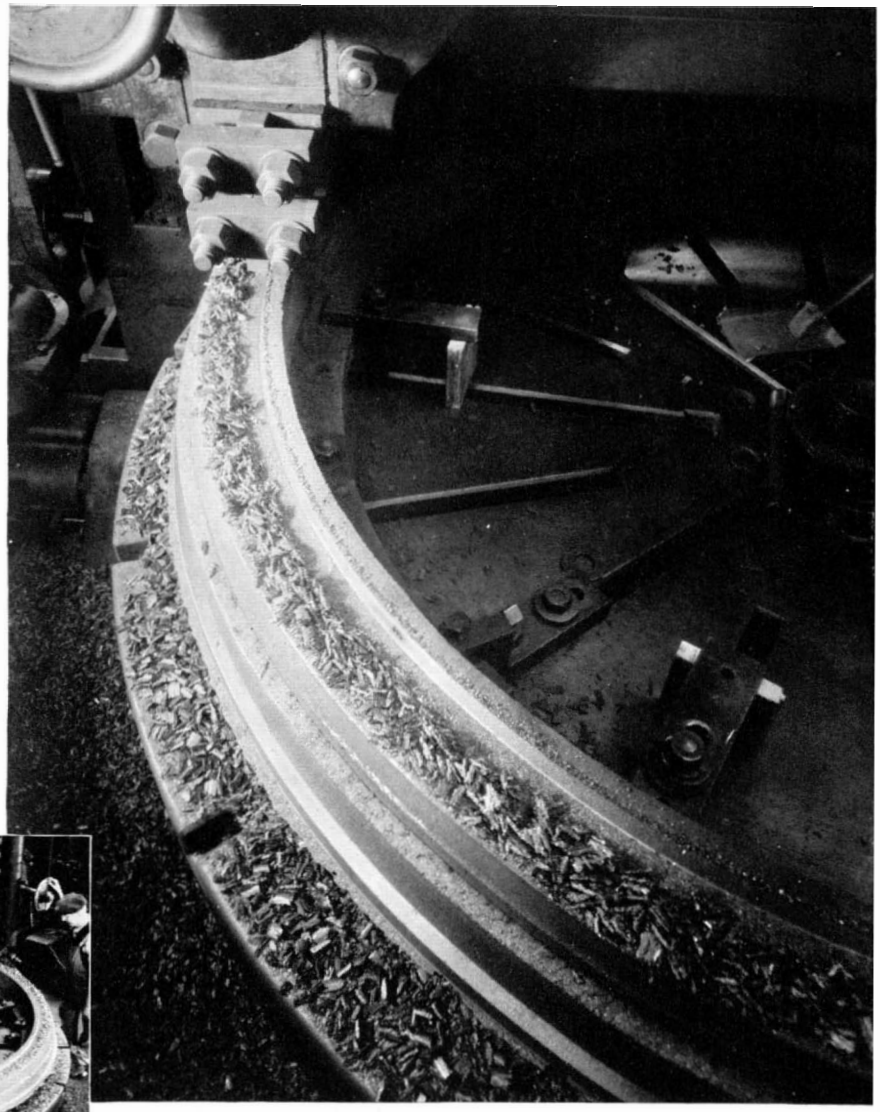
Shall We Reform Our Calendar?··Man's Insect Allies

SCIENTIFIC AMERICAN

June • 1931 ★ 35c A Copy

TRIANGULATION—BUILDING THE BACKBONE OF ACCURATE MAPS

Where PERFORMANCE depends upon PRECISION . . .



A giant boring mill made by William Sellers & Company, Philadelphia, and equipped with SKF Anti-Friction Bearings... That gears may mesh properly, that cutting mechanisms may produce a better and more accurate finish, that disastrous vibration may be eliminated...that all of these essential factors may be obtained not only in the beginning but throughout the life of a machine...are just a few of the reasons why one hundred and forty-three manufacturers of machine tool equipment select SKF Bearings . . . PRECISION Bearings.

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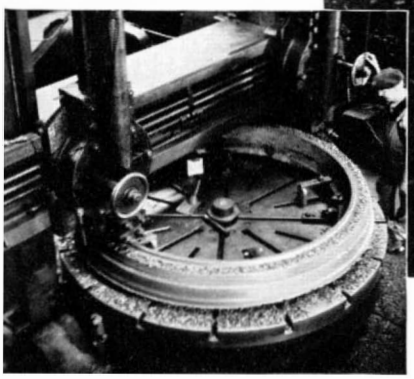
If they're not Precision Bearings It's not a Precision Machine



And in a bearing, of course, there's nothing but performance that counts

THERE'S no engineering degree required to appreciate the fact that a machine can't do a precision job if it is not equipped with precision bearings.

That is almost as obvious as the axiom of the square peg and the round hole. You know that. The leaders among machine tool manufacturers know it, too. For what other reason would one hundred and forty-three of them use SKF?

SKF Anti-Friction Bearings have always been designed to fit the job—never to fit a price. SKF tolerances . . . the extent to which deviation from the perfect in bearing parts is tolerated . . . are measured in *one ten-thousandth* parts of an inch!

SKF Anti-Friction Bearings could be made for less money if SKF were content that they should do *less* of a job.

Yet, in a bearing, there's nothing but performance that counts...nothing. SKF Industries, Inc., 40 East 34th Street, New York, N. Y.

SKF

BALL AND ROLLER BEARINGS

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EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

CONTENTS • JUNE • 1931

THIS MONTH'S COVER

The cover picture shows a party of geodetic engineers of the United States Coast and Geodetic Survey occupying a mountaintop triangulation station in Alaska. The methods employed and the instruments used in this kind of "super-surveying" are far more refined than those demanded in ordinary surveying. The umbrella shades the theodolite from the sun's direct rays, the heat of which would cause unequal expansion of the parts of the surveying instrument, thus making impossible the accuracy required in the measurement of angles involved in exact triangulation. The opening article in this number describes this kind of "precise" surveying. Its author, the government official in charge of many other kinds of refined surveys besides triangulation, has not mentioned that these surveyors are the very "royalty" of the surveying profession; in fact, they are to be regarded as scientists engaged in field work.

ACROSS THE EDITOR'S DESK

IT does not surprise us greatly when some widely traveled scientist or engineer tells us that SCIENTIFIC AMERICAN is the one magazine he can be sure of finding in every corner of this old world of ours, for our records show our wide distribution. We might be blasé and say that it's a commonplace thing for a King and a Crown Prince both to be so interested in the same article in SCIENTIFIC AMERICAN that we get a request for an additional copy of the issue containing the article so that both may have a copy. We *could* be so blasé, but we won't. The request was really quite unusual, and just as interesting.

Mr. K. S. Twitchell, an American engineer who is now a sort of general advisor to the government of Yemen on the Red Sea, sent the request. He wrote: "I shall greatly appreciate it if you will send a copy of SCIENTIFIC AMERICAN, issue of February, 1931, to:

Crown Prince Ahmad Saiff-al-Islam
Hajja, Yemen,
via Aden, Arabia.

"Prince Ahmad was extremely interested in my copy of this issue but I had already promised it at Sanaa to His Majesty The Imam Yahia. The article in which they are most interested is 'Preparedness for Peace.' This country (Yemen) is in the same position as we are, in that they do not wish to make any aggressive war but they do wish to be thoroughly able to defend themselves."

●

A few words more should be said about the author of the article entitled "Triangulation" which appears as the "lead" in this number and which furnished the subject for our cover painting. In addition to being Chief of the Division of Geodesy of the United States Coast and Geodetic Survey, Major Bowie has been president of the International Geodetic Association since 1919, and is ex-president of the Washington Academy of Sciences.

●

"What shall we eat?" is the theme of an article in our next issue that is symbolic of modern advancement in an all-important field—that of food and food distribution. In the old days—not so long ago—meats and fish, frozen for shipment by old methods, tasted anything but fresh when they reached our tables properly cooked; and obtaining fresh summer fruits in January in northern cities, if we except hothouse varieties, was unheard of. Now, however, quick-freezing methods give us throughout the year fish, meats, and fruits that may have been stored for months and shipped perhaps thousands of miles, yet are still really fresh to the taste. The trick is in the methods of freezing and shipping which promise to have a decided influence on our eating habits and, as naturally follows, on our health.

●

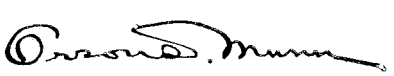
The puzzle of the origin of man in America is still so mystifying, despite the many theories advanced, that archeologists are now attempting to enlist the aid of laymen in the study. Human bones and artifacts, literally millions of them, that have been uncovered by excavators of wells, house foundations, and the like, and by curio seekers, have been lost to science because any relic of this sort is valueless for study unless it is accompanied by an authentic record of its discovery. Therefore, while we do not expect our article on the subject in our July issue to make amateur archeologists of even a tenth of our readers, we do know that it will give them all a new understanding of the importance of this work.

●

Capturing the imaginary yet most desirable "Blue Ribbon of the Atlantic," the record for speed plus a reputation for super-luxuriousness, has become a point of national pride with several large steamship lines. Cunard held this "ribbon" for many years with the *Mauretania* until the North German Lloyd won it with the *Bremen* and the *Europa*. Now Cunard is after it again with a monster liner on the ways. David Masters, the well-known British writer, will tell in our July issue many interesting facts concerning the complex problems that have been encountered by the designers of this Cunarder—which so far is called simply No. 534—and the unique solutions of some of them.

●

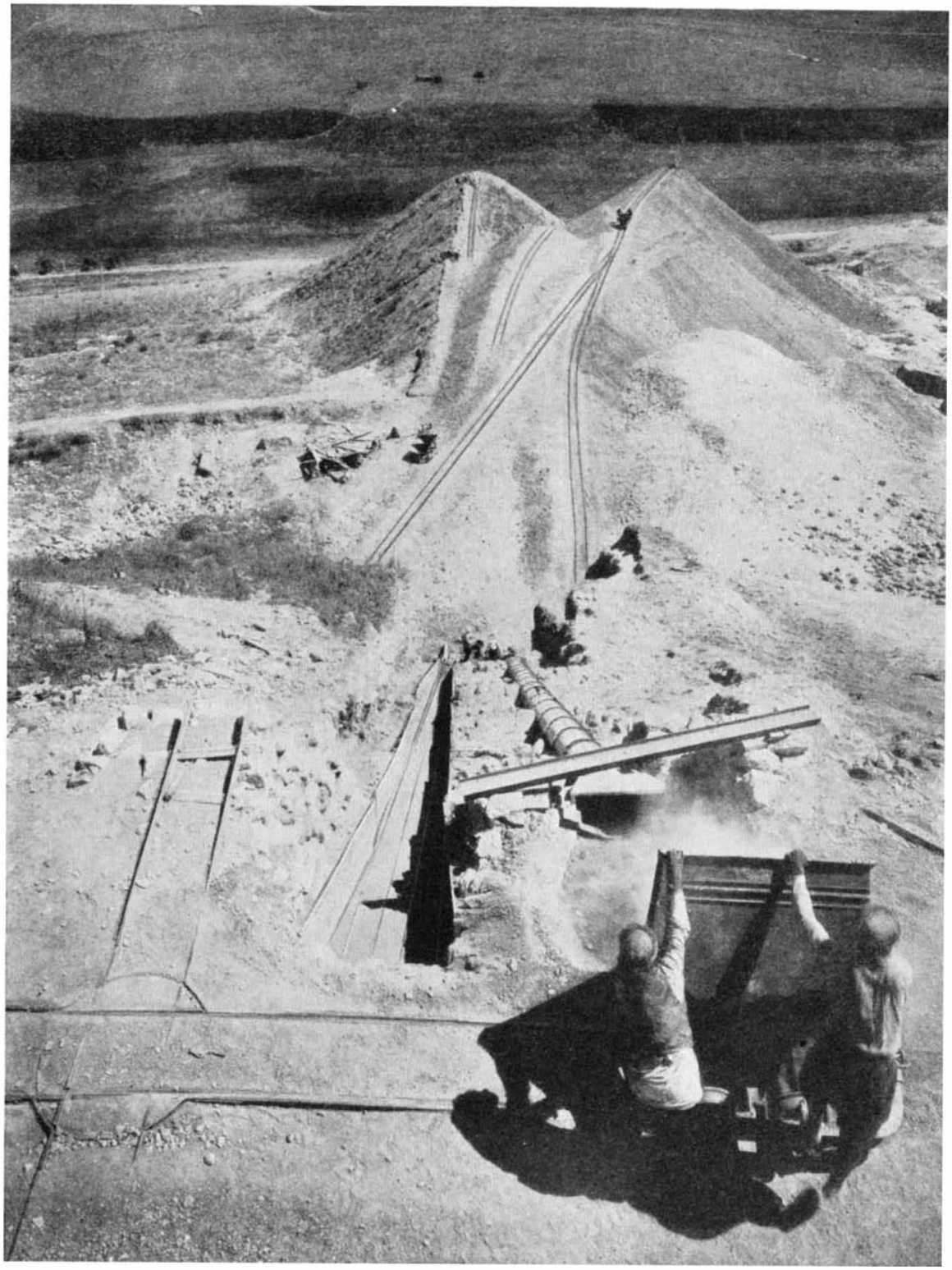
Among other articles to appear in our July issue, there is one on radio beacons for aircraft which was written at our request by two government experts. This article is the last word on the subject which means so much to airplane safety. We find also on our schedule the story of the important but little known Kettleman Hills oil field. This should really be called a "gasoline field" for its wells throw up, not petroleum, but natural gasoline that is practically pure enough to use immediately in the family car. It also produces millions of cubic feet of gas daily, most of which is intentionally wasted to the air.



FEW attain outstanding success merely because they possess some single, even though outstanding, "genius" quality, but success usually follows from the possession of a rounded, balanced combination of fairly well developed asset qualities. It is not likely that the world ever would have heard of George Eastman and his famous Kodak had he been merely an inventor; or merely a manufacturer; or merely a good salesman and business man. But he was all three.

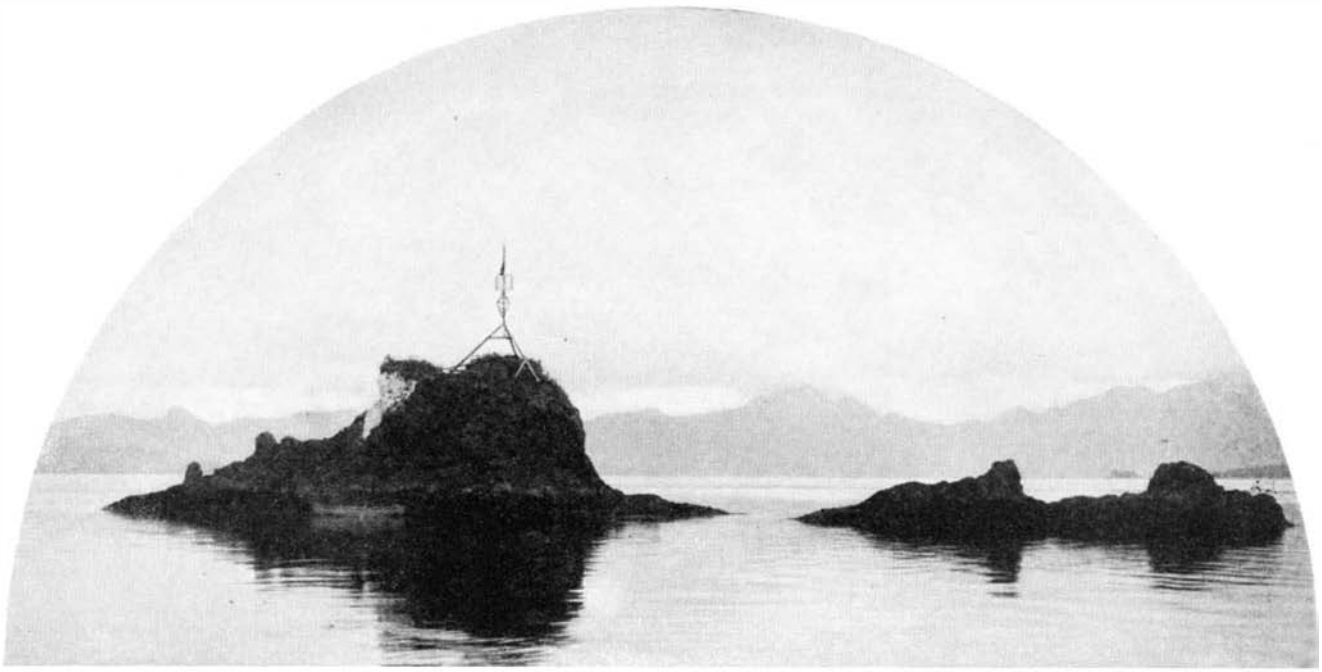
Fifty years ago, long before modern industrial principles were being talked about, Mr. Eastman translated the mass production idea into practice and combined with it what are now seen to have been advanced ideas concerning advertising. He also saw the dollars-and-cents value of calling in technical experts—scientific men—and facilitating their kind of research.

Within recent years Mr. Eastman has devoted much energy to the simplification of the calendar. If a shop machine were seen to be as inefficient as our calendar any business or industrial man would say "Junk it," and design a better one. The newer machine, when available, would cause its operator a few days of inconvenience, but when he had learned its levers he would wonder how he ever put up with the discarded relic. So with the calendar. Mr. Eastman contributes to the present number a thought-provoking but not provocative article on this sometimes warmly debated subject.



MODERN METHODS IN THE FORTRESS CITY OF PALESTINE

THE great mound of Armageddon (or Megiddo), once the strongest fortress city of Palestine, commands the most famous battlefield of the ancient world. It is being excavated, if we may be allowed the term, under the direction of Dr. Breasted, Director of the Oriental Institute of the University of Chicago. Modern methods such as contractor's railways, dump cars, and iron chutes for excavated material are used. It is expected that in time the great mound will yield historical monuments of the greatest importance. The plain of Megiddo was the scene of one of the great victories in the World War



A triangulation station on the coast of Alaska, erected by the United States Coast and Geodetic Survey. Along the coast, islands and bluffs may be used for this purpose. The target shown, constructed of wooden poles, is for a short line

TRIANGULATION

How it is Done and What it is For

By WILLIAM BOWIE, Sc.D., C.E.
Chief, Division of Geodesy, United States Coast and Geodetic Survey

THE day has long since passed when we could carry on the industry of this country with the oxcart, covered wagon, the canal-boat and the sail-boat for transportation, and with the strength of the man and the horse for power. We now have railroad trains, automobiles, auto trucks, air-ships, and steamships for transportation; for power we have great steam and hydro-electric plants which carry power even to the farm and home. The changes in one hundred years in the manner of carrying on our various activities are tremendous and revolutionary.

These developments in our industry and commerce have made necessary changes in other activities, among which are surveying and mapping. The day of the compass and chain has passed. We now use the theodolite and invar base tapes for determining geographic positions, distances and directions. We have substituted the topographic map for the simple route maps or sketches of our forefathers.

Triangulation is classed as higher surveying. It is based on the mathematical principle that when two angles and the length of one side of a triangle are known, the other angle and sides can be computed. In practice, the length of one triangle side and all three of the angles of a triangle are measured.

The curvature of the earth's surface and the dimensions of the earth must be taken into account when applying triangulation to surveying and mapping problems.

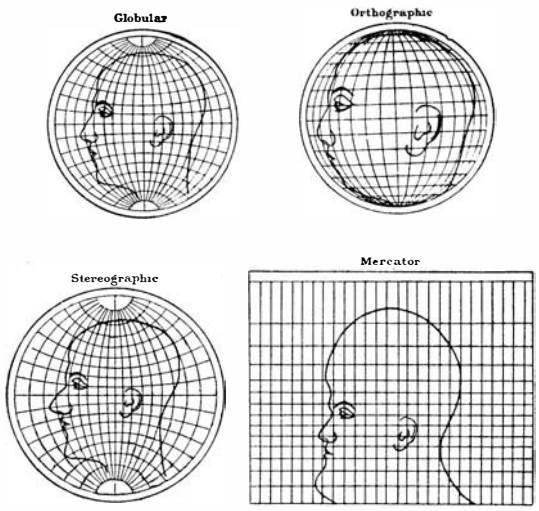
The determination of the dimensions of the earth, or what is usually called its "figure," really depends upon distances measured across the earth's surface by triangulation and the astronomically determined latitudes and longitudes of some of the triangulation stations. When we speak of the figure of the earth we have in mind the surface of the waters of the oceans and of sea level canals extended in imagination through the continents, and not the actual solid surface. There is a good reason for the earth's surface to be irregular and this question will be treated later on. If the water's surface were a perfect sphere, the measurement of the distance between two points on a meridian a degree apart would enable one to compute the circumference and diameter of the earth. Since the meridianal section of the earth is close to an ellipse, it is necessary to have three points on a meridian whose latitudes have been determined by astronomical observations and to measure the distances of one to another. The resulting data will be sufficient for the determination of the figure of the earth.

THE latter is the way in which the early determinations were made. Many determinations of the figure of the earth have been made and most of them have been used in surveying and mapping. The international figure of the earth is the one obtained by the engineers and mathematicians of the United States Coast and Geodetic Survey about 20 years ago. In that work the effect of the irregular surface of the earth on the directions of gravity to which the astronomical observations are referred was taken into account. Measurements within the area of the United States, only about 3,000,000 square miles in extent, were used to obtain the dimensions of the whole surface of approximately 197,000,000 square miles.

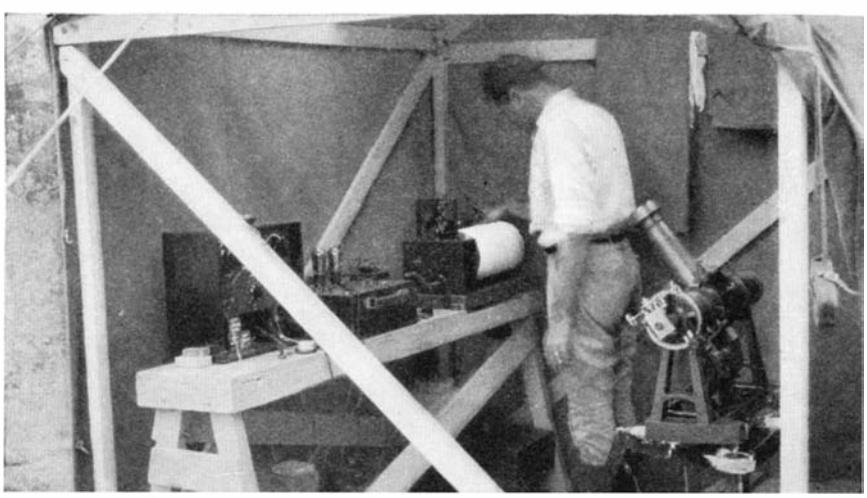
The United States, Canada, and Mexico are using the spheroid, or figure of the earth, which was derived by A. R. Clarke, in 1866. This is sufficiently accurate for all practical purposes. These countries are working together in their mapping and charting activities and even have adopted as the initial point for the surveys, maps, and charts of North America the triangulation station called Meades Ranch in central Kansas.

There are two important phases to triangulation; first, how is it done; and, second, what is the practical value of the results obtained?

Anyone can execute triangulation, but it is only with special instruments in the hands of the experienced engineer that the most accurate results are obtained. Without instruments one can determine the height of a tree by triangulation. First, he draws on a piece of paper or board a right-angled isosceles triangle, then he moves off from the tree to such a point that when one of the short sides of the triangle is held in the horizontal position, the long side, or hypotenuse, will be pointing to the top of the tree. Next, he paces or measures otherwise the distance from the point of observation to the foot of the tree. This distance added to the height of his eye above ground will give him the height of the tree. Of course, this is a rough determination, but the same principle can be applied when using a surveyor's transit. In a manner somewhat similar, the distance across a river may be determined, but here the triangle must be held horizontally rather than vertically.



It is impossible to show any large part of the earth's surface on a map without some distortion. The earth's surface is curved, while the map is a plane. There are many systems of showing the parallels of latitude and meridians of longitude on a map, each system being designed for some special purpose. A face shown on one projection will be distorted when the features are transferred, point by point, to some other. Only a globe is really true to fact



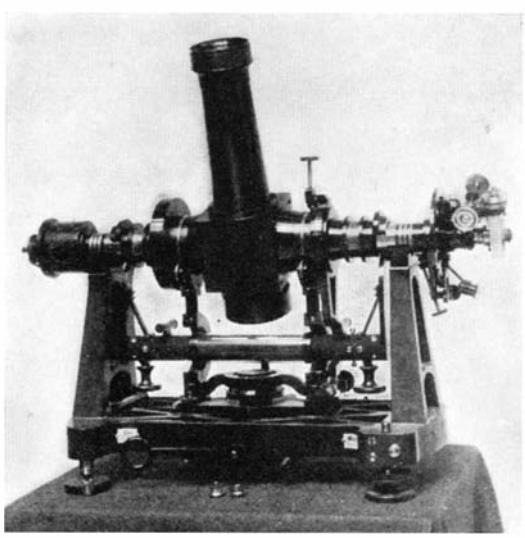
With a small astronomical instrument, chronograph, chronometer, and radio set, the engineer can determine within 20 or 30 feet his longitude and latitude by observations on the stars. The determinations of geographic positions by astronomical observations are used in placing a triangulation net over a country

The Coast and Geodetic Survey began doing triangulation work in 1816, just after it was organized, and except for a brief period during which the coast surveys were discontinued, this old bureau of the Government has been executing triangulation continuously. The first work was done on Long Island as part of the charting of the water surrounding that body of land. During the past hundred years, triangulation has been extended along our Atlantic, Gulf and Pacific Coasts, and all of our charts, used by navigators, are based on the triangulation data secured. About 60 years ago the Coast and Geodetic Survey began the extension of arcs or chains of triangles into the central portions of the country.

Before triangulation can become an effective method of surveying, the latitude and longitude of some point, which is to be used as an apex of a triangle, must be determined from astronomical observations. Then the true direction of a side of a triangle extending from that point must be obtained from observations on *Polaris*—the North Star. The engineer must also select some figure of the earth, for otherwise it would be impossible for him to compute his latitudes and longitudes.

The other operations involve the measurement of the length of a triangle side as a base and of the angles of the triangles. Before 1900, most of the bases of the world were measured by means of short metal bars. The work was very laborious and costly; besides, it was difficult to find ground which was smooth and level enough for a base. The bases vary in length between four and fifteen miles and such distances over very even ground are difficult to find in many parts of this country.

THE problem of the base was solved by the use of long metal tapes. It was found that with steel tapes, 50 meters in length, satisfactory results could be obtained when measurements are made at night or on cloudy days. Good work could not be done with these tapes on sunny days, for then the thermometers used during the measuring did not truly indicate the tape temperatures. An error of 1° Centigrade makes an error of one centimeter in one kilometer, or one part in 100,000 of the length measured, while the required accuracy is greater than one part in 300,000. Steel tapes were used until 1906, when the nickel-steel alloy called "invar" was substituted. Since that date all of the bases have been measured with the invar 50-meter tapes. The coefficient of expansion of the invar used is less than one tenth that of the steel tapes, and bases can be successfully measured with the new tapes, even on sunny days. The probable error of a modern base length is seldom greater

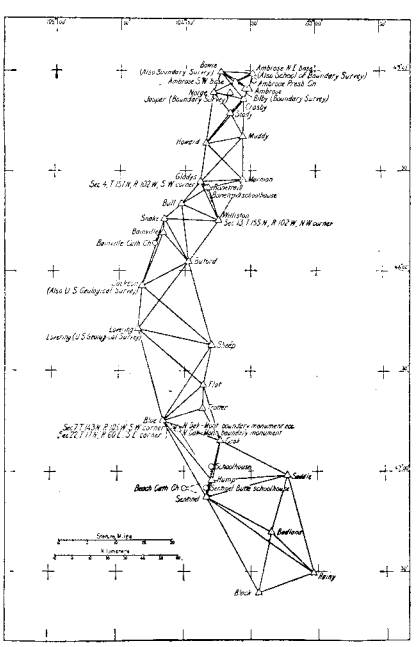


This instrument, a transit, is used for determining the latitude and longitude by observations on the stars. The same transit is also shown above, to the right

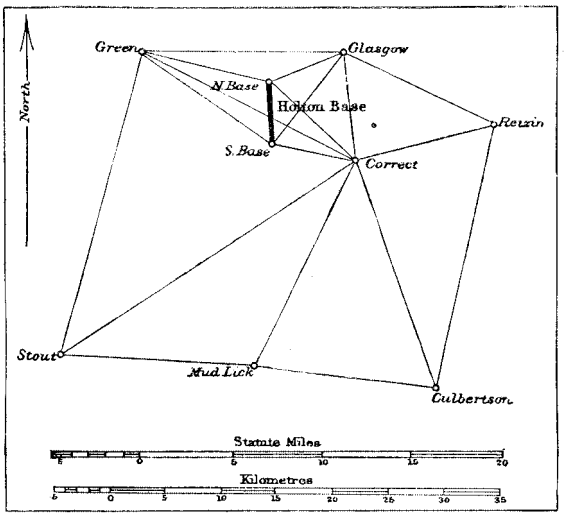
than one part in 1,000,000. The base is measured at least twice with different tapes to avoid undiscovered blunders and the mean of the measures is accepted as the length of the base.

The separate tape lengths are corrected if there is any inclination from a horizontal direction. The tape is supported at the ends and at the middle point and a constant pull is applied. The tapes are standardized at the National Bureau of Standards, both before and after the field measurements are made. The same number of supports and the same tension, or pull, are used in standardizing as during field work. The average elevation of the base is determined and a correction is then applied in order to reduce the measured length to the sea level surface. No close accord in the triangulation results could be obtained unless the sea level surface, a mathematical surface or figure which closely approximates a sphere, is used. Along any arc of triangulation, bases are measured at intervals of about 150 miles to serve as checks on the lengths computed through the triangles.

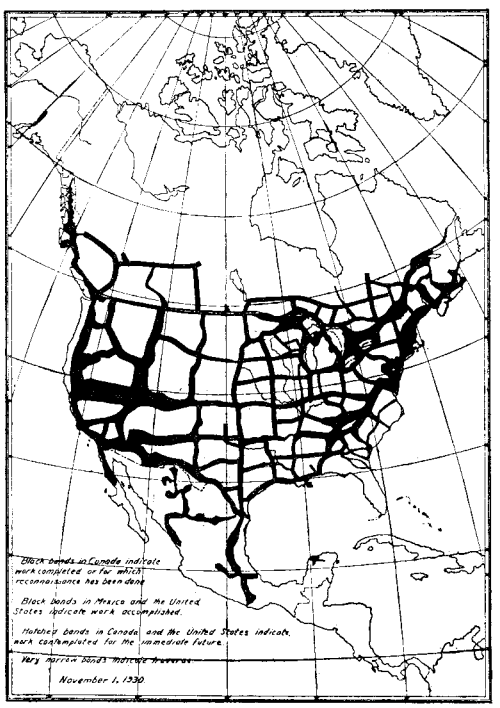
The triangulation of the first order, all of which is now done by the Coast and Geodetic Survey, forms the framework for all other classes of triangulation and necessarily it must be executed with extreme accuracy. The highest type of theodolite is used in the angle measurements, and the objects observed upon must be well defined and perfectly centered over the station marks. In general, an engineer can complete his observing at a station within two hours. The telescope is accurately pointed over each of the triangle sides radiating from a station and after each pointing the direction of the telescope with respect to the accurately graduated horizontal circle of the theodolite is read by means of two micrometer microscopes. The difference between two such sets of readings furnishes a measure of the angle formed by two triangle sides. In order to reduce the effect of the unavoidable errors of pointing the telescope and reading the circle, there are 32 measures of each angle. The average of the separate results is used in the computations.



Triangulation is extended in great chains of triangles over a country. The arcs follow lines of easy communication in order to reduce the costs. Connections are made with church spires, section corners, and state, county, and national boundary monuments, also any other objects which are of geographical interest and value. Stations without significance take casual names



How a triangulation is started. A line is measured with great accuracy. This is the "base line"



Arcs of triangulation completed in Canada, the United States, and Mexico. The heavy black lines represent chains of triangles like those shown at the left, these being too complicated to show in detail on such a map as this. When the Coast and Geodetic Survey's plan is consummated there will be such an amount of first and second order triangulation that few points will be more than 25 miles from a triangulation station

On the first order triangulation, the observations are made at night on the lights of electric lamps. Automobile headlights having special contracted-filament bulbs and with common dry cells for the electric current are employed. The lights are visible to the unaided eye for many miles in clear atmosphere. Two such lamps were used at station Ords in Arizona and the observer at station San Francisco Peak saw the light though the distance between the stations was 153 miles. It is only in mountainous regions that the lengths of the triangle sides are more than 40 miles. Some subsidiary observing is done during daylight and then heliotropes are used as the objects to be pointed on. The longest triangle side over which the sun's rays reflected from a heliotrope were observed was 192 miles. The side was between Mount Shasta and Mount Helena in California.

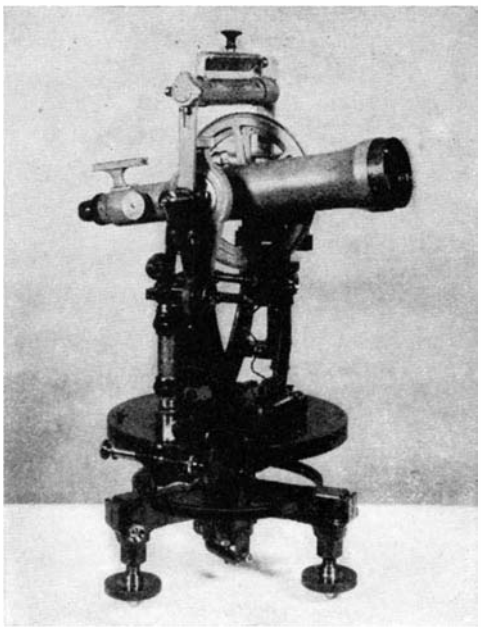
IN flat country or where the hills and ridges are heavily wooded, it is necessary to elevate the theodolite, lamp, and heliotrope to such heights that the lines between stations are clear. For this purpose a steel tower is used. This tower can be erected to any height up to 146 feet. When the engineer selects the station along any proposed route, he estimates the height of the tower needed for each of the stations. The top of the tower is accurately centered over the station mark by means of a special instrument, called a vertical collimator. The tower was designed by J. S. Bilby, Chief Signalman of the Coast and Geodetic Survey, with the assistance of the designing engineer of the Aermotor Company of Chicago.

Prior to 1927 the towers were made of lumber, but the lumber in a tower could not be used a second time and, besides, the erection of the wooden tower required much more time than does the steel tower. Five men can erect a steel tower 103 feet in height in five hours. A triangulation party uses either

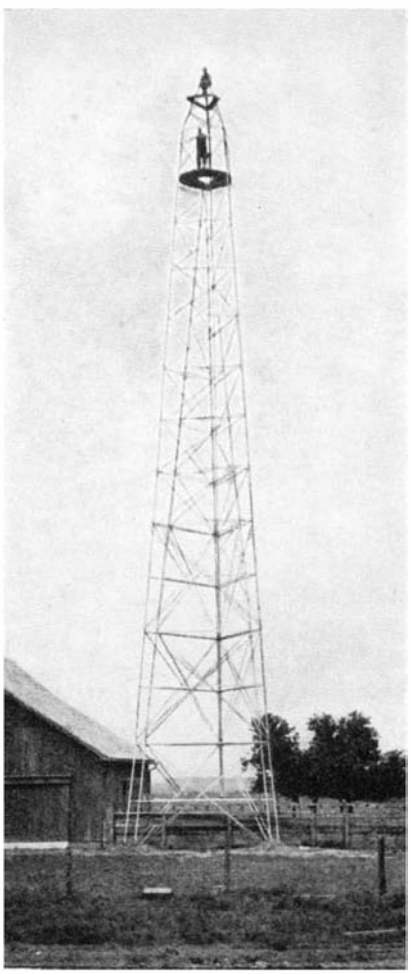
ten or twelve towers. When observations on a tower have been finished, it is taken down and carried forward by trailer trucks to another station.

The plans for the triangulation net of the United States call for arcs of first order (the highest class) spaced about 100 miles apart, with some cross arcs to be used in the adjustments by the mathematicians at Washington. Through the intermediate areas there will be run arcs of the second order. When the work has all been finished—some 12 years from now at the present rate of progress—few places will be more than about 25 miles from a fundamental station. This is the federal project. The spaces lying between adjacent federal arcs will be covered by third order triangulation for use in detailed mapping and surveying. This will be state or county work or federal work done in co-operation with the states by previous arrangement.

It is impossible to over-estimate the value to a country of good maps, and triangulation of the first and second orders plays the same part in the maps that the steel frame does in the modern skyscraper. Without the steel the structure could not be erected, while without the triangulation the maps would be a jumbled mass without accuracy in area, distance, or direction.



The standard theodolite used by the engineers of the Coast and Geodetic Survey on first-order triangulation. It was designed by D. L. Parkhurst, Chief of the Instrument Division of the Coast and Geodetic Survey and constructed under his direction. The average correction to an angle in the adjustment is about one half second. This corresponds to only one foot at a distance of 80 miles. The instrument is rapid in its operation



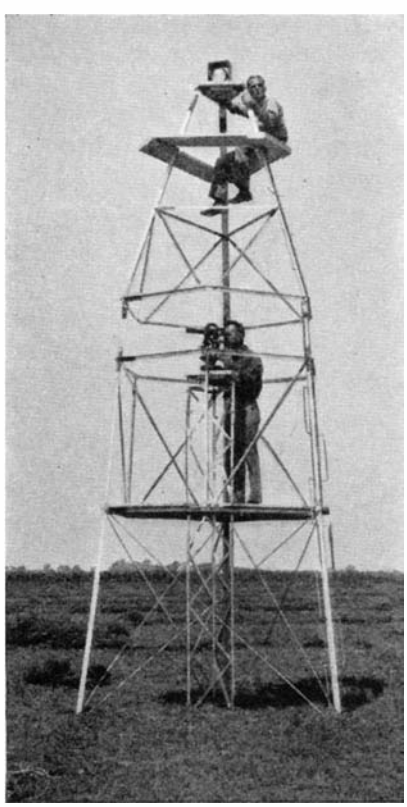
The 47,000,000 square miles of land area of the earth is all we have. There are about 2,000,000,000 human beings on the earth, more than 40 per square mile. Some areas are very densely populated, while in others, like the deserts, there are few persons. Much of the land is extremely cold and practically uninhabitable. Many of the great wars of the world have been fought over the possession of the desirable land. Land has a scarcity value—none can be made. As the population of the world increases, land will become increasingly important.

A piece of land is valuable in proportion to its capability to supply food and other products useful to man. Would it not be well if the governments of the nations of the world would map their areas and then make studies which will lead to definite and complete knowledge as to their natural resources? This would certainly seem desirable. Many areas are now mapped but much remains to be done. At present about 44 per cent of the area of the United States has been covered by topographic maps. Recently there has been a speeding up in the mapping program from which industry and commerce will greatly benefit. Triangulation is the basis of this mapping for the triangulation stations furnish the latitude and longitude of many stations used in the topographic mapping.

The first order triangulation net will soon have arcs close to all the coast lines of the country, thus insuring perfect coordination of the coastal charts and the interior maps.

Two adjoining nations are fortunate if their common boundary is defined in unmistakable terms. Wars and rumors of wars are often due to disputes over boundary lines. Fortunately for us, we have avoided boundary wars, although we have had a number of serious boundary problems. Many will recall the Alaska-Canada boundary problem, which was peacefully settled. It had been troublesome for many years.

Many of the states of this Union have had boundary problems, some running back to the time the states involved were created. All of these problems have not yet been settled. The causes of the trouble can in most cases be traced back to the absence of maps or to poor maps when the boundary was originally defined. The boundary may be defined as "the center of the main branch," the "north fork," or the "south fork" of a



Two views of the Bilby tower, used at different heights, shown at left and right. Usually it is used at 103 feet in elevation; even in flat country the curvature of the earth requires this on long lines. The tower consists of two entirely separate structures, the inner one to carry the theodolite and the outer one for the observer, thus avoiding bad effects from jarring. The outer one also supports a signal lamp

certain river. A correct map may show that it is impossible to decide definitely what part of a river system conforms to the boundary description.

If the boundary between two countries or states is defined in latitude and longitude, there will never be any serious question as to its exact location. If located by astronomical latitudes and longitudes the places where the astronomical observations are to be made should be decided upon and described. The astronomical determinations of latitude and longitude are affected by the irregular terrain and in consequence a north and south boundary may be a very irregular, rather than a straight line. Some of the boundaries of our western states show the effects of astronomical locations. However, in no case is the boundary much affected. A half-mile is about the maximum effect of the terrain on an astronomical location. But even this is more than enough to cause trouble between two states or nations.

A CASE in point is the boundary between Oklahoma and Texas. It is defined as lying in longitude 100° west of Greenwich. Three astronomical locations of the boundary had been made and there were three lines on the ground. The outside ones were separated by a strip several hundred feet in width. This was due to the fact that the astronomical observations were made at different places for the several lines. A few years ago this boundary dispute was taken to the Supreme Court, the final arbitrator in state boundary contests. The Chief Justice ruled that the boundary should be placed on the 100° meridian by the best scientific methods. The Commissioner appointed by the court requested the Director of the Coast and Geodetic Survey to have an arc of first order triangulation extended along the proposed boundary. Since the longitude of each station is determined by triangulation, it was an easy matter for the Commissioner to measure short distances to the east or to the west of the stations in order to get exactly on the 100° meridian. This is probably the most scientifically defined and established political boundary in the world.

A monument at Passamaquoddy Bay, Maine. To it is referred a point on the United States–Canadian boundary, which is out in the middle of the bay. Triangulation is of decided value in locating various political boundaries

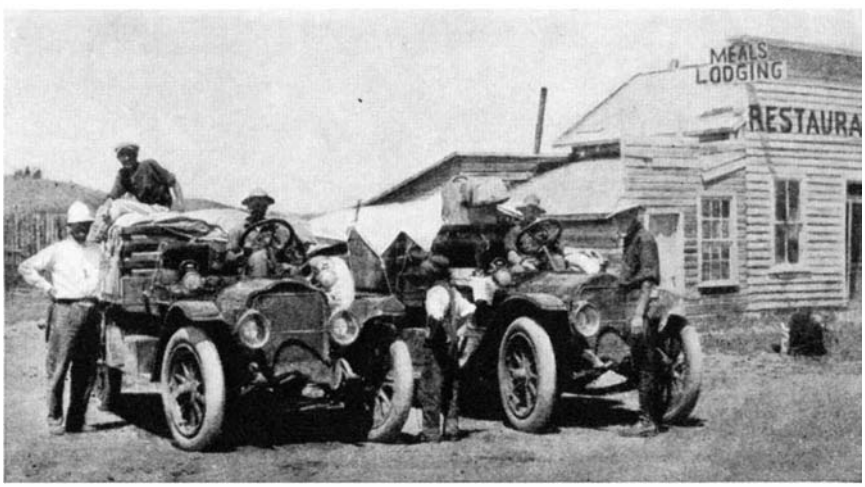
At each triangulation station an inscribed bronze tablet is set into out-cropping rock or in a block of concrete. This monument is placed directly under the center of the top of the Bilby tower. The theodolite and lamp must be placed directly over the mark. The stations are established for the use of surveyors and engineers and therefore the mark must be substantial, permanent, and easily found and identified

While a single astronomical station may be seriously affected by the terrain, yet the average of hundreds of such stations will be very close to the true latitude and longitude. It is for this reason that the latitudes and longitudes of places determined by triangulation are free from the influence of the irregular surface of the earth. The many astronomical stations of the country were used in obtaining the theoretically best latitude and longitude of the triangulation station at Meades Ranch, Kansas, the starting point for all of the triangulation of North America.

The old chart of the island of Porto Rico, which was based on the astronomical stations at Ponce on the south coast, and at San Juan on the north coast, was too wide by nearly one mile. The directions of the plumb line at these stations were affected by the island mass and the deficiency in mass in the adjacent seas.

IT is evident that one cannot use a single astronomical determination of latitude and of longitude, or even such determinations at a small group of stations as the basis for a chart or map or for the basis of a political or other property boundary. It was by means of triangulation that the error of the old chart was discovered.

With land becoming more valuable as the years go by, the private property owner is demanding a more rigid and definite establishment of his boundary lines. The strongest method is to have the boundary monuments connected with the triangulation system of the country. This can be done directly should a triangulation station be located near the property. Otherwise, the connection can be made to traverse stations which have previously been connected with triangulation stations. When such connections have been made, it will be possible to recover very accurately the corners of the original boundary should the monuments be destroyed.



During the past decade the triangulation of the Coast and Geodetic Survey has been expedited by the use of automobile trucks as a means of transportation. From truck to mountaintop the instruments are carried by men or pack animals

OUR POINT OF VIEW

The Nicaragua Canal

THE question of the feasibility of the proposed Nicaragua Canal has assumed an increased controversial importance since the city of Managua was destroyed by earthquake early in April. Opponents of the canal say that such an earth movement would destroy such an engineering work but its proponents say there is as much likelihood of a disastrous quake at Panama as there is of a repetition of the one in Nicaragua.

It is, therefore, time for a few pertinent facts. Panama Canal traffic has been declining since 1928; it has not increased in the straight-line curve that was so firmly predicted for it a few years ago. Accurate analyses by several authorities indicate that the traffic peak will not reach the Panama Canal's present capacity of 60,000,000 tons for years to come. Completion of the Madden Dam and of a third set of locks will raise this capacity to 143,000,000 tons and it is conceivable that this capacity can handle all trans-Isthmian shipping for 75 to 100 years. Long before that time has elapsed, the horror of the Managua quake will have been practically forgotten in a region where quakes are almost as frequent as changes in the weather and engineering practice will doubtless have been improved to the point where nothing short of a major earth movement will be feared.

At present neither proponents nor opponents of the Nicaragua Canal have much to worry about. Both may talk all they please and enjoy themselves to the utmost. The rest of us will sit back content with the knowledge that the government is not going to spend 700,000,000 dollars for a second canal until it is definitely needed—and that may be years hence.

The "R-101" Disaster

AFTER five months of investigation, Sir John Simon and his board of investigators reported, late in March, their unanimous opinion that leaking gas caused the crash of the airship *R-101* over Beauvais, France, on the night of October 4, 1930, while on a trip to India. Leakage of gas from one of the forward gas cells was thought to have followed the ripping by the storm of the forepart of the outer envelope.

Particularly interesting is that part of the report which reads: "She (the *R-101*) had never gone through trials which proved by their length and conditions that she was well able to cope with a continuance of unfavorable conditions. . . . It is impossible to avoid the conclusion that the *R-101* would not have started for India on October 4 if it had not been that reasons of public policy were considered as making it highly desirable for her to do so if she could."

In our May issue we described the new airship *Akron* which is being built for the United States Navy and which will no doubt take the air before this is published. She is believed to be the safest airship so far constructed and, according to calculations, could lose all the gas from two of her gas cells and still remain in the air. And yet there are always chances that something may go wrong, and the *R-101* disaster teaches a lesson of caution. It is expected that the Navy will exercise its usual good judgment in the matter of testing the *Akron* thoroughly before formal acceptance.

Truth Will Out

"MEDIUM whose séances baffled scientists quits profession, confessing he is a 'fake'," was the surprising front-page headline in *The New York Times* that greeted New Yorkers one morning in April. Nino Pecoraro, for years a "successful" medium, was the confessor. He admitted that his seemingly supernatural accomplishments were all a fake, and said, according to the newspaper, "I'm sick and tired of giving séances and having others reap the profits."

Reference to the book "Our American Adventure," by the late Sir Arthur Conan Doyle, shows that while on a visit to the United States in 1922, Sir Arthur attended a séance given by Pecoraro and was convinced of this medium's psychic power. At this séance, there were "two Italian females," Dr. Vecchio whom Sir Arthur described as "a skilled psychic observer and a man of high scientific attainment," Dr. Allerton Cushman, Dr. H. Carrington, a "Persian gentleman named Kervorkian," two unknown young ladies, Sir Arthur, and Lady Doyle. After the *show* had been going some time, Sir Arthur said that "There was a strong cool breeze, a sure sign of the real psychic power," and, commenting on this, said "Do not these psychic air vibrations throw a light on the constant request from spirits that we sing or play and so keep the waves moving?" After vain attempts to converse with a voice that called itself Palladino, a continued billowing outward of the curtains, and much jumping of tables, lasting in all about two hours, the séance was broken up. There was no materialization, so Sir Arthur said that "It was not, it must be admitted, a very successful sitting. . . . I thought the youth was a true medium and might develop into something remarkable."

Our file copy of SCIENTIFIC AMERICAN for the month of February, 1924, gives an account of three séances Pecoraro held that year in an attempt to win the SCIENTIFIC AMERICAN award of 2500 dollars for the production of genuine psychic phenomena. Pecoraro's tricks proved most engaging; in fact, he was so clever that the distinguished investigating board admitted that it could not accuse him of conscious fraud until further sittings had been held. The board finally concluded that he did not produce anything that could not have been produced equally as well by mechanical means.

These are the simple, uncolored facts. Do they not show why science, while not denying wholly the existence of psychic phenomena, has adopted a hands-off attitude on the question of spiritism? It is an emotional study not based on hard and fast facts. The apparent success of some observers is not convincing and science will not be hasty in accepting any of their findings. In view of Pecoraro's confession of his own charlatanry, spiritism has been given a body blow which will make scientists even more skeptical of the genuineness of so-called psychic phenomena.

Why Have A Navy, Indeed!

THE press is continually plagued with letters concerning the Navy written by people who don't know what they are talking about. A recent example appearing in a New York newspaper asked the question "Why have a navy?" and answered with the naive assertion that a navy is wholly unnecessary, having been rendered so by aircraft. Were it not for the fact that, unfortunately, such fatuous remarks often fall on fertile soil and help sway people who form opinions in accord with their prejudices rather than with good judgment, they would excite no more than an amused smile.

In considering this question, let us look only at capital ships and forget the rest of the surface and sub-surface

units, for there are certain interesting facts about these vessels that are not generally known. For example, the victory in the recent war games in the Caribbean was attributed to battleships, assisted, of course, by cruisers, destroyers, and airplanes. Next, consider the fact that France, having forsaken capital ships in favor of fast cruisers, destroyers, and submarines, has now reinstated them. Consider, also, that Great Britain is not and has not been in favor of the abolition of battleships, many American writers to the contrary notwithstanding.

There are those who think that one well placed aerial bomb would disable a modern battleship. Such people have evidently not heard that the modern war vessel can continue to function and its main battery to fire after most of the superstructure has been shot away, the fire control of these vessels being far down below the water line in an almost invulnerable position. They are apparently ignorant of the fact that anti-aircraft guns of surface vessels, firing during tests at a sleeve (the would-be bomber) towed by an airplane, have recorded many hits on the target before it could reach a bombing position.

There is no denying the fact that the airplane is a valuable adjunct to the fleet. This is indicated by the efforts of the naval powers to discover the most effective method of utilization of aircraft. Not content that aircraft carriers represent this ultimate method, the powers are working out plans for new experimental types of ships, of which the "flying-deck cruiser" is an American example. It is plainly evident, therefore, that aircraft will play an increasingly important part with the fleet, but neither they nor any other battle unit will render battleships obsolete—at least for many years to come—and the battleship, like a healthy hen, will always have her brood of chicks: smaller ships and submarines.

Sick Railroads

"WHAT is the matter with the railroads?" is a question that has been repeatedly asked during the past year or two. Many answers have been given and analyses made but there is still no let-up to the anxiety of railroad men. However, Mr. Dillon's illuminating discussion of the subject, on page 376, shows, without saying it in so many words, that the public is wholly indifferent to this momentous problem despite the fact that the solvency of the railroads bears a definite relationship to the well-being of the country at large.

To look backward a bit, let us remember that the rapidity of the development of our rich and spacious west was possible because of railroads. In fact no other one thing has made anything like so great a contribution to the progress of the entire nation. At the present time, according to General W. W. Atterbury, President of the Pennsylvania Railroad, the American people hold 18 billion dollars' worth of railroad securities. These are held not only by close to a million individual investors but also by insurance companies and banking institutions. Thus the soundness of the insurance policies of many millions of people depends in part upon the soundness of railroad security investments.

Professor William Z. Ripley, who is recognized as one of our greatest authorities on railroad economics, stated recently that, "Allowing five to a family, they (the railroads) support directly almost 8,000,000 people." There is no way of estimating the much greater number who are to some extent supported by them indirectly. Professor Ripley said also that they are "far and away the greatest taxpayers—contributing 500,000,000 dollars annually to the public treasury," and that their purchases amount to a billion and a half dollars a year! And yet commercial motor vehicles are given preferred treatment. For example, motor trucks, which pay a disproportionately small total in taxes, which are free to run when and wherever they choose, and over the operation of which there are no such strict regulations as those imposed on the railroads by the Interstate Commerce Commission, are taking the cream of the freighting business. They are not compelled, as the railroads are, to file their rates and hold rigidly to them, nor to take all the business that is offered them, regardless of whether it is profitable. They can and often do practice the worst kind of cut-throat competition.

It is a well-known fact that railroad men have been conservative; that fact is exemplified in Mr. Dillon's statement that the possibility of automobile competition brought a laugh when mentioned to railroad men only a few years ago. But that is all changed. The railroads are looking to the future, weeding out inefficiency, establishing new high standards, and making great progress in coordinating other forms of transportation with their established systems. The immediate future looks rather black but Edward Hungerford, writing in *Forbes Magazine*, says flatly and positively that the railroad is coming back, that "it is no more to be supplanted by the motor vehicle—or the airplane—than the telegraph was supplanted or put out of business by the telephone."

In view of these facts, the question "What is wrong with the railroads?" becomes "What is wrong with the American people?" The railroads *are* alert to their problem but the people, vitally concerned with the outcome of the fight, forget past loyalties to a public necessity that has never failed them, and leave the onus on the shoulders of railroad executives. The railroads want fair, not favored, treatment. They want their competitors placed on an equal basis with themselves, either by a removal of the restrictions placed on the railroads or by the imposition of similar restrictions on commercial motor vehicles. It is time for a return of confidence in the railroads; we should see that they are accorded the fair treatment they deserve.

Lessons Learned

SPEAKING of the world's economic troubles a few days ago, someone commented on the spirit of hopefulness that has been manifest in this country during a year and a half of adversity. Few have lost faith in our system although it has become evident that certain adjustments, both national and international, are necessary. As a nation, we still have our prosperity and it remains for us to determine its full significance and its limitations, and reorganize our mental processes accordingly.

Perhaps the machine *has* contributed to the present unemployment crisis, but that is only because of maladjustment and lack of understanding. Machines will be developed further and that, according to the emotional reasoning that has been rife among the multitudes, will throw more workmen out of employment. But it is not so simple as that; whatever may be the result of progress in machines, the cause may be found only in a correct interpretation of complex economic laws.

It has always been SCIENTIFIC AMERICAN'S mission to supply that interpretation and now, when the world is on the way to economic recovery, we are in the fight with greater earnestness than ever before. There are lessons to be learned from our recent depression and from the scientific advance of industry that may help to prevent a recurrence of world-wide industrial sickness. Our industrial articles will still breathe that spirit of hopefulness that has characterized them in the past, will study the significance of developments and draw from them a moral of progress, will suggest new fields to conquer, will, in fact, provide a constructive service for the thinking man who will be a leader in industry in the new epoch that is inevitably coming.

OUR CHANGING TRANSPORTATION

By CHARLES DILLON

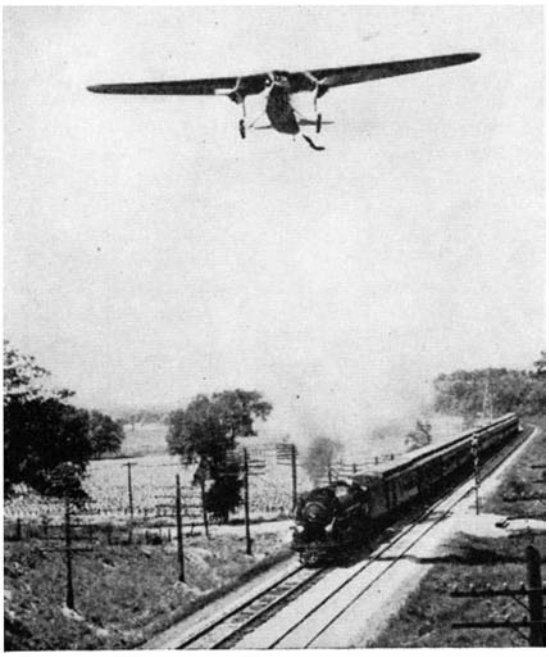
ABOUT the most depressing document on a railroad executive's desk in the final days of 1930 was a report from the passenger department. Going over its gloomy figures solemnly the president could see little that was cheerful. Competition, long declared to be the life of trade, was and is—at least in the railroad passenger business—having just the opposite effect. Wherever he looked the executive saw the fickle public, forgetful of old loyalties, turning in increasingly large numbers to motor buses, private automobiles, and even to the skyways.*

Railroads are such enormous things, and their various reports have to do with amounts so far beyond human understanding that one finds it easy to excuse the public's casual indifference to the stories it hears of declining profits, taxes of more than a million a day, and other such dreary items. The public has heard so much of this in the last generation, and it has so many troubles of its own, anyway, that little heed is given to the railroads' cry of wolf.

IT SEEMS only a few years ago that the suggestion of dangerous competition from motor cars raised a hearty laugh. It doesn't get a hand today. To mention it in some railroad offices is as risky as breaking the news of another rate cut by the Interstate Commerce Commission. To grasp it understandingly one has only to know that in 1911, which is going back far enough, precisely 619,500 passenger automobiles were registered in the United States. At the end of 1929 there were 26,700,000 automotive vehicles registered, and about 24,000,000 of these were passenger-carrying cars—automobiles or buses. There were 21,400,000 of these passenger cars in 1928. To state it in figures provided by unprejudiced sources, the increase in this form of vehicles between 1911 and 1928 was 3351 percent.

Needless to say, although it is convincingly shown with figures, the passenger business of railroads has decreased alarmingly, and this decrease affects the fortunes of many thousands. Obviously, nothing much can be done about it. The government can regulate and control publicly-owned vehicles as common carriers, but it can do nothing to prevent citizens' riding in whatever kind of vehicle they choose to patronize; and certainly a government can not dictate with respect to privately owned cars. These private automobiles, it should be understood, are the chief competitors responsible for loss of railroad passenger business.

If anyone imagines this passenger decrease has not been impressive, it is necessary only to know that in 1920 the railroads in the United States carried 1,234,862,048 passengers. That was a peak year. From that time to the present, passenger traffic has decreased constantly. In 1928 the number of passengers carried had fallen to 790,327,447. In 1929, the decrease continued. Indeed, the traffic was smaller than in any year since 1909. The loss between 1920 and 1930 was 40 percent.



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As the country's population increased more than 16 percent in the last decade and the increase in passenger motor vehicles was so high as to be beyond our comprehension, it seems reasonable to conclude that the people have changed their choice of transportation methods. Certainly, they have not ceased traveling. You get a rather clear view of the situation in dollars and cents when you learn that in 1920 passenger receipts amounted to 1,286,613,000 dollars and that this sum had fallen in 1929 to 874,000,000 dollars. The meaning of this is more understandable if you chance to own railroad stocks or bonds.

What became of all these passengers? The answer to this question is fairly well set down in a careful count prepared during the last summer at the crossing of St. John's River at Jacksonville, Florida. The report was made by experts. Two thirds of the automobiles and passengers had come from "long haul zones." This is the most impressive part of the record:

License Plate	*Cars*	*Passengers*
California	125	304
Illinois	834	2308
Indiana	387	1127
Massachusetts	553	1435
Michigan	920	2611
New Jersey	1385	3836
New York	3208	8601
Ohio	1251	3339
Pennsylvania	1356	3738
Canada	158	475
Total	10,177	27,774

In the count for the month, every state in the union was represented, with Mexico and Hawaii added, and the total, including cars from "short haul" zones, for 31 days was 15,610 cars carrying 42,504 passengers. When one considers how many millions of cars were traveling elsewhere over the nation all summer, every car carrying from one to five or seven passengers, it is not so difficult to understand why the railroads' passenger revenue has declined.

There is another authentic record that conveys interesting information: the travel to Canada. It isn't anyone's business why they went up there, but the fact is that in 1929 exactly 4,508,808 automobiles entered the Dominion from the United States, or 863,353 more than went there in 1928. If there were two persons in every one of those cars, and probably there were three or four, more than nine million potential passengers for railroads rode in automobiles and spent their money in other ways.

BETWEEN 1923 and 1929, inclusive, 481,289 automobiles entered California at three southern gateways where the record is made every day. These cars carried 1,544,194 passengers. How many entered the state at the northern gateways is not a part of the count; neither is there a report for the number of passengers who traveled on publicly-owned buses. Still later reports show that 633,496 persons from other states went to California by motor car from January 1 to September 30, 1930. During September alone, 76,664 tourists in 29,261 automobiles with licenses of other states arrived in California. These totals are from accurate checks made at 25 inspection stations at the state's

*See "Our Point of View" in this issue.

borders by the California Department of Agriculture. And what applies to California traffic probably is equally applicable in other parts of the country.

For years we have heard it said that motor trucks would get only the short haul traffic, but there is much evidence to contradict this belief. In the society column of a Hollywood evening paper, one day in October, two items attracted special attention from railroad men. One told of the arrival of trucks of a company in New York, with the household goods, the *lares* and *penates*, the paper called them, of the Irish tenor, McCormack; and other trucks bringing the belongings of a lecturer from Kansas City. These are long hauls with a vengeance. Inquiry showed that the uncrated household goods were securely packed in the trucks at the owner's door in New York, and unloaded at his door in Fuller Avenue in Hollywood. The expense of crating, usually as much as the freight bill charged by a railroad, and the high cost of trucking from the house to the railroad station and vice versa, were saved. The shipment came through in good order, without delay except at night, and reached its destination certainly much sooner than any railroad would have found it possible to record.

A TRUCKING company in Los Angeles advertises 15-hour freight service to San Francisco, 480 miles away. This is faster service than railroads offer and the rate is lower. Passenger buses, the finest product of the factories, making very nearly as good time as one railroad's fastest train, will carry you from Los Angeles to San Francisco for less money. The night buses have berths for 15 or 16 persons, almost as wide as a single bed, and passengers may turn in and sleep—maybe. We now have a 28-hour mail and passenger service by air from coast to coast. No railroad train ever will go that fast, and we ought to be glad, too.

Another interesting angle in studying the people's changed attitude toward transportation of the day is found in the figures, and there are not many of them, pertaining to gains and losses in different classes of travelers. Since 1921 passenger traffic in sleeping and parlor cars has increased 32 percent—the most costly form of transportation except by air—while revenue from passengers in day coaches decreased just 42 percent.

What became of this 42 percent which usually patronized the cheaper facility? Statistical sharps say the absent passengers bought low priced automobiles, new or second hand, bundled the wife and children and the camp equipment therein, and set out happily to "See America First." The 32 percent increase in the sleepers and parlor cars, the sharps say, was made up largely of persons of means, persons able to own one or more automobiles, but not disposed to use them in crossing the continent. This class prefers to travel in the luxury now provided by all the principal railroads.

AS percentages are not particularly enlightening for an evening's reading, it may be better to say that in 1921 the Pullman passengers produced 358,655,902 dollars in welcome revenue. By 1928 this had grown to 438,073,396 dollars. Now look at the other side of the picture: In 1921 day coach traffic was worth 795,402,216 dollars. At the end of 1928 this had fallen to 464,253,457 dollars; and all the time the population was increasing rapidly, about 17,000,000 in the decade.

What have the railroads done, or what are they doing, to overcome this tremendous decrease in passenger revenues? There are about 2000 railroads of one kind or another in this country, most of them carrying passengers now and then, but the roads with which this article is concerned are called Class 1, and number about 185. These are the lines with which we are all more or less familiar. It should be understood, therefore, that when the term "the railroads" is used it is intended to mean the leaders. Well, for one thing, the country's railroad men quite generally fought the motor buses and trucks day and night, in court and out, and before the state commissions, and in the main they lost the decisions, yet the fight went merrily on.

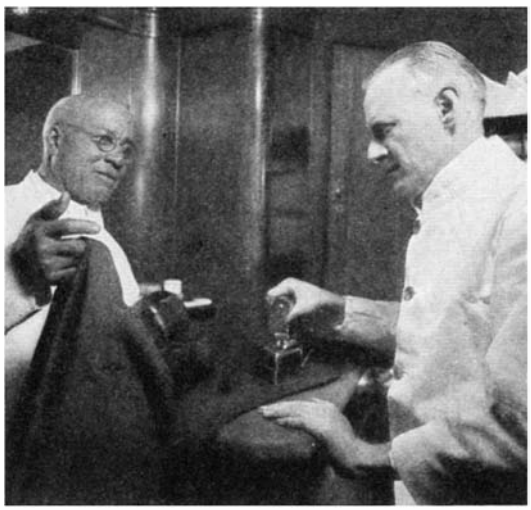
A few far-seeing executives did no fighting. Instead, they entered the bus and truck business themselves. In 1925 only 10 railroads owned motor coaches and operated them in connection with their regular trains. There were 78 such roads in 1929. In 1925 the 10 lines mentioned owned 300 passenger motor coaches. In 1929 this number had grown to 2389. In 1925 the first group had 900 trucks and trailers; in 1929 there were 55 railroads with 5900 such vehicles. But they never have caught up with the automotive industry. True, that industry created an enormous tonnage for the freight department, but this has not overcome the immense losses in passenger traffic, and it has not replaced the millions the roads have spent for new equipment, baby blue upholstery, revolving chairs, radio, valets, manicurists, barbers, tailors, baths, air-cooled dining cars, private rooms in sleepers in addition to the familiar staterooms and compartments, news service daily, library, smoking rooms for women, and so on to the red ink, amid the loud cries of the unfortunate stockholders.

ONCE more, in another way; what have the railroads done to stop the people's drift to other transportation? To buy a few hundred motor coaches, obviously, was a feeble move, but it appeared to be the limit of the railroads' aptitude for overcoming a disaster of such proportions. In the far west some of the roads established low rates for coach passengers only between Los Angeles and Chicago. The result has not been exhilarating. Traffic volume in-

Transcontinental travel: *left*, a hundred years ago; and *right*, today in the sleeping cabin of a new Fokker air yacht with seats for 16, a kitchen, and full dining service

creased immediately, but revenue declined. It took money to provide modern, comfortable, reclining chair cars for those low-rate passengers, and the fares they paid for riding and sitting up a couple of nights did not pay the bills. Railroads may make money with their motor-bus adjuncts, they say, but will not make enough to overcome the losses in coach traffic.

What is the answer to all this? No one has it. If all roads should reduce fares to pre-war levels of 2.5 cents a mile against the present rate of about 3.6 cents, as some have already done, the treasuries might suffer, but at least the railroads would know whether they could fairly hope ever to win back lost business.



Valet service is one of the many "luxuries" of railroad travel adopted to attract more fares

Late last fall various traffic officials began talking about a reduction of 33 percent in fares, realizing that this would require an increase of 50 percent in volume. Before the end of December western roads in several instances had announced a return to the pre-war passenger tariff of 2.5 cents and in some cases to two cents a mile, station-to-station, one-way *intra*state fares. Such reductions needed only the approval of state commissioners

THE experiment revived the old classic about the customer who asked a clothing dealer how he could afford to sell suits at less than cost, as advertised. "Because," was the reply, "I sell so many of them."

This rule will never apply, however, in selling railroad tickets. It takes more coaches to carry more passengers and this, in its turn, means more locomotives and more crews with the highest wage scales paid anywhere in the world for such labor.

Still another experiment became effective January 1 on several lines, mostly in the middle west, and was announced only for a six months' period. This is really an adoption of European classifications in which the three classes of passenger rates are the standard sleeping car rate, tourist sleeping car rate, and day coach rate. The usual fare affecting all passengers was to be continued in force as the standard rate. Persons who ride in tourist cars were to pay 15 percent less for their tickets than those who traveled on the standard rate, while the day coach rate was to be 24 percent less than the tourist rate. The new rates affect passengers boarding trains at terminals and at many intermediate points. This, of course, is an interstate arrangement.

Speed has little to do with the railroads' problem. Railroad trains are running about as fast now on the principal lines as experienced managers believe necessary and safe. The trip from Chicago to Los Angeles can be made in from 54 to 65 hours with all modern comforts. Compare this with the travel of 60 years ago, or contrast it with most of the railroads of Europe, and no very great fault will be found with American facilities.

The first passenger train between San Francisco and Chicago, in 1869, made the trip in 126½ hours, about twice the time required today. First class fare in those days from San Francisco to Chicago was 130 dollars; to New York 150 dollars; to St. Louis 129 dollars—a strange division of rates it seems. Now the fare from the Pacific Coast to Chicago is $79.84 with $23.63 added for a lower berth or $18.90 if you don't mind climbing into an upper. Against this present-day price are low fares charged by motor transport, which runs de luxe coaches clear across the continent. Such a journey has few attractions for persons accustomed to luxury, but nevertheless thousands travel that way at least once. The service may leave much to be desired, but it remains a very formidable competitor.

The people of America have turned or are turning definitely from steam railroads to motor vehicles in such alarmingly large numbers as to threaten the continued operation of adequate passenger facilities. Freight traffic in an increasing volume is going to the highways in trucks, to steamships through the Panama Canal, and to the waterways with the government supplying most of the capital from taxation. Pipe lines carrying oil hundreds of miles across the country constitute a further and very appreciable threat against the railroads' freight revenue.

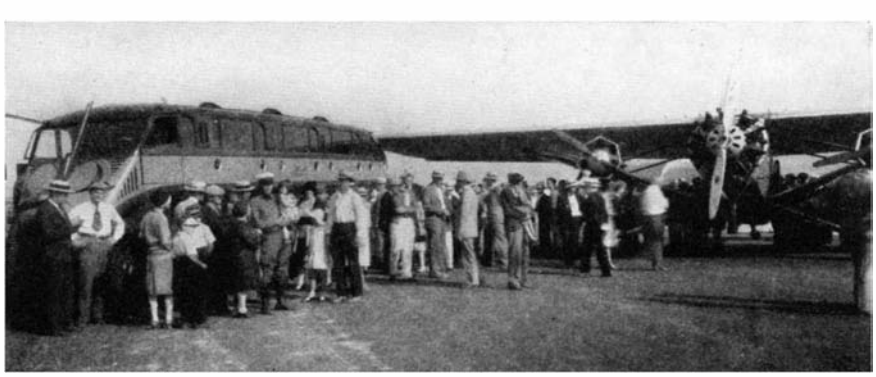
Can steam railways recapture departed passenger traffic by offering tickets for two cents a mile? If this traffic is brought back to the railroads, can they afford to carry it at this pre-war rate and continue the present high wage scales? Can they grant the six-hour day to trainmen, and maintain the wage scales as at present on these low fares?

CAN motor bus and freight truck companies hold and increase their volume of freight and passenger business at rates now very close to, and in some cases below, railroad tariffs?

What will be the fate of air passenger transport now growing in popularity because of lower fares? Air rates now are on an out-of-pocket basis, the service being possible only because of government mail contracts which are, indeed, a fortunate form of subsidy. If air passenger service grows in the future as it is doing at present, how long will it be before the cost of operation and maintenance overtakes the subsidy, and what will happen?

One thing the railroad men say has been proved: Persons with plenty of money never complain about the cost of transportation. Extra fare trains have proved this. Persons of limited means who are in the majority always complain, and then travel in their own automobiles, overlooking what statisticians say is a fact, that no man can motor from New York or Chicago to Los Angeles as cheaply as he can ride on a railroad train.

If the present trend from the railroads continues toward other forms of transportation, is not the country confronted by the danger of government ownership?



A Nitecoach transfers its passengers to a transport airplane. Here are shown together two of the railroads' most feared competitors for passenger business

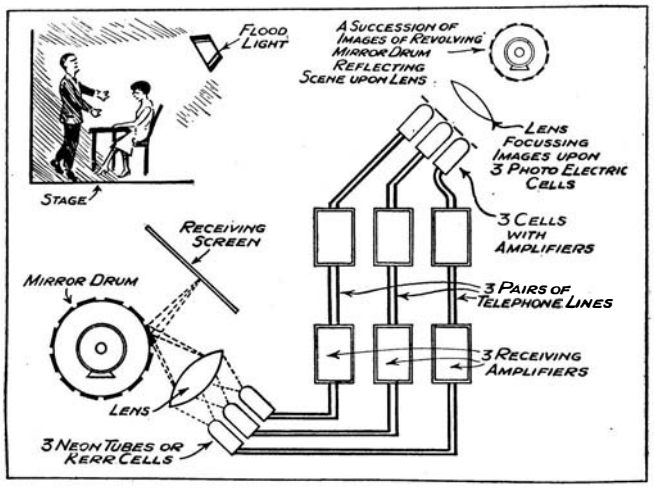
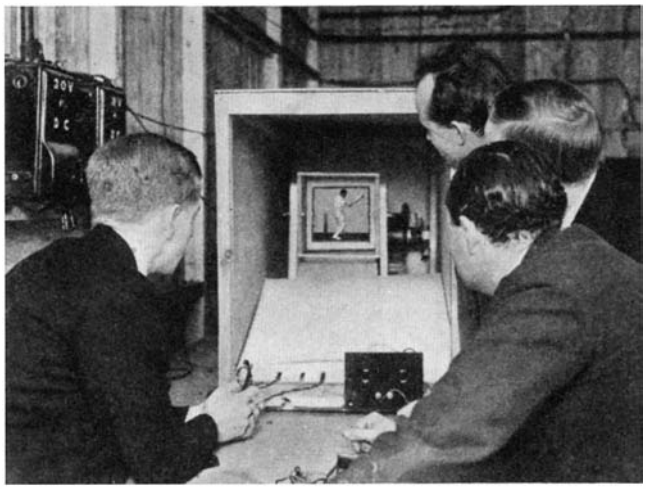


Diagram of the "zone" system of television transmission and reception, using telephone lines to carry the currents



A laboratory set-up of one of the Baird televisors. The half-tone reproduction is viewed on a translucent screen

ZONE TELEVISION AND THE TELEVISION ARC

By SYDNEY A. MOSELEY

ONE of the difficulties in radio television has been to find a sufficient wave band, and until a solution of this problem is found it will not be possible to transmit images containing a very great amount of detail. Where television in theaters and all places of entertainment is concerned, however, this problem does not arise, as the television program can, if required, be transmitted over telephone lines, where two or more channels are readily available. This type of television may be described as "zone" television, and in the Baird laboratories in England a demonstration of zone television was given recently.

An outstanding point of this demonstration was that the light-spot system has been replaced, and instead of scanning the scene by means of a rapidly moving light spot the scene was subjected to ordinary flood lighting. This is a point of some importance, as ordinary scenes illuminated in the usual way can be transmitted by this apparatus—not only scenes illuminated by floodlight, but also scenes by ordinary daylight. Daylight television was, in fact, demonstrated by the Bell Telephone laboratories in this country, and Baird in England, some time ago.

The apparatus used in the Baird zone televisor consists, at the transmitting end, of a large mirror drum with 30 mirrors arranged around its periphery, each mirror being tilted slightly differently from the next. This is the well-known Weiller mirror drum—a device first described by Weiller nearly 40 years ago. The images cast by the mirror drum as it revolves pass over three apertures so arranged that each aperture explores one third of each image. Behind these apertures are three photo-electric cells, connected to the necessary amplifying equipment. Currents from the three amplifiers are then passed by telephone lines to the receiving station.

AT the receiving station the currents are received by three neon tubes, in the smaller type of receiver. These three neon tubes are of a special spot-light type, and the light from them is focused by means of a lens upon a revolving drum, similar to that at the transmitting station, the light being thus reflected upon a translucent screen. The moving spots of light then reproduce the image in three zones. It is exactly as if three television pictures were transmitted by three television transmitters to three television receivers, the three images being placed one next to the other, to form a continuous picture.

The advantage of zone television is that there is no restriction whatsoever as to the detail. Given a sufficient number of zones the detail can be made as great as desired—only, of course, at the expense of further complexity.

In addition to the Baird three-zone apparatus described above, a further advance has been made. This has been called by Mr. Baird the "television arc." Hitherto only two sources of modulated light have been known and used for television—the neon tube, or similar glow discharge tube, and the Kerr cell. Of these the neon tube has definite limitations as to its brilliance, while the Kerr cell, although more brilliant than the neon tube, is an extremely inefficient device. In the Kerr cell, the light from an arc lamp passes through two Nicol prisms, between which is placed a small glass tank containing nitro benzine, in which are immersed two electrodes; the light passes through the narrow space between the electrodes, which are connected to the incoming television signals, and the fluctuations in electrical potential alter the degree of polarisation of the light, and thus regulate the amount of light passing through the device. This entails, however, a very considerable loss of light. The total loss has been estimated at as much as 75 to 80 percent of the light entering the prism. If, now, the light of the arc itself could be modulated, this loss would be obviated, and this is exactly what Baird has succeeded in doing.

Many years ago it was discovered that, if the electrical impulses from a telephone were superimposed upon an arc, the arc would follow the speech modulations and actually reproduce the speech. This phenomenon was well known as the "speaking arc"; but whether the arc could be made to follow the extremely rapid fluctuations of television was another matter and, considering the extreme rapidity of these fluctuations it appeared on the face of it an impossibility. This impossibility has, however, been achieved, and the television arc is an accomplished fact. In a recent demonstration the television signals were superimposed upon a special arc, which replaced the neon tubes, with the result that images obtained were of amazing brilliance. The images were equal in quality to those produced by the neon tube, and incomparably more brilliant.

TIDYING UP THE CONSTELLATIONS

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

FOR so rapidly growing and active a science, astronomy is in some respects curiously conservative. Along with the vast accumulations of modern data, it possesses and still keeps in daily use features which originated back in ancient times. For example the curious system of stellar magnitudes, according to which we represent the faintest stars by the largest numbers, seems grotesque to the student who first encounters it and he is likely to ask why astronomers adopted such a queer backhanded arrangement. The reason is of course that this system goes back to the ancient star catalog of Hipparchus. When accurate measures of the stars' brightness began to be made in the 19th Century the nomenclature by which astronomers were accustomed to describe them was more than 2000 years old. But older terms than this are still in daily astronomical use—so much older, indeed, that no one knows just how old they are.

FROM the remotest antiquity men have noticed that the stars were set in permanent array in the heavens and many of the more conspicuous groups were not merely recognized but named. No one knows when this began to happen—it may have been before recorded history began—but there can be little doubt *where* it happened. The oldest of the constellations bear the names of animals, wild and domesticated—the Ram, the Bull, the greater and lesser Dogs, the Lion, the Bears, the Wolf, the Eagle, the Swan, the Serpent, the Scorpion. Now these are the creatures native to the Near East—the animals of the Bible—and the assemblage points conclusively to a Mesopotamian origin. They can not be Egyptian for there is no hippopotamus and no crocodile; nor Indian—for the tiger and the elephant are absent. The Chinese have to this day an entirely independent system, dividing the stars into quite different groups.

Not all of the greater constellations are of this immemorial antiquity. Another important series bears names taken from Greek mythology—Hercules, Perseus, Orion, Cassiopeia—which again tell their own tale, though these names may have displaced those of more ancient worthies now forgotten.

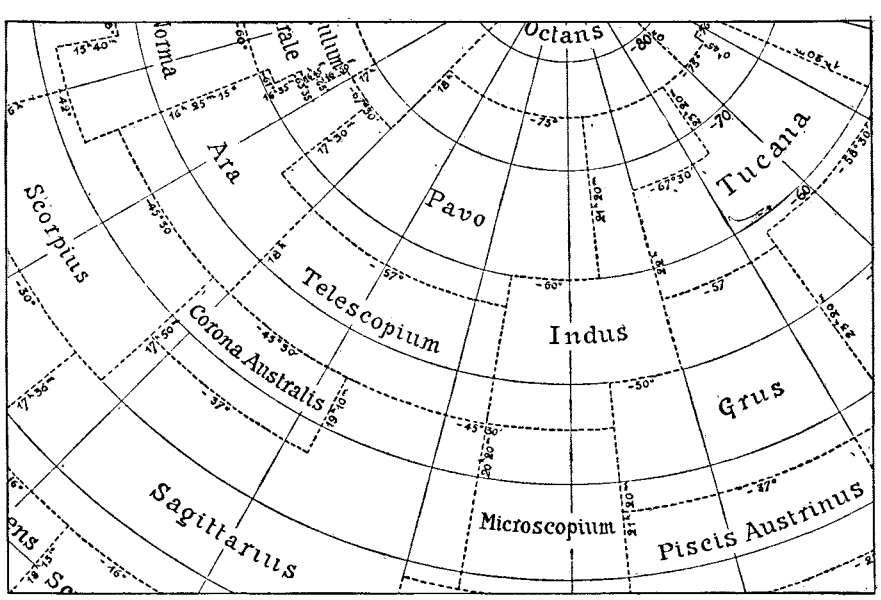
Toward the latter part of the classic times when Ptolemy wrote his famous astronomical treatise, 48 constellations had become established in general usage. These include all the conspicuous star groups which are visible from northern latitudes and some which are by no means prominent; such as Sagitta, Equuleus. How the few faint stars of the latter constellation were ever imagined to represent a "little horse" is a mystery, but the people who named most of the groups must have been blessed with a vivid imagination.

In a few cases some resemblance can be traced between the star group and the figure whose name it bears—the curving tail of the Scorpion, the outstretched wings of the Swan, the circlet of the Northern Crown, and the long lines of the various snakes and dragons —though no terrestrial bears ever had tails as long as those which Ursa Major and Ursa Minor trail across the heavens. Usually, however, the relation is quite arbitrary, yet nevertheless it became stereotyped by convention; so that one could speak of "the star at the end of the bull's right horn" or "in the left knee of Orion" and be fully understood.

This was a clumsy way of identifying the individual stars and so the brightest of them came to have names of their own. Some of these still survive. Many of them are Greek—Sirius, Procyon, Arcturus; a few are Latin—Regulus, Spica; and others Arabic—Aldebaran, Altair, Rigel.

Neither of these methods was applicable when it came to a serious nomenclature applicable to all the stars easily visible to the naked eye. The method which is now in use dates from 1603 when Bayer conceived the idea of designating the stars of each constellation by the letters of the Greek alphabet —*alpha, beta* and so on—followed by the constellation name. Usually but not always he assigned them in the order of brightness; thus *Gamma Geminorum* is the third brightest star in Gemini. In a few constellations—such as Ursa Major—the letters run, in part, in order of the position of the stars. This scheme takes care of 24 stars in each constellation and does very well for the smaller ones. In the larger groups the Greek alphabet runs out and Roman letters were sometimes used for the fainter stars; but this notation is on the way to being dropped by general consent.

ALMOST all the naked eye stars fit into a scheme proposed by Flamsteed early in the 18th Century, in which the stars of each constellation (above a certain limit of brightness) are numbered in order of their right ascension. Thus the star 61 Cygni, though too faint to merit a Greek letter,



A typical section of the (southern) sky, with the formerly meandering borders of the constellations squared up ship-shape and tidy. From the "Atlas Céleste"

is generally known by its Flamsteed number. As a system for labeling the brighter stars this double scheme has proved practical and convenient. The fact that it demands the acquisition of knowledge of the Greek alphabet and of a few Latin forms (the genitive cases of the constellation names) is hardly to be regarded as a loss from the standpoint of general culture.

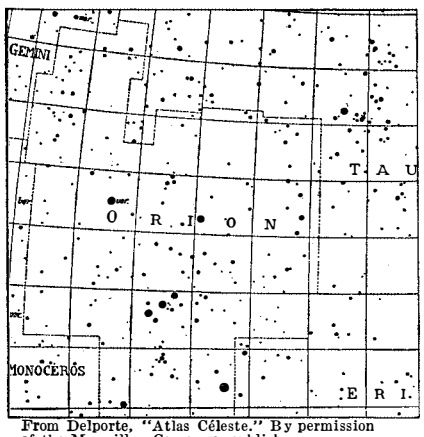
Before this plan was invented it made little or no difference if some of the less conspicuous stars were left outside the constellations. But when the attempt was made to find "a place for everything" it appeared that there were here and there in the skies bits of no-man's-land and new constellations were devised to fill up the gaps. In the northern heavens these naturally occupy dull and almost barren regions, but near the south celestial pole, among the stars unknown to the ancients, some of the new constellations are conspicuous. Only one, however, has made its way into general knowledge and even into poetry—the Southern Cross.

THE half dozen modern constellations in the northern sky have been named in classical fashion—the Giraffe, the Lynx, the Hunting Dog, the Lizard, the Fox. In the southern sky a more modern imagination found its play and a telescope, a sextant, a clock, a microscope, a mariner's compass (Pyxis), an air pump (Antlia), and other tools of science, appear along with the more conventional figures of a dove, a dolphin, a flying fish, a crane, a fly, and the like. Only one of the Ptolemic groups has been modified. The ship Argo occupied such a huge extent of the southern heavens as to be quite inconvenient and it has been divided into three constellations—Puppis (the mast), Vela (the sails) and Carina (the keel). Including these separately, the list of constellations now recognized totals 88.

If the system of naming stars by constellations was limited to those bright enough to be seen with the unaided eye the question could be considered as closed. For the fainter stars, in general, the accepted method is to give the number under which the star appears in some standard catalog; thus, Lalande 21185 is the star bearing this number in Lalande's catalog. (This happens to be one of the nearest in the heavens). This is a rather imperfect scheme, for a star may have as many aliases as a modern racketeer and special codes are used for objects of distinctive interest. Double stars, for example, are known by a letter representing the name of their discoverer, followed by a catalog number. Thus $\beta 648$ represents one of the late Professor Burnham's discoveries.

For variable stars the constellation names are used, preceded by capital letters—R Arietis, S Cancri. As the list of discoveries grew, Z had to be followed by RR, RS . . . RZ; then SS . . . SZ, and so on to ZZ, after which a fresh start was made with AA, leaving enough room for the present, though in time we may have to come to three letters.

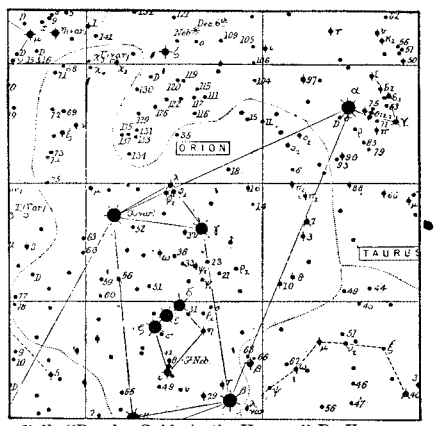
Now there are thousands of variable stars scattered all over the celestial sphere. When a discovery has been published and duly confirmed by further observations, an international committee under the auspices of the *Astronomische Gesellschaft* gives it a permanent designation. This committee must evidently have some established rule by which it may tell in what constellation the new variable belongs; that is, it must have a map upon which the boundaries of all the constellations are exactly delineated. This delineation of the constellations has been entrusted to a Committee of the Astronomical International Union which, working in friendly co-operation with the *Gesellschaft*, completed its work last year and published a star atlas giving the definitive boundaries.



From Delporte, "Atlas Céleste." By permission of the Macmillan Company, publishers

It proved possible to draw limits such as to include all the variable stars which had been assigned to each constellation previous to the middle of 1929 (at which time the committee began to use the new unpublished scheme). The adopted boundaries always follow either hour circles or parallels of declination; that is, they run either north and south or east and west in the heavens. The practical advantage of this is clear. If the boundaries ran slanting, or still worse if they were curved, a laborious calculation would be required to determine whether some newly discovered variable close to the line fell on one side or the other. As things are, a mere inspection of the right ascension and declination settles the matter. To remove all uncertainty the meridians and parallels are adopted relative to the position of the celestial pole and equator in 1875.

The atlas itself, which is published by the Cambridge University Press in England and the Macmillan Company in New York, shows all the stars to the sixth magnitude in 26 maps covering the whole heavens and is a valuable addition to any astronomical library.



Ball, "Popular Guide to the Heavens" D. Van Nostrand Company

A contrast. Constellation of Orion with irregular boundaries and, at left, the same constellation after its boundaries were tidied up by the International Astronomical Union

Lists of all the stars brighter than magnitude 4.5 opposite each chart provide the data for the identification of the more conspicuous stars.

THE ancient mythological figures of the constellations are of course missing, since the atlas is for scientific use. These outlines, drawn after medieval originals, may still be found on celestial globes. A few years ago such globes, which are among the most useful accessories in teaching astronomy, were almost "out of print" (if the phrase may be used) and hard to get, but fortunately an excellent model of moderate dimensions has just been put out by the Rand McNally Co. The novice must remember that he is looking at the globe from the outside, while the stars are placed on it as they would be seen through its surface by an observer at the center. The star groups on the globe are therefore all reversed left for right in comparison with the actual appearance of the sky or of an ordinary star map, and a certain mental effort is required in identifying the actual constellations. A very amusing instance of this was once to be seen in a great metropolitan railway station in New York. The huge vaulted roof of the great hall was decorated—with excellent artistic effect—in gold on a blue ground, with the mythological figures of Orion, Taurus, Aries, and the rest, points of light shining through for the brighter stars. Unfortunately the artist had copied his figures from a celestial globe in innocence of the geometrical trap which yawned before him, so that the effect of the admirable decoration upon the astronomer was decidedly mixed!—*Princeton University Observatory.*

PROBLEMS OF CALENDAR IMPROVEMENT

By GEORGE EASTMAN

OUR present method of marking the progression of the days, weeks, and months is referred to as *the* calendar. As a matter of fact, it would be more apt to describe it, in the words of one irritated student of this subject, as "them calendars," because, instead of one calendar, we really have fourteen. Every one knows that the calendar changes, but few people realize that there are seven different patterns of it for ordinary years and seven for leap years, and that it takes 28 years to complete the cycle of the changes.

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

Every month of every year would be alike. No more of "Thirty days hath September. . ."

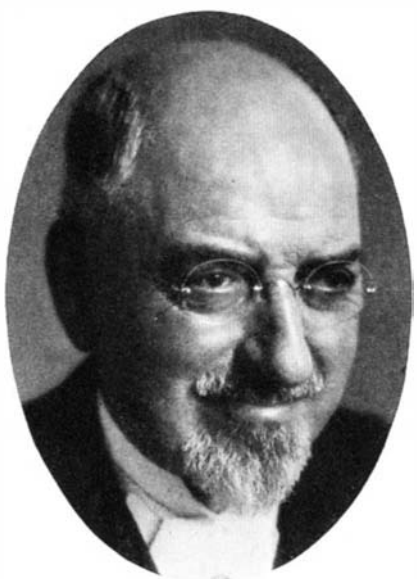
Probably few people realize, too, that these 14 patterns are caused by the fact that our seven day week will not fit in the solar year an exact number of times, there being one week-day left over in ordinary years and two week-days in leap years. The consequence is that January first of each year changes to a different day of the week, and so does every other date. Furthermore, because the months are composed of differing numbers of days, and because none of them except February will contain a whole number of weeks, not even the dates of the months in the same year can fall on corresponding week days. There are no less than 28 varieties of months in the 14 kinds of years. It is quite easy to construct a calendar of a single pattern, and not difficult to establish it.

AS long ago as 1745, a man by the name of Urban, living in Maryland, published in the *Gentleman's Magazine* of London, a proposal to establish a fixed, perpetual calendar with uniform months. He put forward a plan to have 13 uniform months of four weeks each, and to give the left over week-days an individuality of their own, so that all week-days, Sundays, and holidays would stay fixed to unchanging dates.

"How confusedly," wrote this colonial American in the odd script of the 18th Century, "is the year divided into 12 kalendar months, some consisting of 30, some of 31 and February of 28, and sometimes 29 days!

"How preposterously do the days of the week vary in different months of the same year, and again in the same months of different years!"

In 1751, six years later, the British Parliament did, indeed, enact a law for the improvement of the "kalendar," but, unfortunately for posterity, ignored the suggestions of the man in Maryland. The British lawmakers went no further than to adjust the Julian calendar then in use in the British dominions to the Gregorian reckoning, dropping 11 dates from the year 1752 and changing the beginning of the year from March 25 to January 1. The hodge-podge structure of unequal months and independent weeks, the first bequeathed by Julius Caesar and the other jointly derived from pagan astrology and Hebrew religious custom, as historians tell us, was left as it was and as it still is.



Moses B. Cotsworth, widely known exponent of the 13-month calendar

Without doubt the reason that the proposals of Urban failed to receive consideration was that, while they were logical and scientific, they did not seem in that day of much practical importance. When Urban posted his essay from Baltimore to London, it may have been two months enroute. The steam engine had not even been invented and the steam vessel still belonged to a century of the future. Economic life was simple. International intercourse was on a small scale. Agriculture was the dominant occupation. Individual life was less ordered and less dependent upon calendar appointments. The calendar's chief utility was that it accurately marked the seasons for the benefit of the farmer, showing the fixed dates for the equinoxes and solstices. As units of time, the month and week were far less important than the seasons or, roughly, quarters of the calendar year. The complex and swift-moving "Scientific Age," "Industrial" or "Machine Age," as we variously call our present times, had not arrived. Urban, who seems to have been the first man to propose the adoption of a fixed, uniform calendar of 13 months was far in advance of his day.

NOW, under the pressure of vastly changed conditions, intimately affecting every individual, the month and the week have become the paramount units of the calendar. The commercial and industrial agencies of our new civilization require much shorter periods than the seasons to measure their progress and control their activities, as do the scientific agencies for analyzing data. Perforce, they must use the month and week, because these are the only short units which the calendar provides. This being so, the fact that the months are not symmetrical and the weeks can neither symmetrically nor permanently be fitted into them, calls loudly for the reform of the one and the adjustment of the other.

Such is the purpose of the international movement to improve the calendar, which took shape about ten years ago, and will culminate in the International Conference to be held at Geneva next October under the auspices of the League of Nations. Various plans will be considered at this Conference, but in my personal judgment, none is superior to the plan for 13 months of four weeks, each month with week-days fixed to perpetual dates. Others since Urban's day have proposed this plan with the details worked out in different ways. In the present century, Moses B.

Cotsworth has undoubtedly done more than any other man to bring its advantages to public attention. Mr. Cotsworth has worked out the details in admirable fashion, with careful regard for usages of the calendar already fixed by science, and with as much respect for tradition and established terminology as is consistent with the essential changes. In substance the plan is this:

Those months which now have 30 or 31 days would be shortened to 28 days each, like February. The days thus removed, except one (two in leap years), would be combined into another month of 28 days called "Sol" and placed in the middle of the year between June and July. With "Sol" in this central position rather than at the end of the year, the other months would hold their places in the seasons. Thus with each month the same length as another, and each containing exactly four weeks, the problem of uniformity is simply solved.

THE problem of fixing the week-days to the same dates each year is likewise easy. It is logical and desirable that the first day of the year should always coincide with the first day of the month and with the first day of the week; that is, that January 1 should always be Sunday. To accomplish this all that is necessary is to give a separate name to the extra week-day beyond 52 weeks that occurs in every year at present, and a separate name also to the additional extra week-day in leap years. Mr. Cotsworth has suggested "Year Day" and "Leap Day" as appropriate names. In this way the one or two days not needed for "Sol" would be taken up.

It is easy to see that then, not only would every year always begin on Sunday, but each of the 4-week months would always begin on Sunday, and every week-day would fall on the same four recurring dates in every month. Saturdays, for example, would always be the 7th, 14th, 21st and 28th. Month ends would coincide with week ends.

Since "Year Day" and "Leap Day" would need dates as much as the other days, he gives the one the date December 29, the other the date June 29, and proposes that both be holidays. Thus, calendrically, each would have a place in a month. "Year Day" would at the same time become the 8th day of the last week in December, and "Leap Day" the 8th day of the last week in June every four years.

The placing of all the present holidays on a Monday, as is done at present with certain holidays in Australia, and the fixing of Easter, if the churches agree, complete the details of the plan.

The manifold benefits which would be conferred by a calendar of fixed week-days and uniform months in all our affairs, public and private, have been frequently described and need not be repeated here. Various other calendar plans now being urged remedy some defects of the present calendar in one way or another, but it can be shown that there is none other than the 13 months fixed calendar that can remedy all the defects and at the same time meet *all* the four following requirements of an ideal universal calendar for our civilization:

1. *Continue to keep the calendar in step with the solar year;*
2. *Keep the 7-day week as a time unit;*
3. *Fix the week-days to perpetual dates;*
4. *Establish uniform months commensurate with the weeks.*

From the point of view of these requirements, some of the other proposals are interesting to examine. The plan known as the 12 month equal-quarters fixed calendar has gained favor among those who feel that introducing a new month would be too much of a departure from tradition to be acceptable. Under this plan each quarter would consist of months of 31, 30 and 30 days, or in reverse order. Also, as in the 13 month plan, a "Year Day" and "Leap Day" would take up the extra week-days. This kind of calendar does Numbers 1, 2, and 3, but not 4. Only the quarters of the year are commensurate with the week, each having thirteen. Its months all contain fractions of weeks and are not themselves uniform, as in the present calendar. It does not do the whole job.

NOT a few schemes follow the principle of the calendar which we are told the Russians are using, dividing the year into 12 months of 30 days each and placing 5 or 6 holidays here and there to take up the slack. The months in these schemes are divided into 6 five-day weeks or 5 six-day weeks. This principle does numbers 1, 3, and 4, but fails at 2. It is surely too radical a departure from our hebdomadal rest-day system to stand a chance of acceptance with most of us.

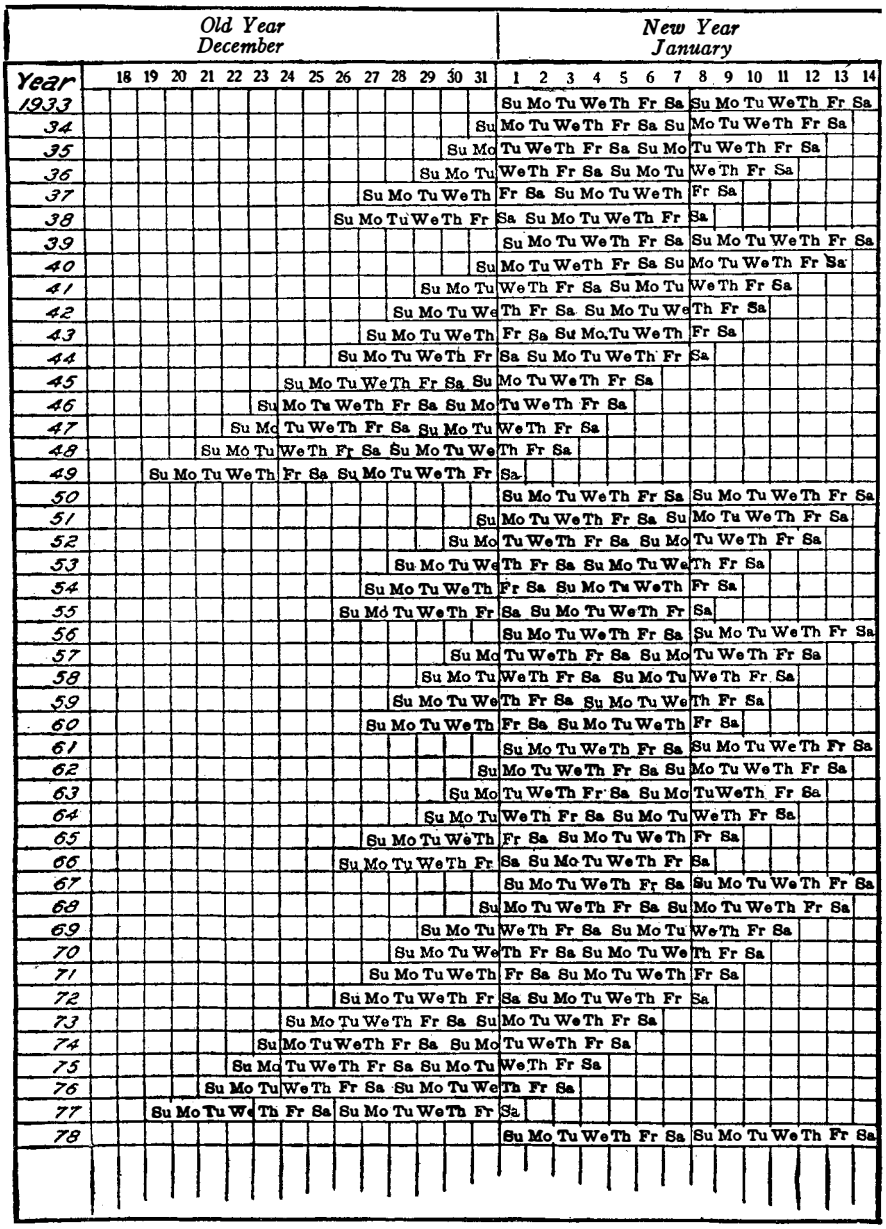
MONTH	1st WEEK							2nd WEEK							3rd WEEK							4th WEEK							5th WEEK							6th WEEK		MONTH
	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	
Jan					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31			Jan
Feb	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28										Feb
Mar	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31							Mar
Apr				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30					Apr
May						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		May
Jun	1	2	3	4	5	6		7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30							Jun
July				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31				July
Aug							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Aug
Sep	1	2	3	4	5			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30						Sep
Oct					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31			Oct
Nov	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30								Nov
Dec		1	2	3	4	5		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					Dec

What a contrast between the present calendar (shown above) and the fixed 13-month calendar below; the one a hodge-podge, the other orderly, uniform, and systematic

MONTH	1st WEEK							2nd WEEK							3rd WEEK							4th WEEK							NO SPLIT WEEKS
	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	
Jan	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Feb	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Mar	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Apr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
May	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Jun	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29 "LEAP DAY" EVERY FOUR YEARS
Sol	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
July	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Aug	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Sep	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Oct	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Nov	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
Dec	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29 "YEAR-DAY"

Another scheme quite eloquently advocated rejects the "Year Day" and "Leap Day" principle, and sets up arbitrary calendar years containing an exact number of weeks. It would begin with a short year of 364 days, or exactly 52 weeks. The calendar year would then divide into 13 four-week months without remainder. The one or two extra days necessary to complete the solar year would be set aside in the first and following years until they amount to a week and then put back into the calendar as a 53rd or "leap week" every 5 or 6 years.

Superficially this seems to be an elegant solution of the problem of uniformity for a 13-month calendar, with the leap week coming only occasionally. It has been particularly urged by cer-



How the weeks of the present calendar drift, day names changing to different dates each year. A sample taken out of our present calendar at the New Year

tain religionists who object to the "Year Day" principle because it interrupts the perfect sequence of their Sabbath. But so many practical objections have been raised to this solution from scientific, economic, social and religious points of view, that one can imagine most people preferring the present calendar as less objectionable. Obviously it does not meet requirement Number 1, and in failing to do so, it is declared with reason that to adopt such a scheme would be a retrograde step in the long evolution of the calendar to its present state of perfection as a measure of the solar or tropical year.

Certainly a calendar of long and short years would be impracticable for scientific and astronomical purposes. The length of the tropical year is now 365.24219689 days according to Newcomb's equation. The Gregorian leap year rule, which omits three leap years in 400 years, so adjusted the calendar that it marches very closely in step with this equation, and it will continue to do so for quite a long time. It is possible to adjust it still more closely by a more accurate rule, but the vernal equinox, the pivot of any solar calendar, is kept by the Gregorian rule fairly constant to noon March 21, the 80th day in the calendar year. The proposers of the leap-week scheme seem not to apprehend that, by omitting from the calendar one or two days each year and then putting back seven of them every 5 or 6 years, the date of the vernal equinox would be dislocated and oscillate from year to year to different dates. Worse than this, if this calendar is always to begin on Sunday, it will be necessary, at certain intervals, to accumulate the extra week-days for as much as 11 years and then insert two weeks. This would cause an extreme oscillation of the vernal equinox from the 80th to the 94th day of the calendar year. Such fluctuations of this and the other tropical dates would, for one thing, throw the Nautical Almanac into confusion and perhaps, I am told, lead to marine disasters.

Some years in such a calendar would be 364 days in length, some 371 and some 378. Such long and short years would seriously confuse the Julian day count used by astronomers. Such years are not comparable for economic and scientific data. No one would know his age with precision. It would confuse the calculation of actuarial tables, pension plans, annuities and the like, make difficult the fixing of anniversaries and dislocate the liturgies of churches.

SOME who are opposed to a fixed calendar advocate the adoption of the foregoing leap-week scheme for business uses only, leaving the present calendar as it is. As a means of obtaining the advantages of fixity, as they conceive them, they have devised a system for numbering the weeks by the number of their Sunday in the year and designating dates by them. Such a week-numbering and week-dating system, it is claimed, would give the advantages of a fixed calendar because days in numbered weeks would have a permanent relation from year to year, and what are defined as "permanent schedules" of business and community events could be satisfactorily arranged. They suggest that this system, extensively used by business, would come to be used by the public. An example given is "F-51-1931," or Friday of Week 51, as the date of Christmas this year. A fair held from Monday, August 10 to Saturday, August 15, 1931 would be dated as Monday to Saturday of Week 32. Such events, it is suggested, could always be held according to a numbered week.

The advocates of this scheme probably are not aware that similar dating schemes have already been tried by business concerns now operating on the 4-week period system, and given up as impracticable. Experience has shown that confusion and mistakes occur when dates such as 4-6 (4th period, 6th day) also have to be referred to by the dates of the regular calendar, as is often necessary in actual practice. Further, no solution is offered for the difficulty of holidays and other anniversary dates changing to a different week-day each year and drifting from one numbered week into another and in some cases, from one 4-week period into another. The latter inescapable difficulty is one of the disadvantages of using the 13 four-week period system in business at present.

As to the week-dating system from the point of view of the public, it is not difficult to show by calendar tables that,

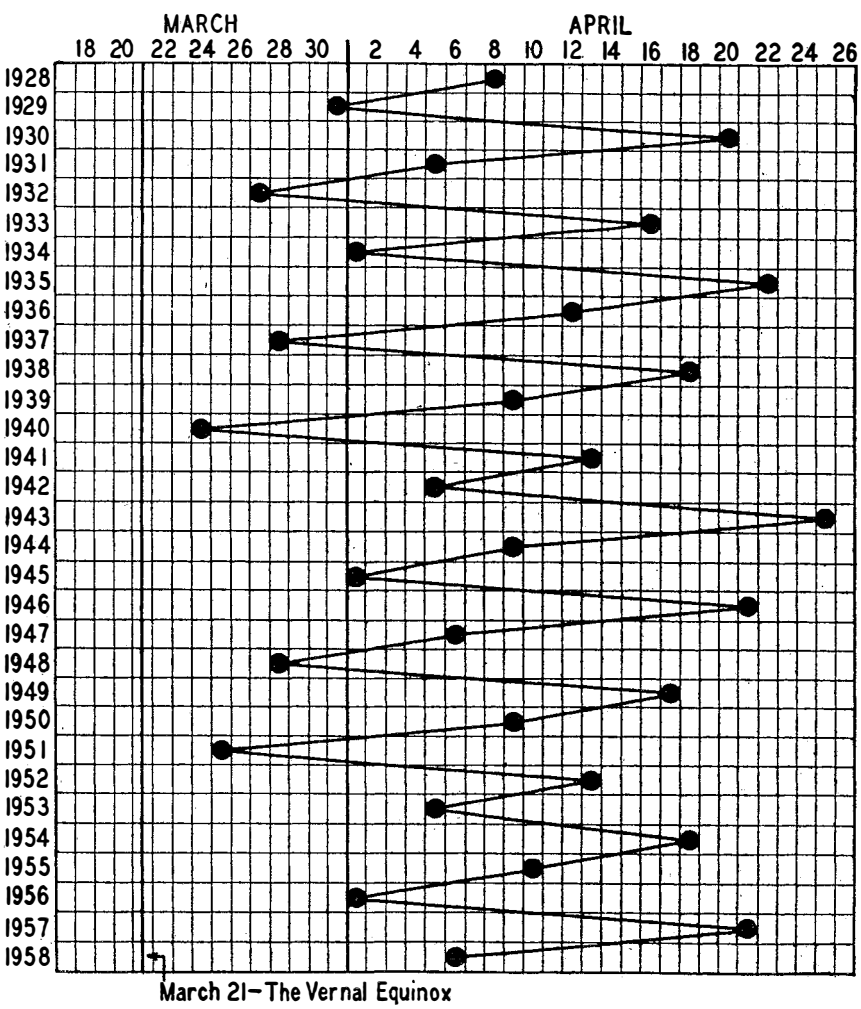
if *every* week of the weekly cycle is to be counted and numbered according to its Sunday, one week or another that follows a Week 52 and is partly in one year and partly in another, must be omitted from the count, else the following year will have a Week 53. Presumably the proponents do not intend to have us omit a week from the count, but on the other hand if one is not at some time omitted, the end of Week 52 will always drift back to December 24, leaving a complete week at the end of the year. A Week 53 is inescapable. In this week Christmas will fall. In other words, Christmas can not regularly fall in the same numbered week each year (Week 52) without leaving one week of the cycle unnumbered from time to time.

Again, if the scheme does omit a week, as is perhaps inadvertently the way the proponents arrive at their illustration "F-51-1931," it is easy to show that Christmas can not regularly fall in Week 51, but sometimes in Week 52. Likewise, it is easy to show that Week 32 as the date of the August fair will in some years become Week 33 unless the number of one week is from time to time omitted from the cycle. In either case, arranging schedules of fairs and the like by numbered weeks compels them to fall on a different set of calendar dates each year. It is difficult to see just where the character of permanency resides in this scheme.

Indeed, it seems fantastic to suppose that the public would welcome any sort of week-dating system as a convenience. Without referring to a complicated, annually-changing, printed calendar on which the weeks are numbered and graphically distinguished from the months which they overlap, who of us could easily remember in what part of the year or in what month the 39th week would fall, for example, to say nothing of having to keep account of the irregularly recurring Week 53? The whole scheme obviously not only fails to meet requirements No. 1 and No. 3, but as a device for remedying the defects of the present calendar is "confusion worse confounded."

Still other schemes, without altering the length of the year, provide for greater uniformity of months or quarters as far as possible, without taking up the extra week-days with special names. These fail, of course, to meet requirement No. 3. We should still have 14 different calendar patterns.

The delegates to the Geneva calendar conference will doubtless thresh out the advantages and disadvantages of all these proposals and make a decision. The program is for them to consider calendar simplification from the economic and social viewpoint, and draw up a treaty for the ratification of Governments with an agreed date for putting the improved calendar into effect. The Conference, of course, will take into consideration the views that may be expressed by interested religious bodies in so far as any change may affect their creeds, dogmas, or traditions, For putting a new calendar into effect legislation to legalize the changed dates is all that is necessary. The inconvenience of adjustment would quickly disappear.



The present date of Easter is governed by the first full moon after the vernal equinox, and drifts 35 days between March 22 and April 25, as indicated

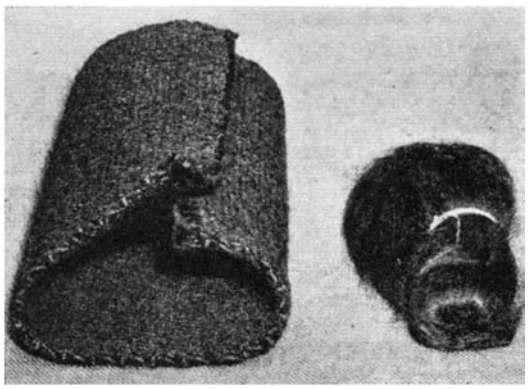
DR. CHARLES F. MARVIN, Chief of the United States Weather Bureau, and, I believe, our foremost American authority on the calendar, has suggested a time and way for putting a fixed calendar into effect which is of most interesting significance to Christianity. It happened that the Gregorian reckoning adopted in 1582 A.D. corrected the Julian reckoning only as far back as the year 325 A.D., the year of the Council of Nicaea, when the rule for fixing Easter was established. Pope Gregory made this much needed correction by dropping 10 dates from the Julian calendar, so as to restore the vernal equinox to March 21, its date in 325 A.D., and re-establish correct dates for the Easter festival. If, however, he had dropped out two more dates, he would have corrected the Julian reckoning back to the year 1 A.D.

Dr. Marvin suggests that these two dates could now be dropped in connection with the adoption of a new calendar, thus making our chronology exact from the beginning of the Christian Era. If the dates December 30 and December 31 of 1935 were omitted, and the first "Year Day" inserted as December 29, then January 1, 1936 would be Sunday. If this were done, it is of remarkable interest that every year in a fixed calendar started in 1936 would be an exact counterpart of the year 30 A.D., the last year of the life of Christ. The Crucifixion occurred in that year on the 97th day which was a Friday and the Resurrection on the 99th day which was a Sunday. If the new fixed calendar were started in the above manner, these two days would always be Friday and Sunday respectively, always the exact anniversaries in day name and number in the year of these two fundamental events in the history of Christianity. Instead of the present wandering date for Easter, the festival could always be celebrated on this true anniversary Sunday. If the churches agree, it would be simple under a fixed calendar to fix a permanent date for Easter.

TONS OF HUMAN HAIR IN INDUSTRY

By GRACE LOCKHART

IN the city of Augusta, Georgia, famed for fair skies, magnificent pines, and superlative winter golf, is a unique, little known, and interesting industry conducted by the Southern Press Cloth Manufacturing Company. The finished product is a coarse, tough fabric known as "oil press cloth," woven of Chinese hair. The cloth is used for the extraction of oils from vegetable seeds—cotton-seed, flaxseed, linseed, copra, the cohune nut, and the sunflower seed—and, in some forms, in pressing vinegar, syrups of various kinds, malt liquors, cocoa-butter, glucose, and similar industrially pressed products, where a medium is required that permits free drainage and is able to withstand great pressure and extreme changes in temperature.



THERE are only four plants in the country engaged in the manufacture of press cloth, and of the 3,000,000 pounds of Asiatic hair imported annually for press-cloth purposes, the Augusta plant uses a large proportion. Its busy looms last year turned out 133 lineal miles of this strange fabric, sufficient to carpet the fairways of both championship golf courses at the Augusta Country Club.

Based on the Bradford draft system of wool spinning and weaving, press cloth is made in this country in Georgia, Texas, Louisiana, and South Carolina. Abroad, important plants are located chiefly in France and Germany. Augusta is the second largest inland cotton market in the world, receiving 1000 bales every day including Sundays, and the press cloth factory, established in the year 1916 near the Carolina piedmont section, is a highly important link in the economic chain of cotton-seed oil mills. Of these there are some 600, five of which are located in Augusta. The oils and their derivatives are used for many purposes such as salad oils, shortening, butter substitutes, soap stocks, paint bases, and medicinal compounds.

Formerly the individual landowner, needing essential oils, crushed his oil-bearing seeds in hand presses. For production in commercial quantities, the hand press was, of course, wholly inadequate. Gradually was developed the present powerful hydraulic press. To meet the requirements of the hydraulic press, "oil press cloth" was designed and perfected. Thereby was opened up an important new market for Chinese hair, discovered to be the most satisfactory fiber for withstanding the terrific heat and pressure to which the cloth is subjected.

Upper left: **A piece of press cloth and a hank of Chinese hair from which this material is woven.** *Above:* **Sorting a shipment of hair at a press-cloth factory**

An eight-press mill, operating on standard schedule, can put through 25,000 tons of cotton seed in a seven- to eight-month season. Out of this quantity are produced 7,500,000 pounds of crude oil—about 300 pounds of crude oil to every ton of seed.

The cotton-seed meats are first run through a crusher where the oil cells are literally "unlocked." The mass is then heated in steam sectional cookers to about 180 degrees Fahrenheit, whence it emerges through a mechanically operated gate into what is known as a press former. Here, wrapped in press cloth, and placed on a steel pan, it is charged into the press. When the press, which consists of about 15 boxes separated by steel plates slotted for drainage, is completely charged, hydraulic pressure is applied at from 3500 to 5000 pounds per square inch. It requires from 20 to 30 minutes for the press column with its slotted plates and charge of meats to move up and back down again.

Although apparently level in the boxes when the press is charged, the meats, when pressure is applied, begin to seek a true level. This stretch-out is known as the "crawl of the meats," and the pressure in every direction subjects the cloth to terrific strain. The increasing temperature of the meats to about 240 degrees, Fahrenheit, during the process, through reduction in volume and increase in density, adds heat to strain. The ammonia content, high degree of moisture in the seed, and free fatty acid in the oil tends further toward the destruction of the cloth. The average life of press cloth under ordinary cotton-seed oil milling conditions is 7 to 15 days. Under linseed-oil milling conditions, the cloth lasts considerably longer. Usually it burns out before it disintegrates or wears out.

Thus it may be seen that no ordinary fiber can be used for the manufacture of press cloth. In the early days of press-

cloth manufacture, Russian camel's hair was considered the peer of fibers. Press cloth, first manufactured in this country toward the end of the 19th Century, was made almost entirely of this material. During the World War, however, camels were used as beasts of burden in the Russian armies for transportation of munitions and supplies, and were rapidly slaughtered in battle. As a result of the extinction of the Russian herds, it became practically impossible to obtain camel's hair for commercial use.

AS usual, necessity was the mother of invention. The industry looked around for substitutes. Chinese camel's hair was tried first. But the herds were relatively small and the quality of the hair not as suitable. At one time or another various fibers had been tried and found wanting—cotton, horsehair, cattle tails, wool, mohair, and llama hair. These had proved either too costly, or too easily destructible. Finally press-cloth analysts experimented with Chinese human hair. Perfect!

Of the several types of human hair used for commercial purposes—Italian, Czechoslovakian, German, and Asiatic—oriental hair is markedly superior for press-cloth purposes. Grown on the heads of people born to manual labor and outdoor life, it has more resiliency, greater tensile strength, is larger in diameter, and has more oil cells to the strand than average human hair. Likewise it has none of the brittle tendencies common to horsehair, cattle tails, or hog bristles.

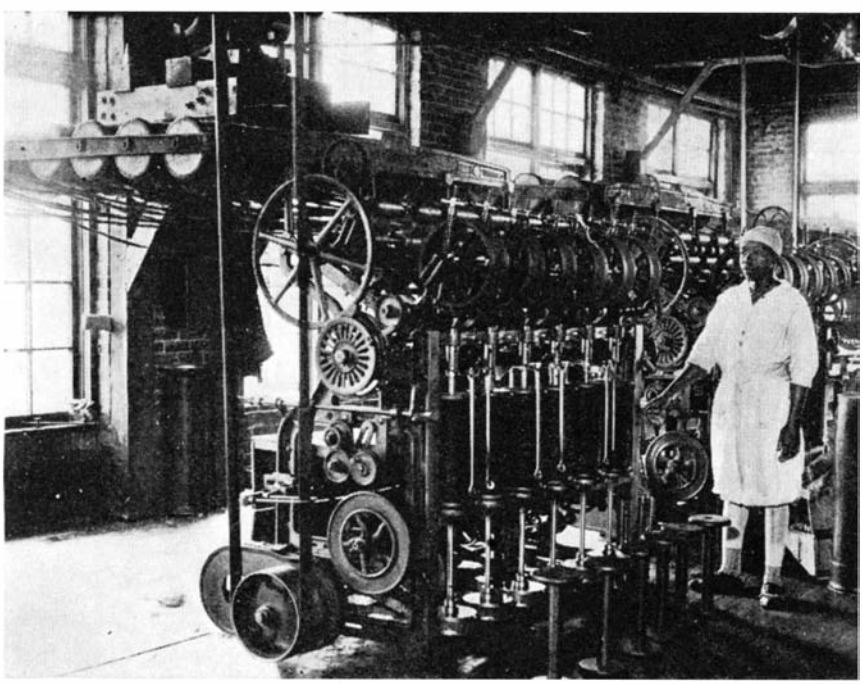
Cultivation of hair, therefore, is an important business to China's millions. The general opinion that queues furnish the bulk of the shipments is incorrect. In 1910 Manchu orders against this sign of bondage occasioned millions of queues to be lopped off which, incidentally, were cashed in by the millions for a bowl or two of rice. Since that time women have almost entirely monopolized the sale of human hair. Eight- to fourteen-inch hair is the desirable length for press-cloth use, the average feminine Chinese head producing 10 or 12 ounces of hair a year.

The hair is gathered in China's sleepy interior, and from her far outposts by oriental dealers who have built up their business through the years. They are more or less vague about the hundreds of thousands of families from whom they obtain hair of the required length and consistency.

So-called "sidewalk barber shops" are common in China, a "seat on the curb" as it were, where the barber cuts his customer's hair for the value of the hair. Then there is the itinerant barber who goes to his customer, and who cuts tresses for their market value.

So in various and devious ways and means the hair is gathered. Thence it passes through the hands of countless middlemen, is sorted, graded and prepared for re-sale to the Chinese merchant. Next it is carted by mule or camel, floated on a flatboat, or freighted in junks to a central city or point of navigation.

Arriving at the factory the bales are unpacked and the bundles sorted, dusted, and cleaned. The hair is put through a scouring machine, washed in water, and dried. Then it is blown by compressed air through a pneumatic tube to the processing department where it is neatly combed with a giant comb having steel teeth, and "drawn"; that is, its length increased and its diameter decreased. It is now ready for spinning. By a reducing process the diameter of the spun hair is further decreased, and the strength increased by twisting into 2, 3, or 5 ply threads. Finally the separate strands are twisted together to form the finished yarn. Out of this yarn, press cloth is woven on massive looms in widths ranging from 11½ to 22 inches and in single or double thicknesses, with heavy center and light edge, with light center and heavy edge, in twill or diagonal weave as is required. The cloth is woven in continuous lengths and wound in rolls containing about 400 feet.



One of the machines used in the preparation of press cloth from Chinese hair. Here the cleaned and stretched hair is twisted into strands of 2, 3, or 5 plies

Chinese business greetings: See translation in column directly below

BECAUSE of the distance of the source of supply—it is 15,000 miles from the farthermost point of supply to the Augusta mill—it is necessary to keep the hair crop moving smoothly through the channels of trade. A reasonable stock must be kept on hand, and in process of production and distribution. Commitments must be made far enough ahead to ensure a steady supply on hand at orderly spaced intervals without overstocking the shelves.

Gold paper scrolls, hand lettered in Chinese symbols, hang in the office of Mr. Fielding Wallace, president and owner of the Southern Press Cloth Manufacturing Company, presented to him at the conclusion of a year's business transactions between East and West. They say:

"Alert by activity you have achieved success and your ancient repute is rooted like an oak."

"May you forever gain wealth and vast estate, winning the trust of all."

THIS NEW BIG BUSINESS OF GARDENING

By ARCHER P. WHALLON

HE was a familiar and pathetic figure, as he sat with hunched back on the seat of his ramshackle wagon. His strident voice vied with creaking wheels, as the bony horse plodded its dejected way up and down the streets of the old home town, inviting thrifty housewives to penny-pinching dickering for potatoes, cabbages, beets, carrots, turnips.

Such was, and possibly even now is, the mental picture carried by most of us of the market gardener, a sorry old fellow, peasant-like and humble, willing to bend his back in interminable weed-pulling for a pittance, flattered by the condescending patronage of main-street magnates, the butt of small boys' pranks, and of his more fortunate neighbors' commiseration.

He still survives, but only as a curious and archaic figure. In the present-day production of vegetable crops, his place is inconsiderable. The one-time job of manual drudgery has grown up into a mechanized industry in which the poor, old, hoe-wielding gardener has scarcely a larger place than has the village blacksmith in the modern steel industry.

TURN now to modern scenes: greenhouse ranges that rival in size and value large manufacturing plants; a fleet of 124 large tractors run by a canner of sweet corn and peas; 400 acres under the overhead irrigation pipe lines of a New Jersey gardening corporation; 250 acres of onions in a block cared for by a fleet of 20 garden tractors; a grower of 175 acres of dandelions—truly, it seems, the modern vegetable grower is a big business man.

This transformation of individualized manual drudgery to a large scale mechanized industry, though it really began a quarter of a century ago, has had a most pronounced acceleration in the past five years. Several interlocking influences have contributed: the development of efficient methods in the transportation, preservation, and marketing of fruits and vegetables; a pronounced change in American diet and living conditions; the mechanization of agriculture; the conquest of intensive cultivation by mechanical and technical innovations—the modern greenhouse, sprinkler irrigation, the garden tractor and its allies—in a way that would once have been thought impossible; and the introduction of many new and improved vegetable crops.

Cultivating with a one-wheel garden tractor, the modern farm horse

It seems almost incredible that New Yorkers are now devouring head lettuce and melons by the car load, grown in a region 3000 miles away that scarcely more than 50 years ago was marked on the maps as the "Great American Desert." There is also no small contrast between modern refrigeration and storage methods and that of the Frenchman, M. Rose Charmeux, who in 1852 invented a device for the display and conservation of fresh grapes—a rack fitted with rows of bottles of water, each holding its portion of fruit-bearing vine. Progress continues. To the refrigerator railroad car has been added the refrigerator motor truck. Dry Ice (solid carbon dioxide) and Silica Gel promise still further facility in the transportation of fresh produce from the grower's fields to the grocer's counters. But there is no pause here. Before me is an advertisement in a French horticultural publication offering airplane delivery of flowers and plants; in Germany, a considerable quantity of perishable fruit is now being shipped by air. In one case reported, 800 pounds of German strawberries, shipped from Berlin in the morning, arrived at Copenhagen, Denmark, in three hours. Thirty hours would have been required by rail.

IT is impossible to foretell what the effect of rapid air transportation of southern grown fruits and vegetables will be. It will undoubtedly influence the business of the northern grower, the greenhouse man, and the canner. But it is unreasonable to expect that these branches of the vegetable industry will not be able to survive this increased competition, for each has its own field of advantage. Closer territorial specialization may follow, the commercial production of different crops probably being more closely restricted to regions particularly well suited to their growth. Understand, also, that the advantage of the greenhouse man is not merely that he can grow crops "out of season," for the term "season" with regard to most vegetables is becoming obsolete, but that with his superior control of growing conditions, he can produce vegetables of a quality unapproachable by the outdoor grower in any climate.

To make better foods at lower prices: An overhead sprinkler irrigation system in use in the production of root crops

Furthermore, the canner's business is not the mere preservation of fruits and vegetables, but the manufacture of them into a delectable and immediately available table product. He has even complied with the modern woman's predilection for "cooking with a can opener" by packing canned boiled potatoes, "so convenient for making a potato salad," and one need but inspect the shelves of

a single first-class grocery to see how thoroughly the canning trade has searched the cooking lore and the kitchen art of the four corners of the globe.

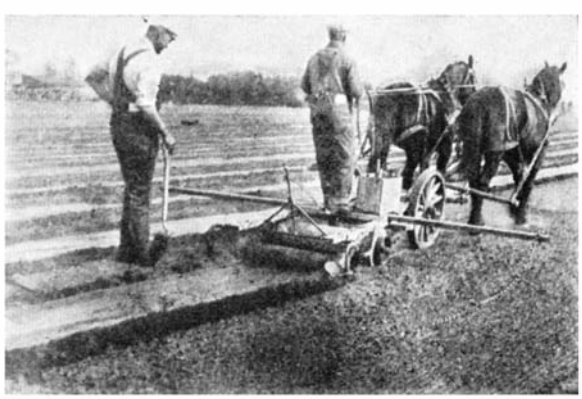
Coincident and closely linked with this change in the production and distribution of fruits and vegetables, a marked change in the American diet has taken place. To this, better living conditions, better home heating, a decline in the necessity for hard manual labor, a better understanding of the nature of a balanced protective diet and of the value of vitamins, have all contributed. In most every trade the old, hard, heavy, energy-consuming, manual labor jobs are being eliminated, and the great mass of working people no longer have the ravenous appetites of wood-choppers and roustabouts. Carried about in automotive vehicles, we no longer have to feed heavily to compensate for the energy lost in walking; in well heated homes, we need not practice the meat gluttony of the Eskimo to keep us warm. We are becoming increasingly epicurean, and whereas the old diet consisted primarily of bread, meat, potatoes, coffee, and sugar, we are now eating more fruits and vegetables. This change in diet is beginning to influence crop production; it shows in the low price of wheat and corn, and will tend to restrict staple crop production further.

A profitable crop of choice greenhouse cucumbers showing the stick and overhead wire-mesh support. Notice the sprinkler irrigation pipe in operation

Another factor is the readjustment of agriculture caused by the rapid extension of the use of large automotive machines, particularly in the western grain and corn belts. This is gradually forcing small farmers out of grain and staple crop growing and into intensive cultivation of fruits and vegetables. The capital requirement for efficient grain growing is rapidly becoming by far too heavy for the small farmer. Let a man try to equip himself with the large modern machinery for corn and grain growing—tractor, corn picker, and combine—and he will soon find 10,000 dollars' worth of machinery on his hands. This is impossible to the large proportion of eastern farmers cultivating from 40 to 80 acres.

A large size, riding-type powerful garden tractor is used to advantage for pulling an efficient field crop spraying outfit

But if, to the small farmer, one door is being shut, another is being opened. The man who cannot afford a 4000-dollar tractor and combine harvester outfit, can use to advantage a 300-dollar garden tractor, and will often be able to produce a much more profitable crop if he abandons corn and grain growing entirely. This garden tractor, with the great variety of auxiliary equipment now available, enables one man to accomplish as much as could 10 men working with the old man-power gardening implements. It is now possible for the small farmer to cultivate the same acreage in fine garden crops that his father did in general farming.



A horse-drawn mulch paper layer. As the paper unrolls, plows throw soil on its edges to hold it

Other technical developments in vegetable production increase the efficiency of the worker and eliminate risk and loss. Peat pots, hotbeds, and greenhouses assure early starting and safe maturity of crops. Hotkap plant protectors protect them from frost and insects. Automotive plant setters set such small plants as celery, onions, and lettuce as close as four inches apart in the row. These machines steer themselves across the field and for precision and delicacy of touch rival the complicated automatons of the textile and printing trades.

Mulch paper covers the ground, conserves soil moisture, prevents weed growth, and eliminates the larger share of cultivation. Overhead sprinkler irrigation systems assure a crop regardless of drought, and give frost protection. Tractor-mounted sprayers and dusters defeat insect and fungus foes over 20 or more acres a day. Revolving comb weeders pull weeds from the onion rows and do away with hand weeding. The electric tomato pollinator assures full crops both in the greenhouse and in the open air. Ethylene gas blanches celery and ripens and colors melons and tomatoes. Still the list is incomplete—vegetable washers, sorters and graders, bunch tyers, onion set planters, soil shredders, bulb planters, onion toppers, canning plants—these and more show how completely the work of the gardener has been mechanized.

WHERE the old time gardener was restricted to the old home town or to the tender mercies of city commission merchants, his successor now markets his product by motor truck over a radius of a hundred miles, and if his produce fails of ready sale, his

home canning plant converts it into a non-perishable product. The vegetable grower is no longer helpless in a buyer's market.

Now this long array of gardening equipment is not really as formidable and forbidding to the beginner of small means as at first thought it might appear. The initial capital requirement is small in relation to the size of the opportunity and the possibility of quick returns. Most of the units are small and inexpensive, and it is not necessary for the beginner to have everything at once.

A "horse that doesn't eat its head off." A medium size garden tractor is used for heavy cultivation

For the man who is willing to work rented land, and who is able to hire his plowing done, 200 dollars is enough to start business. This will more than buy a small garden tractor and all the necessary cultivating tools. Tractors of this type are usually fitted with 2½ horsepower motors and weigh around 200 pounds. They are too small and light to do much plowing, but are entirely practical for row crop cultivation, and fleets of a dozen or more of this size of tractors are used by many large growers.

IF one raises crops drilled in the row, a seeder costing around 20 dollars is necessary, but if operations are at first restricted to hill-planted crops such as potatoes, sweet corn, melons, cucumbers, squash, tomatoes, peppers, egg plant, cabbage, cauliflower, and broccoli, even this is not required. All these and more can be taken care of with the small cultivating tractor, some kind of sprayer or duster, and some cheap, simple hand tools. A 10-acre crop is well within the capacity of such an outfit.

The equipment of the man who does his own plowing and heavy work and is entirely independent, is naturally, somewhat more expensive. He has the choice of three alternatives. He may invest in a medium or large size garden tractor outfit, or in the British-built once-over rotary soil tiller now being introduced in this country, or he may prefer to buy a used regular farm tractor to do the heavy work and a small garden tractor to do cultivating. In any case, the price of a very complete outfit will not be far from 500 dollars.

There is, of course, no plain line of demarcation between medium and large garden tractors, a progressive gradation in power and price being available. Those of three or four horsepower, costing from around 250 dollars, pull eight-inch and ten-inch plows in ordinary plowing. The larger, five to ten horsepower machines handle regular two-horse farm implements and ten-inch to twelve-inch plows in practically any soil. Most of these larger tractors are available in riding as well as walking designs, and the largest, a ten horsepower riding tractor, might better be termed a small farm tractor, as it is suitable for serving as the main power plant for 50-acre farms. These larger garden tractors render the grower independent of outside help, but plainly, the larger of them are somewhat heavy and awkward for cultivating small plants in narrow rows, such as, for example, muck-land onions.

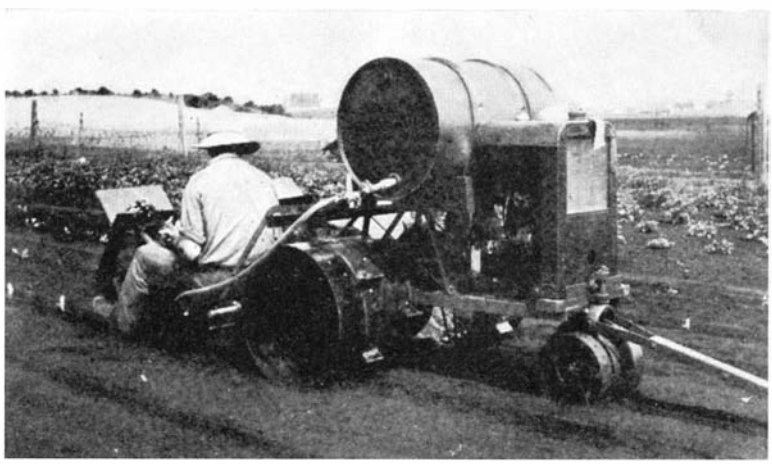
The plain fact is that undertaking to plow with a single eight-inch or ten-inch plow is a time-killing proposition, impracticable except for small places. For many a grower the more efficient plan would be the purchase of a used two-plow farm tractor, only depending upon the small garden tractor for row cultivation.

The economic and social value of the garden tractor is no small matter. It will enable thousands of suburbanites and small land holders, to whom the keeping of a single horse would be impossible, to put their land under remunerative cultivation. Many families of this class, though their usual main income is from industrial employment, will be able in emergencies to maintain themselves from the products of their own land. The garden tractor is clean, it requires but little storage space, it does not demand daily care, nor does it "eat its head off while idle."

ONE more factor should not be overlooked. The gardener's field of opportunity is being enlarged, and the increasingly epicurean instincts of the public are being met, by the introduction and commercial cultivation of many valuable new crops unknown to our fathers. Escarole, the French globe artichoke, Chinese celery cabbage, the Italian vegetable marrow, casaba and Persian melons, Calabrese sprouting broccoli, Florence fennel, the cultivated dandelions, and Witloof chicory, now rival in market possibilities the familiar vegetables cultivated for a century.

All things considered, it is doubtful if there is open to the man with small capital another opportunity to get a start in business for himself with such a reasonable hope of ultimate independence, as this new big business of vegetable gardening presents.

Rear view of the automatic, self steering plant setter showing method of operation



The two men, riding backwards on the automatic plant setter, transplant such crops as celery, onions, lettuce, tomatoes, at proper intervals

FROM THE ARCHEOLOGIST'S NOTEBOOK

Bronze Bowl with Cow

THE collection of the late Theodore M. Davis, after years of litigation, has come into possession of the Metropolitan Museum and contains priceless

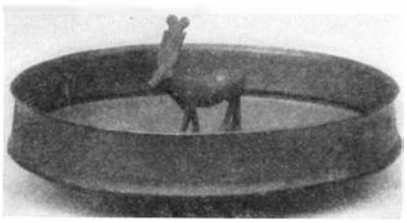


Figure 1

treasures of Egyptian Art. In 1902 Mr. Davis obtained a concession to excavate in the Valley of the Tombs of the Kings at Thebes. One piece, a shallow bronze bowl (Figure 1) has a cow in the center, crowned with the horns and disk of the goddess Hat-Hor.

Home of a Notorious Roman

ANZIO is almost due south, 36 miles from Rome, on the Mediterranean Sea. It is the ancient Antium and has a long and interesting history. It became a fashionable summer resort of the Romans towards the end of the republic. Both of the bad emperors, Caligula and Nero, were born here. The latter, indeed, had a special affection for the town, and built an artificial port and a splendid villa in which he received the news of the burning of Rome. This villa is now being excavated and magnificent pavements and mosaics (Figure 2) of the Imperial Age have been uncovered. Our illustration shows one of the patterns and the remains of the walls. Nero's harbor was about 150 acres in area and was protected by a breakwater of which traces are still visible. Anzio is still a popular summer resort.

Lid of Canopic Jar

ONE of the masterpieces of the Davis collection is the lid (Figure 3) to a Canopic jar. Found in a tomb excavated by Mr. Davis in 1907, it is a portrait of

Figure 3

the pharaoh Akh-En-Aten who attempted to substitute a monotheistic cult of the sun's disk for the old gods. The sculptor has softened the peculiarities of his subject, often exaggerated. The material is alabaster and the eyes and eyebrows are inlaid.

Figure 2

Figure 4

A Roman Portrait

A BEAUTIFUL Roman portrait bust (Figure 4) of the early 3rd Century A.D. has been acquired from the Baron Heyl collection. The height is 26 inches, the marble is white and fine grained and the flesh is differentiated from the coarser texture of the drapery by a light polish. An interesting attempt was made to imitate the mobility of the living eye by the use of two intersecting drill holes to mark the position of the pupil. The bust produces an air of femininity and gentle melancholy rare for the time.

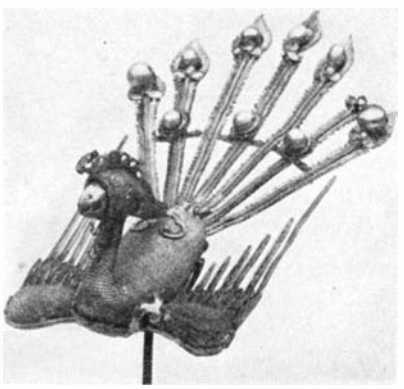


Figure 5

Chinese Head-dress Ornament

CHINESE jewelry of the T'ang Dynasty (618-906 A.D.) is highly artistic, though bizarre, as is shown by one of the examples recently acquired by the Metropolitan Museum of Art. The Chinese rarely employ precious stones, with the exception of pearls as in the present case (Figure 5), where the phoenix (symbol of good fortune) has pearls set on the tail-feathers. The filigree work is of exquisite workmanship, comparable to fine chain mail.

MAN'S INSECT ALLIES*

By G. RAWSON, from Scientific Data supplied by G. LIGHTFOOT, a Member of the Australian Commonwealth Prickly Pear Board

AUSTRALIA has been termed a land of pests, mostly imported from other countries. Not the least of these is the prickly pear, a plant of American origin belonging to the cactus family (*Cactaceæ*), a species which has spread over 50,000,000 acres of land in Queensland and New South Wales, and is known throughout Australia as the pest pear, or more simply, "the pear" (*Opuntia inermis*). A century and a half ago, when Australia was first colonized, the cochineal industry was a monopoly of Spain and Portugal; cochineal, of course, being a red dye obtained from an insect which lives exclusively on certain kinds of prickly pear. When the first fleet landed at Sydney in 1788, there were landed also specimens of the insect and pear privily obtained by the commander in Brazil on the voyage out, it being hoped to establish the cochineal industry at Botany Bay; but the plant and insects died, and for the time being Australia remained free from the pest.

FIFTY years later, a Dr. Carlisle, migrating in a sailing-ship to Australia from England, took with him, and carefully tended on the long voyage out, a rare plant in a pot. He settled at Scone, some 200 miles north of Sydney, and the doctor's gardener, enamored of the strange plant, carried it about and established it here and there, expecting it to be a good reserve food for stock in a dry year. Other plants found their way into Queensland farther north. They spread rapidly far and wide; the climatic and soil conditions suited the pear; soon it established itself everywhere, and about 1870 it was found that the pest had got beyond control.

From then on the pear rapidly spread throughout the sparsely inhabited hinterland of Queensland; it advanced in every direction; it grew with amazing rapidity; it was extraordinarily prolific; there was no stopping it; farmers and graziers were in despair. Forty years later—in 1910—it was estimated that the pear had overrun 20,000,000 acres, and was advancing at the rate of 1,000,000 acres yearly. Over 30,000 square miles of territory had been invaded. By 1916 nearly 23,000,000 acres had succumbed to the pear, or 6,000,000 acres more than the total area under crops in the whole of Australia.

What is this terrible pear? It is a typical giant cactus armed with needle-shaped and powerful spines and bristles. These spines can penetrate a stout boot sole; the bristles are barbed, and, once they enter the skin or clothing, are not easily removed, and will cause serious irritation both to man and beast, and even illness. The flower is a large, yellow blossom, and the plum-sized fruit is pear shaped—hence the name. The plant is drought resistant, and makes a dense growth of considerable height, constituting an impenetrable jungle of vegetation.

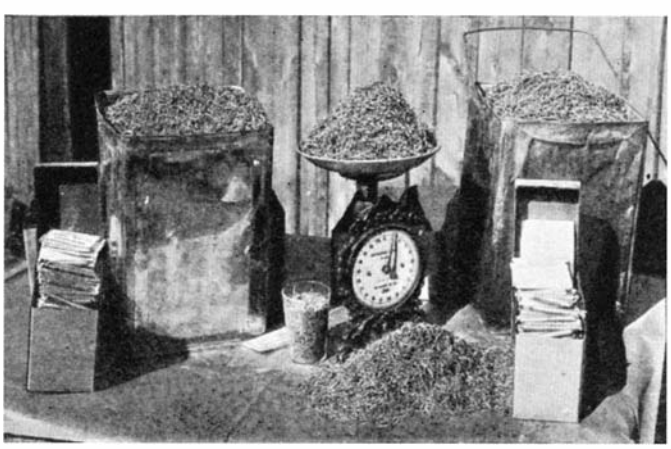
Once the authorities had become aware of the enormous spread of the plant and its devastating properties, steps were taken to deal with it. A Government Prickly Pear Traveling Commission was set up, which traveled round the world in 1912-14 studying the plant. An immense amount of information was obtained, particularly from the skilled botanists of the United States. Two solutions of the problem presented themselves. The pear could either be economically utilized, or it must be eradicated. Experiments were made to ascertain whether it had any marketable or useful qualities, but research failed to establish any means by which this immense area of plant growth could be economically exploited. Nothing remained but to attempt to eradicate the pest.

Illustrations courtesy *Illustrated London News*

A regiment of Cactoblastis tunneling out the interior of the cactus

ELABORATE machines were constructed for cutting, breaking down, rolling, and destroying the pear. Powerful tractors were brought up and attempts made to drive them through the jungle of growth. Teams of bullocks were harnessed to heavy logs by chains in such a way that the log worked at the side. But all these methods proved inadequate to the tremendous task of destroying the pear over 50,000,000 acres. Mechanical means and human and animal labor having been abandoned, chemical poisoning was next attempted. Injection and spraying of arsenic compounds proved effective, but the method was found very costly (from two pounds ten shillings to four pounds per acre) and other disadvantages accompanied the unrestricted use of arsenic. The discharge of poisonous vapors was tried, but was found wasteful and inefficient, and only satisfactory with a very light breeze in the desired direction. Finally, it was decided that eradication by mechanical or chemical means would never completely solve this national problem facing the whole continent.

At this juncture, the whole resources of the Commonwealth were mobilized. The Governments of Queensland and New South



56 million Cactoblastis eggs collected in Australia for distribution to ranchers who will turn them loose to work

*Courtesy *Illustrated London News*

Wales were assisted by the Commonwealth Government; all the best scientific brains were enlisted; funds were provided for a new campaign, and a new method was decided upon—biological control. The Traveling Commission had found that in India and Ceylon the tree pear had, in many localities, been almost exterminated by a cochineal insect. Accordingly, segments of the tree pear with colonies of these insects were sent to Queensland from Ceylon, and also from South Africa. Tests were made, but alas! the insects could not even be induced to feed on any kind of prickly pear except the tree pear, and the pest pear had triumphed once again. What was to be done?

A striking case of "before and after taking:" at the right is a typical sample of Australian prickly pear infestation, and below is the result of three years' work on the part of the Cactoblastis caterpillar. It annihilates the host plant, even penetrating to the very roots

Enemies of plants fall into two classes—those which live on a great variety and are termed "omnivorous vegetarians," and those which live only on a single type of plant and are termed "restricted vegetarians." Obviously, a restricted vegetarian had to be found. But there were difficulties, and not the least was the fear of introducing some new pest worse than the pear pest itself.

Consequently, in seeking a "restricted vegetarian" which would prey upon the pest pear and on nothing else, the greatest caution was required. "Biological control" promised the only hope of success, but the insect itself must be completely under control; must do its work and then die! An experimental station was set up, and insects and parasites of all kinds were imported from North and South America. From exhaustive tests there emerged a faint ray of hope in the shape of "Cactoblastis cactorum." Soon this stout-hearted little insect began to be regarded as Australia's "white hope" in the fight with the pear. He is extraordinarily prolific; he is a most accommodating insect; and yet he is very particular in his diet, and shows a marked partiality for the pear—so marked, indeed, that he will eat nothing else. He was soon acclimatized and has been easily established.

THEN, however, arose the necessity for investigating the adaptation of Cactoblastis to Australian conditions, and of his immunity from natural enemies. Climatic changes affect the welfare of moth caterpillars in general. Excessive rains, for example, bring diseases; but Cactoblastis has shown great hardihood in these circumstances, whereas extreme dry heat is a severe trial to him. Again, certain Australian parasites and predatory creatures have turned their attention from native hosts to the new arrival. These enemies and their effect are being carefully watched. Where a vast number of caterpillars of Cactoblastis have been congregated in a limited area, however, they have been practically immune from bird attack.

The Commonwealth Prickly Pear Board and the Council for Scientific and Industrial Research now believe that the end of the pear is in sight. Nearly 100,000 dollars a year is being spent on behalf of Cactoblastis in his battle with the pear, and he is winning all along the line. The war is being watched with intense interest throughout Australia and by entomologists throughout the world. At frequent intervals bulletins and communiqués are issued by the Board detailing the results of the latest attack on some particular salient, and noting the health and fighting disposition of the troops. Immense reserves are in hand, and the front line armies are constantly being reinforced. Only five years have elapsed since the first 2500 eggs were brought to Australia from Uruguay. The consignment proved an immediate success; the caterpillars thrived on the pear and produced moths that deposited 100,000 eggs. The second generation yielded 2,540,000 eggs. From October 1927 to June 1929, in Queensland alone, in the main pear area, 220,000,000 eggs were liberated and distributed, and in 1930 the Board liberated 500,000,000 eggs.

The havoc which Cactoblastis is wreaking on the pear is marvelous to behold. Soon after the attack begins the plant becomes yellow and sickens. A few months later the entire plant has rotted away, only skin and fiber being left. Any new shoots which may spring up are, in their turn, attacked, and soon perish. The female lays eggs in sticks about 1½ inches long, holding an average of 75 eggs, which hatch twice a year, taking from three to six weeks to develop. The caterpillars pass their existence within the pear segments; they attain a length of about one inch, and live in colonies of 20 to 100. When full grown they spin loose white silky cocoons, which have a duration of about five weeks. The moths live only for a few days. The caterpillars eat out the interior of the pear joints, tunneling from joint to joint. In the younger segments, the whole inside is eaten, leaving only the thin papery cuticle; older pads are not destroyed entirely, but wet rots, caused by various fungi and bacteria finding suitable conditions for development, hasten and complete the destruction. The caterpillars may even penetrate into the underground bulbs and roots, and with the aid of the associated rots the clumps are entirely killed.

GREAT numbers of eggs may be laid in a limited area, even 1,000,000 eggs an acre. With this vast quantity of caterpillars feeding, and enabling rot conditions to develop, the spectacle is afforded of the pear collapsing and dying as though visited by some virulent plague. The host of Cactoblastis now in Australia numbers many thousands of millions, and this vast horde has sprung from the original 2500 eggs introduced in May, 1925. The terrific work of destruction proceeds silently, continuously, incessantly. It is suggested now that, besides devouring the pear, Cactoblastis communicates to it some disease.

CHANGE—THE GREAT COMPETITOR*

By RAYMOND WILLOUGHBY
Of the editorial staff of *Nation's Business*

Courtesy *The Detroit News*

The Autogiro, the result of a new idea, has invaded the transport plane's field and is now in use by several firms

IT is immediately significant that the eagle is our national emblem. The carpet slipper and the easy chair have no place on our coat of arms. America is a nation definitely on the move. "Move on" is more than the directing text of our police departments. It is the most active coin in our national currency.

So characteristic is the itch to keep going that we find an articulate impatience with loafing. "Let's burn all the chairs, divans, davenports, and benches," urges W. A. Blees, vice president of the Oakland Motor Company, and justifies his inflammatory tonic with saying, "If burning the chairs did nothing but make the chair sitters go out and buy more chairs to sit in so they could comfortably complain about poor business, we would at least put a few people back to work making chairs."

Tree sitters, flag-pole perchers, and bench warmers have at times provided exclamation points in the news. But it is apparent that they have not written the declarations of our industrial independence. The business that says "I do not choose to change" is a bad risk, as many bankers and investment companies know to their cost.

Better services, improved products every day win converts from familiar services. Look through the advertising pages of any magazine. How many brands of trademarks were there 20 years ago—five years ago? Probably the magazine itself is not that old!

A nation is as young as its ideas. Every business has two junk piles. One inside the walls, the other outside. Good times or bad times, depreciation and obsolescence of plant and equipment are always on the job and many good heads have been put together to work out the retirement of superannuated machinery. But it is becoming clear that too little thought has been given to the high cost of carrying on with outworn ideas.

An engineer of the General Electric Company strikes the keynote of industrial progress by saying, "Know what is best, what trends are, press relentlessly for modernization, install conscientiously, and maintain intelligently."

The American people have a new attitude toward life and the apparatus with which life is lived. That state of mind greatly affects the things they buy and consume. Its expression has been aptly labeled "the American tempo."

"It means," says Ernest Elmo Calkins, "that new ways, new things, new ideas are eagerly spread and eagerly assimilated, and that a semblance, at least, of that smartness which was once the prerogative of the privileged few, is now demanded by virtually all."

The manufacturer, the wholesaler, the retailer, the transportation companies, the bankers, the insurance writers—the whole vast organism that we know as business—must play up to this new national consciousness if profit and permanence are the goals. Business must be synchronized with the pace of today if it is to keep the pace of tomorrow.

Products and services must be seen in a new light by their creators and distributors if the public is to see them in a new light. The change in viewpoint is internal before it can be external. It comes by design. Change is rarely an accident. Patient searching for the better way, the improved process or product is the tried and proved formula. And there is no lack of evidence that organized quest of the unknown has paid its way. The case of the Gorham Manufacturing Company, for example. Edmund C. Mayo, its president, reported that the firm's chemical and physical laboratory saved 125,000 dollars the first year. "If your business won't support a research department," he said, "go into some other business."

In the old days a firm that established itself in a general way was rated progressive. Market domination is now only a matter of months. Labor, capital, raw materials, productive processes, marketing facilities can be marshalled quickly. They need only the spark of an idea to energize them into fruitfulness, and ideas are traveling faster and faster. Some day we shall see "new ideas" listed among the assets of going concerns. The business that pleads it doesn't have a chance means that it doesn't have a change maker. Even now an investment rating on "new idea" departments is in progress.

A NATIONAL investment organization has thought it worth while to report on the "new idea" facilities of the 40 business enterprises included in its portfolio. Notable achievements in savings effected, new products developed, and new industries created are also revealed.

Pointing out that ten years ago there were not more than 200 industrial laboratories in this country, and that today 1500 companies are spending 200 million dollars a year on industrial research, the report says, "in a decade science has become the mainspring of industry. It has reorganized, expanded, and revitalized modern business and lighted the way to vast industrial realms hitherto unexplored."

But the ways of the change makers are not always easy. The world must be shown again and again, for the old is tenacious. It took 18 years to get the first million automobiles on the road. Two years to get the second million in the public's hands. One year to put the third million in use. But in a generation the national registration has risen to 26 million motor vehicles. It took only seven years to sell 13 million radios, and sales of electric refrigerators multiplied one hundred times in seven years.

*Reprinted by permission from *Nation's Business.*

America's hospitality to change is everywhere apparent. One third of the factory output, the word goes, is of goods entirely unknown 50 years ago. A sharper focus of fact is at hand in the General Electric's report that items developed in the last ten years constituted 25 percent of its sales in 1929.

Call the roll of American industries and you will find that where there is leadership there is change. A crystallized management is no match for a fluid market.

The way of industrial salvation through change is ably exemplified in recent business history. The Union Carbide Company, for an object lesson. Once Prestolite was its big product. Electric starting and lighting for motor cars cut sales. The company turned to making radio batteries. They sold well. Then the electric radio sets began to dominate. The company went to work on radio tubes, health lamps, and related products using carbon elements. Change, change, change, but the company is still going strong.

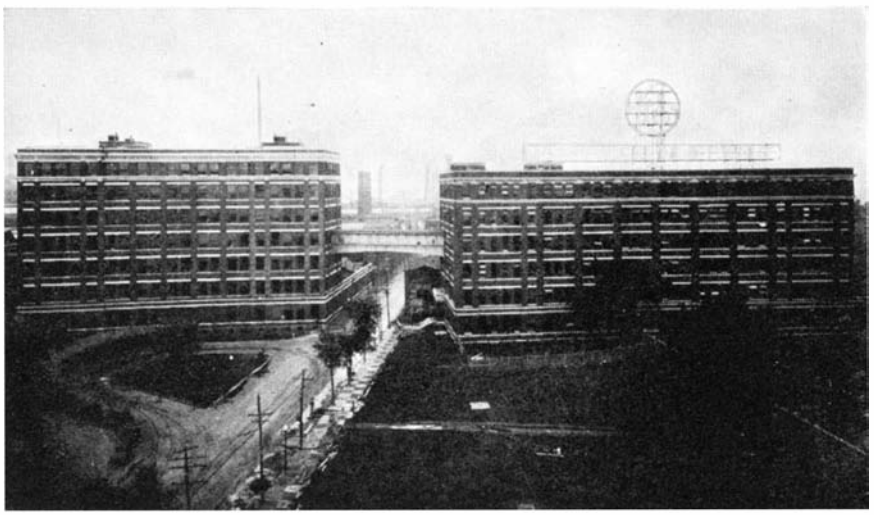
THE Radio Corporation of America is another great change maker. It began as a holding company for radio patents. Then it licensed builders of broadcasting stations. The manufacture of radio sets and tubes was an easy step. Was an inducement needed for the public to buy? Well, it would provide programs. Were the movies a competitor? Why not go into the theater business and take over vaudeville? The Keith-Orpheum circuit was bought. Along came the talkies threatening to kill radio, movies, and vaudeville, and the corporation found a profitable voice. Growth by accretion, advance by absorption, progress by projecting the present. So, too, with General Electric, General Foods, du Pont, and Sherwin-Williams. When the United States Steel Corporation made up its collective mind that cement was a competitor it bought out the Universal Company.

The versatility of the Hercules Powder Company is a case in point. Explosives lost their market at the end of the War, and the company decided to try "naval stores"—rosin, turpentine, and pine oil. Its turpentine campaign aimed at paint and varnish makers fell short. It found that nine million of the 12 million gallons sold annually went over retail counters, chiefly to painters. It learned that turpentine had been sold from the barrel—no brands, no trademark, nothing to give distinction. Why not break down the container to five gallon, one gallon, and one quart sizes, package it attractively, put on a distinguishing mark, and go after the consumer? Answered as indicated, sales increased 81 percent and a larger plant was required.

Among the old industrial faces that have put on new makeup, none perhaps is more remarkable for change than aluminum. Long a mainstay of pots and pans, aluminum and its alloys now figure prominently in the metal working industries. Through the intelligent legerdemain of the change makers, notably the Aluminum Company of America, aluminum has become important in the manufacture of airplanes, automobiles, railway cars, and locomotives. Intensive experiment and study have made a place for aluminum in the manufacture of metal furniture, power transmission equipment, oil burners, and spray painting devices.

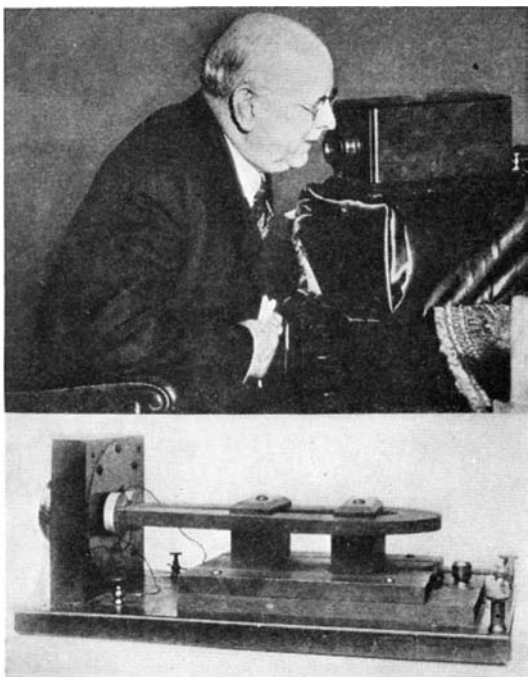
Aluminum's new place in the construction sun is conspicuously revealed in the façades of certain new buildings; as a shining example, the A. O. Smith Building, Milwaukee. Five million aluminum hub caps are now used on automobile wheels. The development of "Alclad," an aluminum alloy, made possible the construction of the *ZMC-2*, "the world's first all-metal dirigible," built at Detroit for the United States Navy. Aluminum paint is a commonplace, yet the ability to change the familiar bluish silver surface of aluminum to desired shades is a fairly recent laboratory triumph. Where color is demanded—as it seems to be in products of every sort—the industrial hue and cry puts a literal emphasis on the chromatic scale.

How new steel products are modifying building practices is a matter of more and more concern to architects, engineers, and contractors. New "rustless" steels are being fabricated into outside wall panels which include the window frame, sash, sills, and even the heating unit. By use of this design, structural sections may be more economically assembled in the shop than on the job.



Scientific research has firmly established itself as the backbone of business. The photograph above shows the research laboratory of the General Electric Company in 1896; the one below, the modern buildings devoted to research in 1931

"Rustless" and "stainless" steels are inviting use where their nonoxidizing properties are decisively valuable, as for chemical storage tanks and filters, for silos, in the preparation of foods, in metal mining and reduction works, in pasteurization processes, pumps and pistons. The idea of all-steel buildings now in a way of practical translation holds important commercial implications for cement, stone, brick, and lumber. Long a mere bearer of burdens, steel has been touched by the change makers and made into a thing of beauty.



Organized research has raised the telephone from this crudity to the present efficient unit

If one thing cannot be changed to improve sales, perhaps another can. Noses, for illustration. A maker of silverware found himself almost in bankruptcy because the fancy boxes in which his goods were packed smelled bad. The glue was the offender. A change of container restored his ware to good standing.

This idea of deodorizing is more than an industrial footnote in its relation to leather and linoleum. Laundry soap, wall finishes, and raincoats are taking more and more notice of the sense of smell. Theater interiors are scented and probably it could be demonstrated that houses have been sold by the smell of new paint and varnish. Perhaps it will turn out that some books have been censored more for the odor of their inks than of their contents. The olfactory nerve has been known to control the pocket nerve.

ONCE it was an industrial fashion to look on by-products as poor relations but not rarely by-products have outdone the main line. The examples are legion. Blast furnace slag is now used in the manufacture of cement. A by-product of baking powder is used as a binder material in building construction. Possibly the meat packers provide the classic example of the prevention of waste. Now that the court decree which kept them out of the retail food and meat trade has been modified, wholesalers of those products face a sharper edge to competition from a new source.

The courts, legislatures, and governments all have a hand in revising the economic pattern. They introduce the "X" factor, the unknown quantity, into the business equation. It is one thing to know about the existence of their modifying influences. It is quite another —and far more important— to have at hand the interpretation of their meaning to business.

The recovery of greases and animal foods from garbage puts a changed accent on thrift. Cheap fertilizer filler is also produced from this waste. Where change is the rule, it is easy to believe that city dumps will be able to match the reduction of refuse with the reduction of taxes.

Changes in the ideas of "farm relief" are more or less apparent on the agricultural front. Arthur Little, Inc., chemists and engineers of Cambridge, Massachusetts, have reported frequently on the industrial utilization of agricultural wastes. No one seems to know the tonnage. Estimates range from 500,000 to one billion tons a year. These wastes include cereal, flax and rice straws, sugar cane, bagasse, cornstalks and cobs, oat and peanut hulls, cull potatoes and lemons, beet sugar residues, and fruit pits and skins.

MANY of these wastes are so closely related chemically to products in wide demand—such as starch, alcohol, paper, pyroxylin lacquers, rayon, and several types of building materials— as properly to focus attention on ways to recover potential values yet unrealized.

Naturally there is a broad divergence of opinion over the economic possibilities. Some views see a deterring limitation to profitable reclamation; others profess to see great wealth through conversion of many familiar by-products.

However, it is evident that "idea men" have been sharpening their pencils and figuring on ways to turn waste into money. These change makers have transformed wheat straw into corrugated board for shipping containers, made cellulose from cornstalks, converted sugar cane bagasse into building board, derived insulating material for houses from the straw of seed flax. They have worked peanut hulls into fibrous filler for building materials, recovered starch from potato culls, wrested cooking oils from cotton seed, and won citric acid, lemon oil, and pectin from lemon culls.

In the Middle West much thought and energy are given to the wealth latent in the waste material of corn and wheat. Get out the cellulose, and there is the stuff of which various types of paper and rayon are manufactured.

Furfural—used in plastics and varnishes—is produced from oat hulls and corn cobs. Pectin for jellies is now extracted from apple cores and skins which canners formerly threw away. Alcohol and glycerine are now recovered from molasses formerly discarded by sugar companies. The chemists change the fate of old industries and create new ones while you wait.

If your business is at all concerned about its life extension, it is worth while to brush up your own ideas daily, and see a "new idea" man at least twice a year. On all fronts industry is pushing forward to find new markets for staples and broader uses for by-products.

LOOK at the glass makers. They have widened sales by changing their traditional lines. Now they are making containers for the packing industry, glass pipe for the chemical industries, glass coal chutes, and insulating and heat resisting products in competition with porcelain and mica. Glassware for cooking, and non-shattering glass for automobiles are no longer novelties, and glass bricks for building are beyond the laboratory stage.

Rayon, too, has worked many changes. It worked a profound effect on cotton textiles, revising markets and methods of manufacture. It stimulated the maker of wood fiber to develop a new and highly purified product as a substitute for cotton rags used in paper making, and for the use of rayon manufacturers in place of cotton linters. The cotton textile people levy on expert minds to turn up new uses for cotton cloths.

It is true that competition's other name is change, and necessity is the mother of progress. Witness the makers of rubber tubing who were about to lose piano makers as customers. The tubing cracked and rotted too quickly. Its makers found an antioxident that increased its life ten times, and the market was held. Germany, rich in coal but poor in petroleum, contrives a motor that uses pulverized coal for fuel. Londoners complain of noise and a rubber-coated street is laid down, cutting the din 30 percent.

It is commonly observed that patents and processes are the key to industrial leadership. Market security sometimes comes by way of finding a voice for special pleading—as the toy industry did when it got the "mamma" doll to speaking throughout the land. Before 1925, Germany supplied most of the toys for American children. Two years later native inventiveness and salesmanship had captured the domestic market and were exporting in volume.

Quick-setting cement grew out of the need to cut the time on highway construction. Half a dozen American com-

panies saw opportunity in this necessity, and their brands are on the market. Pressure on high value space in metropolitan business areas gave birth to companies specializing in the manufacture and distribution of steam. Space for coal bunkers, boiler rooms, and chimneys is released for revenue.

This promptness to accept opportunity has examples without end. For one, the brilliant success of Cason Calloway in building a great business from cotton waste. Employees of his father's textile mills had frequently suffered injuries to their hands by using cotton waste to wipe machinery. The laboratory prepared a wiping cloth with the waste material. A national survey revealed that 10,000 industrial plants needed such a cloth. Some could not install their own laundries. The Calloway mills agreed to provide service through local laundries. A dollar and an idea founded the Valley Waste Mill. Half a dozen other enterprises have issued from it. Last year they did a business of more than nine million dollars in tire fabrics, cotton trousers, and duck cloth.

Another industrial footnote is daily on view in the dull finish of women's stockings. Not so long ago, women began to turn their silk stockings inside out. They said they liked the lustreless side for a change. Some manufacturers immediately bowed to this whim of fashion, and turned to harder twist yarns. But the new stockings shrank more, and that made a problem for the laundry owners. They put it up to the American Institute of Laundering, and a new method of washing was developed. A caprice of fashion, a new product, a new problem—a chain of changes affecting one business by its influence on another.

THE idea of providing gas to rural dwellings got nowhere until chemists captured the butane and propane which escaped in the manufacture of gasoline. Waste gases once, they are now put in steel tanks and distributed to consumers who have no access to gas mains. The long distance piping of natural gas is itself a change that has come in the last two years. Before the perfection of new welding processes, a 250-mile pipe line was about the maximum. Now distribution 1300 miles from the source has been achieved. Manufacturers of steel sheets and tubes have been quick to get in the market. One of the first to realize the possibilities was a famous maker of automobile frames.

What these underground carriers mean to the railroads in loss of traffic in oil and gasoline no one seems to know. Now there is talk of using them for moving pulverized coal.

Knowing the public's mind before that mind is made up has been the salvation of many a manufacturer. Johns-Manville put its faith in asbestos shingles, but its managers sensed a growing demand for asphalt shingles, and so put them in production to fortify its sales position. The National Lead Company's record also accents the virtue of industrial flexibility. Sales to paint makers never tested plant capacities. Radio batteries once accounted for 10 percent of the sales. Electric sets cut into the market. A new outlet was found in storage batteries for industrial trucks and delivery wagons.

It may be that the depression was the salvation of pewter, for it is generally evident that many dealers in solid silverware have added pewter ware to their lines. In the industries silver faces ingenious competition from other metals —nickel, Monel Metal, and chromium, to name a few.

No industry, perhaps, pays more devoted tribute to the spirit of change than the automobile business. At this year's show it displayed a fresh bag of novelties—air foil fenders, double and down-draft carburetors, fuel pumps instead of vacuum feed.

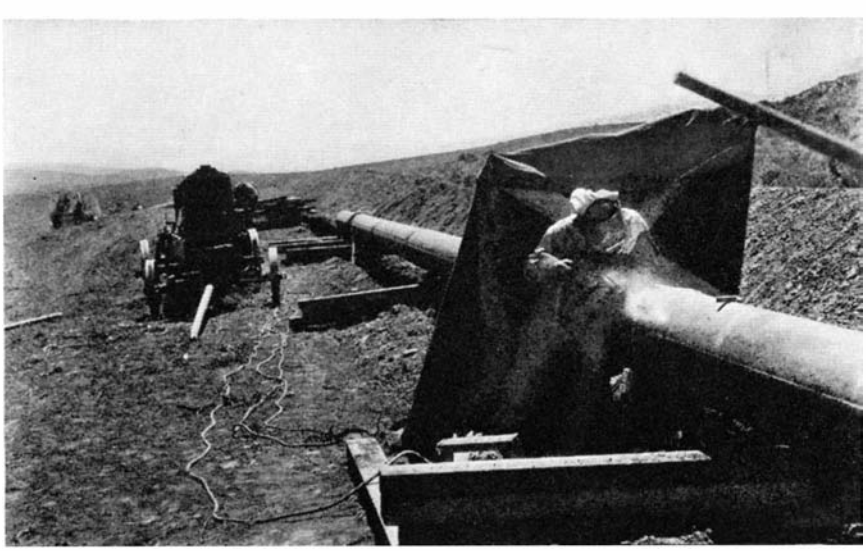
WHAT does it all mean on the balance sheets? Well, one manufacturer reports that 2000 of his new 16 cylinder cars were sold in nine months, and another announces that his free-wheeling feature raised his car from tenth to fifth in sales volume.

Possibly the motor makers have taken their cue from one of their own great change makers. It was Charles F. Kettering, head of the General Motors Research Laboratories, who recently stated:

"There is no place where you can sit and rest in an industrial situation. It is a question of change, change, change, all the time. Don't try to make progress in steps. It won't do. You have to keep in phase with the times. . . . You can't stop the thing called progress, but you can get in harmony with it."

This keeping "in phase with the times" has invited the attention of a national financial service. It ticks off the new props to our standard of living with this staccato recital of progress:

NATURAL gas and pipe-line developments; a radio crime service which will send an automobile instantly speeding to the source of crime; frozen foods; Dry Ice; greater use and development of electrical power; the airplane industry; film phonographs; rustless metals; smokeless fuels; heating by radio; artificial ventilation; humidified indoor air; the electrification of railroads; centralized heating and cooling systems; central newspaper plants, flashing newspaper pages by photo-transmission across the country; electrically made steel, electric welding; the practical development and application of television; steel edifices instead of brick; the use of glass brick; the use of chromium, copper, bronze, aluminum, rustless steels for building exterior; steel constructed residences; low cost standardized houses manufactured and distributed by mail-order houses in parts; steel floors in construction, surfaced with tile; ice engineering with the control of climate evils; electric ships; the welding and fabrication of steel floors for tall buildings, with weight much less than at present; windowless structures; artificial lighting rich in ultra-violet rays; the cooling as well as heating of homes and offices; new and improved processes for the manufacture of wrought iron, steel, and so on; the practical use in countless directions of the photo-electric cell; and a thousand new inventions and developments for greater uses of electricity, are among the things to which the genius of the nation is being applied in the great research laboratories.



Extensive pipe-line systems for natural gas and oil have been made possible by the perfection of new processes for welding the joints between pipe sections

SULFUR*

By W. L. WHITEHEAD
Special Lecturer in Geology, Massachusetts Institute of Technology

SINCE the first use of gunpowder in warfare sometime in the 14th Century, sulfur has been of importance to the chemical industry of man. Earliest mining was confined to scattered volcanic deposits of small extent; and not until the discovery of methods of manufacture and utilization of sulfuric acid in England and the consequent development of the Sicilian sulfur deposits did the element become of definite commercial interest. In 1839, with the granting of a monopoly of Sicilian mining to a French company, English acid manufacturers turned to Spanish pyrites, containing some 48 percent sulfur, for a part of their needs, and these two sources alone also served American manufacturers in the late 19th Century. The Sicilian product, mined from beds of limestone and gypsum by shallow underground workings or open pits and extracted by melting in furnaces, was imported to the United States in 1895 to the extent of 165,000 tons. Close control of the native sulfur production and high prices existed, however, in these days and had encouraged American initiative in a search for home sources of the element.

SULFUR had been discovered in 1869 while drilling for oil in the marshes on the Gulf Coastal plain in Calcasieu Parish, Louisiana. Here, at about 600 feet, the drill had encountered sulfur-bearing rock; but the swamps and beds of quicksands below the surface had caused failure of all attempts to sink shafts.

The discovery finally came to the attention of Herman Frasch, chief chemist of the Standard Oil Company, and in 1891 he devised and patented a method for extracting the sulfur by wells. He believed that super-heated water introduced under pressure into the rocks from the type of well usual in petroleum extraction would melt the sulfur at 239° Fahrenheit and that the molten sulfur could be pumped to the surface. Before tests could be begun, however, Frasch had skeptics to convince and at last when operations commenced the quicksands again gave trouble in the drilling of wells.

Not until 1901, when Captain Lucas drilled the first successful oil well on the Gulf Coast at Spindletop, Texas, by means of a new rotary method of drilling, were the coastal quicksands easily penetrated. The Louisiana sulfur development then advanced rapidly. Plant design and erection were accomplished and in 1903, after prolonged heating of the ground by hot water, Frasch opened the valves of his pump line and saw molten sulfur flow from the wells. (The Frasch process was described in last month's number, pages 309-310—*Ed.*)

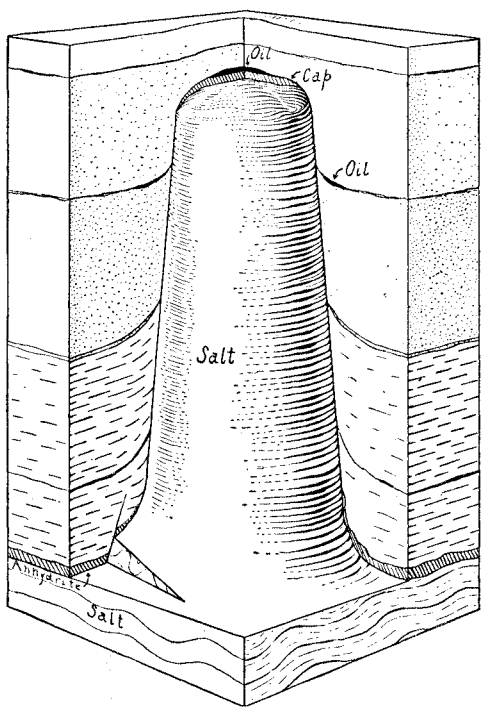


Diagram of a salt dome. These vast hidden domes are three or four miles in height

The size of installations in recent exploitations of sulfur may be illustrated by the Bryanmound development in Texas. Here boilers in the plant have a rating of 16,800 horsepower and may be operated at twice the rated capacity. The plant consumes 24,000,000 cubic feet of natural gas and uses about 7,500,000 gallons of specially treated water daily. About 1200 wells have been drilled on this property of 786 acres, including wells used as "bleeder" wells, from which water at 180° Fahrenheit is extracted from the sulfur rock to control pressure. At the Hoskins Mound plant this water, as well as flue gases and exhaust steam, is used for preheating the 5,000,000 gallons of water introduced into the ground per day.

Louisiana has now long ceased to produce sulfur, but new discoveries have been made in Texas to sustain and increase the production on the Gulf Coast. These discoveries have been due to the knowledge of the geology and occurrence of sulfur obtained during the development of the Louisiana deposit and during the intensive drilling for oil in the coastal region which began in 1901 with the discovery of the Spindletop field.

Along the marshy level prairies of the Gulf border in Louisiana and Texas, elevations of only a few feet are visible for long distances. Spindletop was one of these low mounds or domes rising 20 to 30 feet above the plain. It had been drilled with the idea that such eminences had some connection with underlying bodies of salt and that oil might occur in the salt bodies, some of which had been mined in Louisiana. Spindletop proved a large producer of oil and drilling was carried out on many other coastal mounds.

THEY were found, as expected, to be underlain by salt at considerable depths, but the petroleum occupied cavities and porous areas in beds of limestone, gypsum ($CaSO_4 \cdot 2H_2O$), and anhydrite ($CaSO_4$) overlying the salt and capping it. Above these cap rocks were the soft sands and clays typical of the coastal belt. The cap rocks and upper surface of the salt were arched, roughly circular in plan, and varied from one eighth of a mile to two miles in diameter. These structures, the salt domes, are now known to be the cause of all of the sulfur deposits and of most of the petroleum occurrences of the Gulf Coast.

Developments of the last 30 years have given much information regarding these peculiar salt bodies. Not only from the records of wells drilled, but by geophysical investigations permitted by the relative density of the salt, cap rock, and surrounding sediments, by gravity determinations, and by seismograph, their positions and shapes have been studied. Today some 200 salt domes are known and a clear idea of the characteristic form and occurrence has been obtained.

The arched cap rocks lie at depths varying from a few hundred feet to

*Reprinted by courtesy of the *Tech Engineering News*.

several thousand feet below the surface and may even be exposed at ground level in rare instances. The thickness and composition of the cap rocks also vary. The sulfur dome in Louisiana has a cap 1100 feet thick, strongly arched, with its top only 350 feet from the surface. Other domes have thin caps overlying the typically lesser arched salt surface. Limestone is present in most cap rocks and is usually found nearer the surface than underlying anhydrite. Gypsum also may be present, perhaps as interlayered beds between the limestone and anhydrite. The flanks of the salt mass are steep. Dips of the salt border increase from the flat top to angles near the edge that may reach the vertical. Overhanging projections even have been discovered by the drill. The flanks of salt are in direct contact with the surrounding soft sediments of the Coastal plain to the greatest depths drilled at present, about 8000 feet. The salt dome is thus a pipe-like mass of salt capped by hard porous rock and surrounded by sedimentary formations bent up on its flanks.

THE origin of these bodies is believed to be from a thick bed of salt at great depth. Such beds, 1500 feet thick and covered by beds of anhydrite, occur in western Texas near the surface. Folding of the rocks and pressure from the great thickness of overlying sediments are believed to have caused flow, such as occurs in glaciers, in this deeplying salt bed and to have forced the salt into the soft superincumbent sands and clays. The plug-like mass has probably carried fragments of overlying beds of anhydrite and limestone upward on its top during the slow movement of penetration and these fragments, greatly crushed and distorted, constitute the present cap rocks. Geophysical work indicates that the salt beds lie at depths of not less than 15,000 to 20,000 feet.

Petroleum occurs related to the salt domes both in the porous cap rocks and in porous bent-up sands near the salt on the flanks. Associated with it are salt waters containing hydrogen sulfide. The sulfur is found only in the porous cap rocks and in relatively few salt domes. It occupies cavities and fractures in contorted beds of limestone or gypsum above solid compact anhydrite. The greatest thickness of sulfur-bearing rock is usually near the edge of the cap rock, although some good deposits existed on the flat top at Sulphur, Louisiana, and at Bryanmound, Texas.

The origin of the native sulfur has caused much discussion. Recent investigations by Dr. Waldemar Lindgren and the author indicate that considerable quantities of calcium sulfate have been altered in the cap rocks to calcium carbonate, limestone, by the action of sodium bicarbonate waters flowing into the cap rocks from water-bearing zones in the surrounding sands. It is quite probable that the hydrogen sulfide waters of the deeper flanks may rise on the salt contact, meet the carbonate waters and, on mixing with them in the zone of alteration of calcium sulfate, precipitate the sulfur contained in solution as sodium sulfide in the form of native sulfur. Precipitation of sulfur by bacteria has also been suggested.

With the development of geological knowledge of the occurrence of sulfur, new discoveries were made. In 1912 Bryanmound, Texas, was prospected and with its exploitation the American monopoly of the Union Sulfur Company, the owners of the Louisiana dome, ceased to exist. Later the sulfur-bearing salt domes at Hoskins Mound and Gulf, Texas, were opened up and in recent years the smaller developments at Palangana and Long Point and the great deposit at Boling, all in Texas, were put into production.

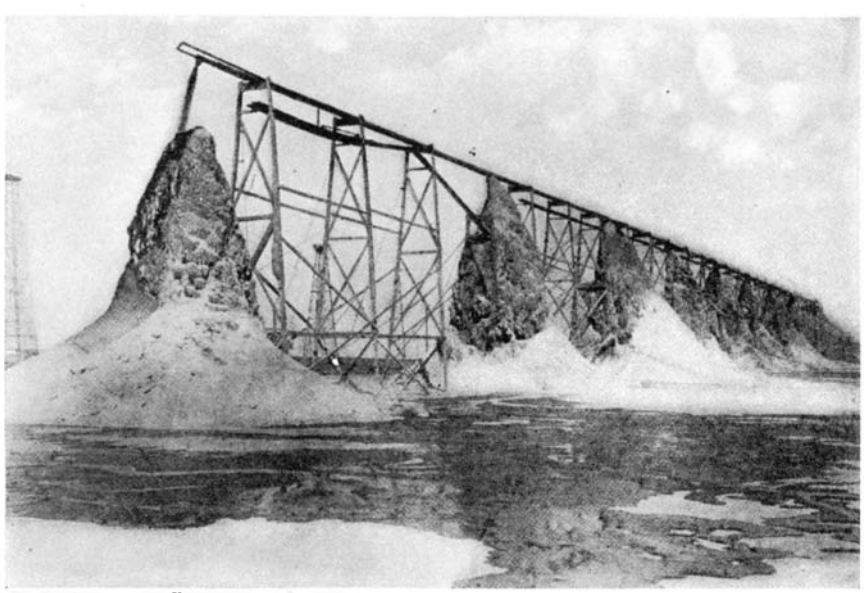
As a result of early discoveries, sulfur output in the United States rose to 2,036,097 long tons in 1923. After this time considerable reduction in production was caused in 1924 by the exhaustion of the Sulphur, Louisiana, deposit, but increase continued through later years to a maximum in 1929 of 2,362,389 long tons. These figures may be compared with Sicilian sulfur produced in the same year to the extent of about 200,000 tons and Japanese production of somewhat over 65,000 tons.

In 1929 the United States exported 855,500 long tons of sulfur and consumed 1,582,000 tons. Utilization of this quantity was distributed as follows:

Heavy chemicals	560,000 tons
Fertilizers and insecticides	415,000
Pulp and paper	265,000
Explosives	67,000
Dyes and coal tar products	47,000
Rubber	43,000
Electro-chemicals	23,000
Fine chemicals	15,000
Paint and varnish	5,000
Food products	5,000
Miscellaneous	137,000
Total	1,582,000 tons

THE use of sulfuric acid is widespread in industry, large quantities being required in petroleum refining, in iron and steel treatment, and in metallurgy. Therefore, although the sulfur mining industry ranks only 17th in the United States in the value of its product, it affects a most varied list of manufactures and the consumption of sulfur serves as a first-rate index to business conditions.

The future of this extraordinary mining in the liquid form is of considerable interest. Some apprehension was felt in 1924 with the closing of the Louisiana plants as to possibilities of maintaining large sulfur production on the Gulf Coast, but more recent developments have tended to a more optimistic outlook. Although but seven commercial sulfur domes have so far been found in about 200 known salt domes, many domes have been inadequately explored and future discoveries are probable.



Illustrations courtesy Freeport Texas Company

Molten sulfur is pumped under pressure from the subterranean deposits into large storage bins of wood. Here it cools, solidifies, and is broken up for use

●

This is the second of three related articles on salt, sulfur, and petroleum from salt domes, the first having appeared last month. The third article will have to do with the geophysical methods employed by the modern petroleum geologist in working out the hidden sub-surface structure of the rocks. We shall go into the field with him and see him at work. —The Editor

CLEMENCEAU AND FOCH

The United States Enters the War: The Armistice: The Peace Conference

By CAPTAIN W. D. PULESTON
United States Navy

(Continued from May)

AS soon as it was apparent that America would actively intervene in the war, both England and France began urging that American contingents be sent over as battalions of infantry to be brigaded with the English and French armies. They contended that incorporating American soldiers directly into the veteran divisions of the Allies would give the greatest amount of assistance at the earliest possible moment. The real obstacle to this procedure was that American soldiers would never be at their best commanded by foreign officers. President Wilson and Secretary Baker realized this and in Pershing's letter of instructions embodied the following: "In military operations against the Imperial German Government, you are directed to co-operate with the forces of the other countries employed against the enemy; but in so doing the underlying idea must be kept in view that the forces of the United States are a separate and distinct component of the combined forces, the identity of which must be preserved."

In the crisis of March, two days after Foch took over the French-English armies, General Pershing placed his army unreservedly at the disposal of Foch for the duration of the crisis, but insisted upon resuming the creation of an autonomous American Army as soon as the crisis was passed. Lloyd George and Clemenceau both renewed the demand that American troops be used in Allied divisions, and when Pershing would not yield they instructed their ambassadors at Washington to urge President Wilson to intervene, and were prepared to suggest that Pershing be removed if he continued to deny their request.

Foch would have nothing to do with this plan to coerce Pershing; and in October when Clemenceau again urged him to put more pressure on Pershing, he pointed out that of 30 American divisions fit for service, 10 were shared among the French and British, and 20 were formed into the American Army under Pershing. Foch appreciated the reluctance of soldiers to serve under foreign officers; Clemenceau in his ardor only desired to find replacements for the battle-scarred infantry of France. He was as exacting of the British, and learning of the number of soldiers retained in England as unfit for service abroad, demanded the right to send a French officer to verify the list. To show their good faith, the British authorities actually assented to this unprecedented request that a French officer inspect British soldiers invalided home to judge their fitness for returning to the front. On reflection, even Clemenceau was convinced of the unwisdom of such an undertaking and the request was dropped.

On August 8, Haig began an attack on the German front with the British Army that did not cease until November 11, at Mons. In September, Pershing, in personal command of the American Army, reduced the St. Mihiel salient, and in October began the advance through the Argonne that ended in the neighborhood of Sedan on November 11. In between these armies advanced the French Army until it reached Sedan on November 11.

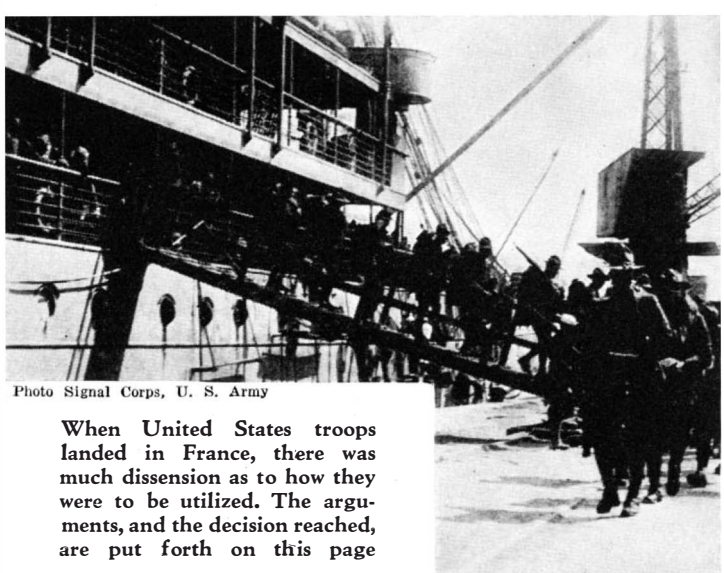


Photo Signal Corps, U. S. Army

When United States troops landed in France, there was much dissension as to how they were to be utilized. The arguments, and the decision reached, are put forth on this page

Clemenceau complained that Foch would not command Haig and Pershing, but only advise them; and it is true that Haig submitted his own plan of advance for a plan suggested to him by Foch, who accepted the modification. Foch's conciliatory attitude with Haig and Pershing was incomprehensible to the fierce Vendean who had devoted the prime of his life to pulling down cabinets. Foch finally reminded Clemenceau that as Allied Commander-in-Chief he was not subordinate to the French Prime Minister; this caused Clemenceau to give Foch a sharp warning about listening to bad advisers.

THESE differences were comparatively minor but in September, Foch, sensing the impending German collapse, told Clemenceau that the end of the war was near and asked what the peace terms would be, so that the necessary military measures could be taken to secure them. Clemenceau tartly replied that he would manage the peace terms; and the rift between the two widened. It was natural for the trained, studious Marshal, who despised improvisations, to look ahead and to inquire of the political head of his Government what the political objectives were so that he might plan to secure them. It was equally natural for Clemenceau—whose father had revolted against Napoleon III, who was mayor of Montmartre during the 1870 Commune, who for over 30 years had been on guard lest a popular soldier overthrow the Republic—to take fright, when Foch, the successful Generalissimo, who was rapidly ridding France of the detested Germans, showed an inclination to take an active part in the peace making. After this difference the relations between the two steadily grew worse.

On October 8, Foch again asked to be informed of the policy of the French Government concerning the Rhineland; his letter contained the following paragraph:

"The occupation of the Rhine will put us in possession of pledges; but will these pledges suffice to guarantee reparations? When reparations have been made, what fate is in store for the Rhineland? Will France persevere in her idea of creating a neutral independent buffer state?"

(*Please turn to page* 423)

DIESEL VERSUS GASOLINE-ENGINED PLANE

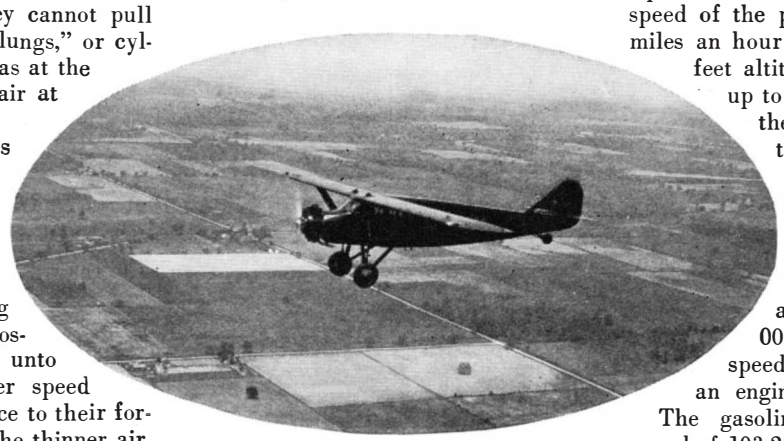
HERETOFORE when men have voiced the opinion that the airplane of the future would travel at terrific speed from one side of the world to the other many miles above the earth's surface there has always been an immutable fact to arouse serious doubts in the minds of others, perhaps more practical. This fact has been that airplane motors must breathe and —just like humans—they cannot pull as much air into their "lungs," or cylinders, at high altitudes as at the earth's surface, for the air at altitude is more rare.

The flying man has known from experience that altitude affects the performance of gasoline engines adversely. He has scoffed at these visions of planes getting up into the rarer atmosphere and gathering unto themselves vastly greater speed through lowered resistance to their forward motion offered by the thinner air. He has done so because he has known that the speed of a plane equipped with any internal combustion engine up to the present lessens as the altitude grows greater.

An entirely new element, however, has been injected into the situation by the Diesel engine which has been developed for aircraft work by the Packard Motor Car Company and now is being produced. Through an inherent feature of the Diesel principle, the effect of increasing altitude on the Packard Diesel aircraft engine is exactly opposite to that on the gasoline engine. Performance of the Diesel engine grows better as altitude increases.

Whereas the speed of the plane equipped with a gasoline engine begins falling immediately as it goes to higher altitudes, the Diesel-engined plane gains speed. It continues to gain in speed up to a certain point and after that the rate of loss is considerably smaller than with the gasoline-engined plane.

In a recent test of two planes, this altitude performance for aircraft engines was said to have been definitely established. The test was made by a disinterested organization independently of the manufacturers.



One of the early flights of a Diesel-equipped plane which showed the reliability of this new power plant

Two planes of the same design were equipped, one with the Diesel engine, and the other with a gasoline engine, each engine having the same 225-horsepower rating. Although the Diesel engine had 200 cubic inches more displacement, the gross weight of the plane with the Diesel powerplant was 141.4 pounds lighter than the gasoline engine installation. In other respects there was practically no difference between the two planes.

The Packard Diesel engine gave a speed of 116.5 miles an hour at ground level, with the throttle set to give an engine speed of 1980 revolutions per minute. With the throttle unchanged and with no other manual adjustments, the engine speed increased to 2010 r.p.m. at 5000 feet altitude and the speed of the plane increased to 118.4 miles an hour in level flight. At 8000 feet altitude the speed had gone up to 118.6 miles an hour and the engine speed increased to 2015 r.p.m.

Above 8000 feet, the speed of the plane and engine began slowly to decrease. The plane continued climbing to an absolute ceiling of 20,000 feet where it had a speed of 82 miles an hour with an engine speed of 1750 r.p.m.

The gasoline-engined ship had a speed of 103.2 miles an hour at ground level with an engine speed of 1990 r.p.m. At 5000 feet the plane speed had fallen to 99.4 miles an hour and the engine speed to 1970 r.p.m. Engine and plane speed continued to decrease until the absolute ceiling of the plane was reached at 14,270 feet where the speed was 64 miles an hour and the engine speed 1745 r.p.m.

THE Diesel-engined plane at its absolute ceiling of 20,000 feet—more than a mile higher than the absolute ceiling of the other—still had 18 miles an hour greater speed, and had climbed at a considerably faster rate. Complete details of the tests are given in the tables on this page.

The reasons for the difference in altitude performance between the Packard Diesel and the gasoline engine lie in the difference in piston displacement, and the fact that the Diesel engine does not depend upon the same finely balanced mixture of air and fuel necessary for the gasoline engine.

The Diesel engine sucks only air into its cylinders on each induction stroke, instead of a mixture of air and gasoline as in the gasoline engine. This air is compressed so greatly that it is heated to approximately 1000 degrees, Fahrenheit. Just before the piston reaches top dead center (when in a gasoline engine an electric spark would leap across the points of a spark plug to ignite the mixture) oil is sprayed into the combustion chamber under great pressure. It is ignited instantly by the heated compressed air.

(*Please turn to page* 424)

The Packard Diesel-engined plane:

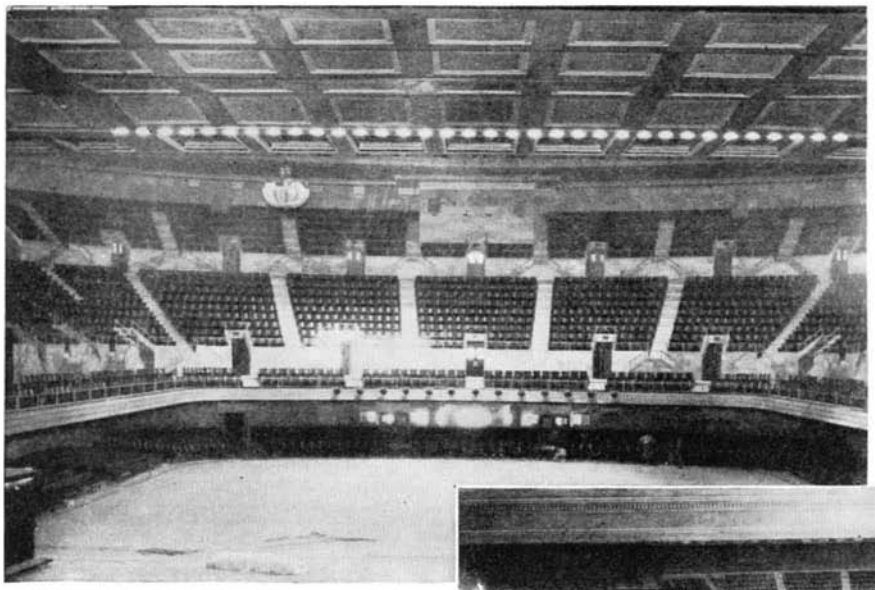
Standard: Altitude:	Level Speed MPH	Level R.P.M.	Climb Speed MPH	Climb R.P.M.	Climb Rate Ft. Min.	Climb Time Min.
0	116.5	1980	77	1750	730	0
5000	118.4	2010	79	1795	676	7.06
8000	118.6	2015	80	1820	617	11.69
10000	118.0	2010	80.5	1830	567	15.06
15000	110.6	1950	82	1830	390	25.47
Serv. Ceiling 19250	92.6	1810	82.3	1775	100	42.90
Abs. Ceiling 20000	82.0	1750	82	1750	0	

The gasoline-engined plane:

Standard: Altitude:	Level Speed MPH	Level R.P.M.	Climb Speed MPH	Climb R.P.M.	Climb Rate Ft. Min.	Climb Time Min.
0	103.2	1990	61.2	1790	635	0
5000	99.4	1970	63.4	1785	412	9.7
10000	91.3	1905	65.0	1775	190	27.1
Serv. Ceiling 12000	85.7	1855	65.0	1765	100	100
Abs. Ceiling 14270	64.0	1745	64.0	1745	0	

Performance data of the two planes in the tests described here

A FLEXIBLE AMUSEMENT BUILDING

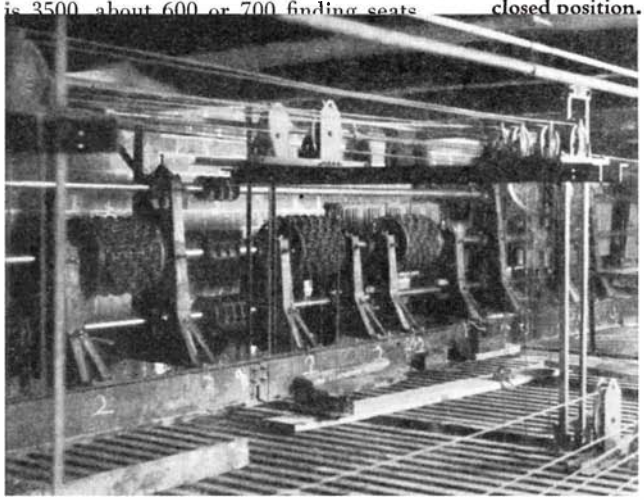


MUNICIPAL auditoriums are a good investment, as they tend to bring conventions and similar gatherings which benefit hotels and merchants. New Orleans, Louisiana, has solved its problem of a general utility structure in a novel manner, and at a cost of about 2,000,000 dollars. This cost is low considering that the auditorium seats about 12,000 persons. The building plot is approximately 360 feet square with an open area of the same size in front. By an ingenious system of rising proscenium walls, a concert hall can be thrown together with the auditorium section so that the combined seating capacity is 12,000 as noted. The main auditorium seats approximately 6500 people; about 1750 are seated in portable seats on the main auditorium floor. The seating capacity of the concert hall is 3500, about 600 or 700 finding seats on chairs on the floor. There are no columns in either the auditorium or the concert hall or in the entire arena when the two halls are combined and the stage is lowered.

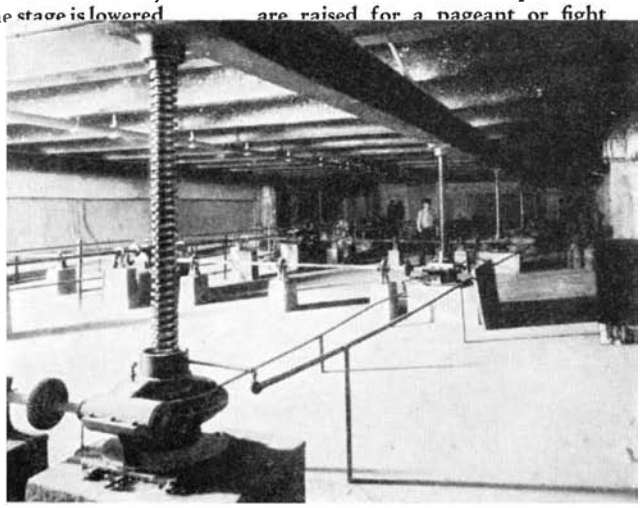
Between the auditorium and the concert hall is located the stage which is common to both. The stage floor covers an area 50 feet wide by 129 feet long. Machinery actuating six screw jacks on each side serves to raise the stage section from the level of the arena floor to a high level for use in pageants and prize fights. The stage is of steel frame construction covered with planking, and is further equipped with a removable finished floor. The orchestra platform,

Upper Left: **Picture taken from the concert hall looking towards the auditorium balcony. The movable ceiling panels are in a nearly closed position. The stage is lowered**

Above: **Auditorium and concert hall merged by the raising of the proscenium walls. The stage platform and the orchestra platform are raised for a pageant or fight**



Eighty-five feet above stage level is a system of equalizing shafting and drums carrying the counterweighted walls



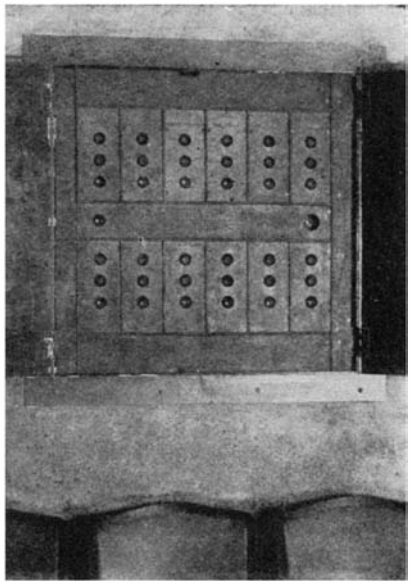
The basement holds the equipment for raising and lowering stage and orchestra. There are six jacks on each side

on the concert hall side, is variable in height from a point three feet below the arena floor grade to the high stage level. With the stage, orchestra platform, and arena floor at the same level, the entire floor area is approximately 92 feet wide by 180 feet long; the joints between the movable sections are close enough to permit dancing or any other use for which a permanent floor would be required.

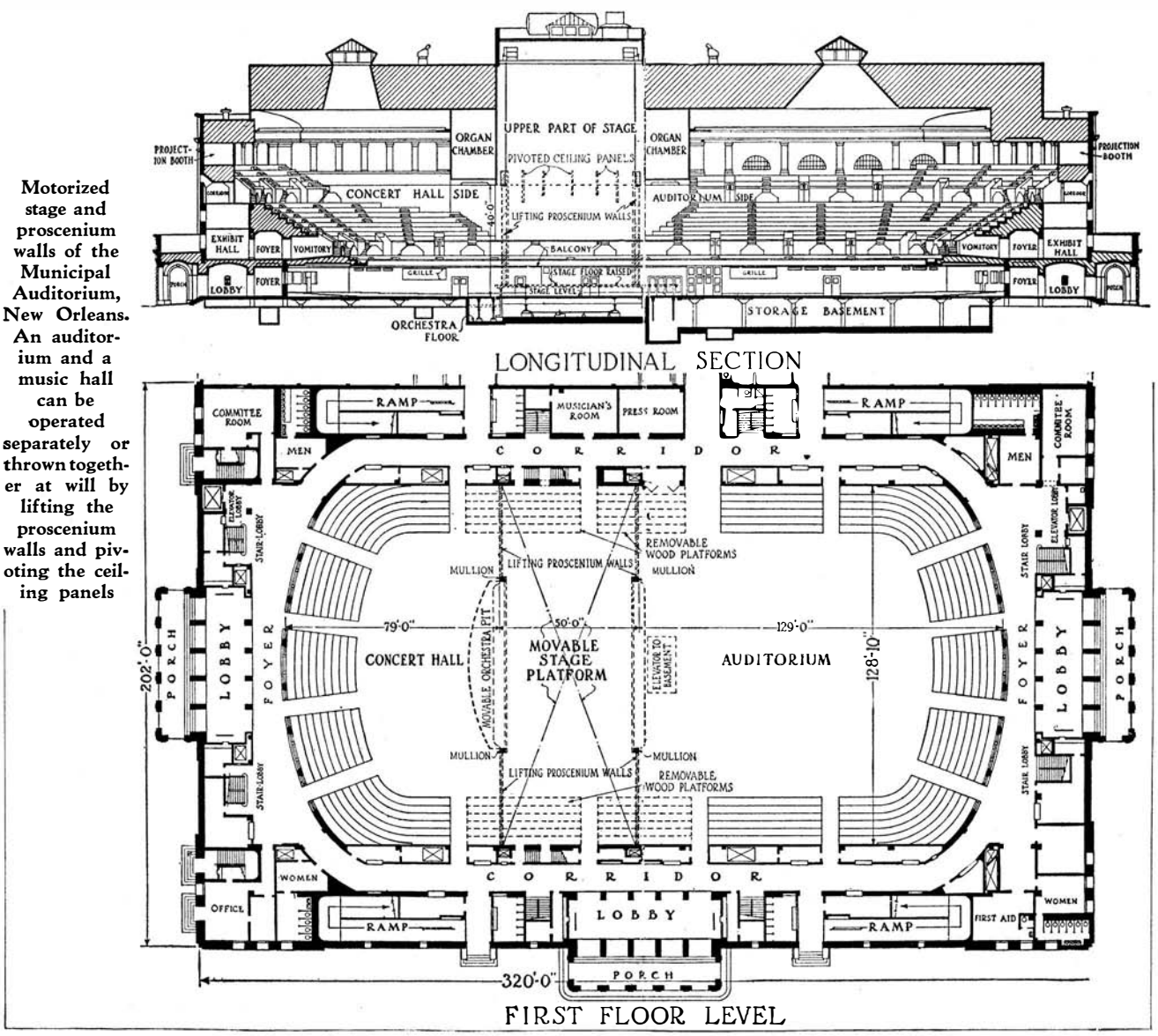
PERHAPS the most interesting feature in the whole building is the method of cutting off the stage at either side by means of counterweighted rising proscenium walls which give great flexibility of use to the structure. The stage area is closed off by means of movable walls of steel frame construction filled with sound proof material on the stage side and plastered on the other side. These movable walls make it possible to have the use of the stage for either the concert hall, or the auditorium, or both. The proscenium width can be increased to 90 feet by raising the two side walls and their dividing mullions. This system is used on both sides of the stage and is available either for the concert hall or the auditorium. If both of the main walls are raised a production may be viewed from both halls. To turn the building into a large arena it is only necessary to raise the walls, sink the stage and the orchestra platform to arena floor level, and close the pivoted ceiling panels. The walls are raised from the gridiron 85 feet above floor level.

The ceiling panels over the stage can be opened or closed at will to allow for the handling of scenery, electric light battens and so on, from the gridiron. All these operations are controlled from a push button cabinet so that all portions of the movable structure can be coordinated. An emergency stop button causes all motors to cease functioning.

The structure contains many other interesting features as will be noted by a study of the plan and section. We are indebted to the Allen-Drew Company of Cambridge, Massachusetts, for our illustrations and description of the system which they designed and installed.



All moving parts have remote control from this push-button cabinet which enables one person to cause all portions to function as required. An emergency stop button will stop all working parts if it is necessary



Motorized stage and proscenium walls of the Municipal Auditorium, New Orleans. An auditorium and a music hall can be operated separately or thrown together at will by lifting the proscenium walls and pivoting the ceiling panels

A TWO-MILE INDUSTRIAL WATER TUNNEL

IN order that it may increase its capacity for immediate and future needs, the main power plant of the Ford Motor Company at Dearborn, Michigan, is undergoing several remarkable changes. These include the installation of two new high-pressure boiler units, a powerful steeple-type turbine-generator and turbo-blowers of increased capacity, and the construction of a water tunnel more than two miles long. The entire change-over is being handled without interruption of production.

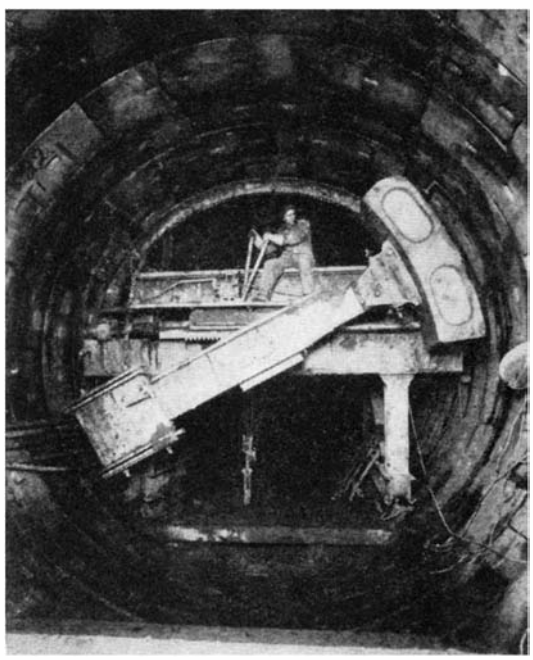
The new boilers, which have a steaming output of 700,000 pounds of steam each per hour, will replace two boilers which generated only 500,000 pounds of steam each per hour. The unusual feature from an engineering standpoint is that this increase in steaming is to be had by installing the new boilers in almost identically the same space as that formerly occupied by smaller boilers which yielded only a fraction of the steam capacity.

The turbine-generator will have a capacity of 110,000 kilowatts and will replace two that afforded a combined energy of only 25,000 kilowatts. The new turbo-blowers will increase the air output by 30,000 cubic feet per minute to each of the plant's blast furnaces.

The tunnel, with which we are more concerned in this discussion, will have a 24-hour capacity of close to 1,000,000,000 gallons and will not only provide more cooling water for the condensers, but water at a lower temperature than has heretofore ever been available. Its exact daily capacity will be 913,600,000 gallons, amounting annually to 333,464,000,000, or over 80 billions of gallons more than is used in a like period by the cities of Detroit, Cincinnati, Washington, and Philadelphia combined. So far as is known it is the largest tunnel ever built to serve the needs of a single industrial concern.

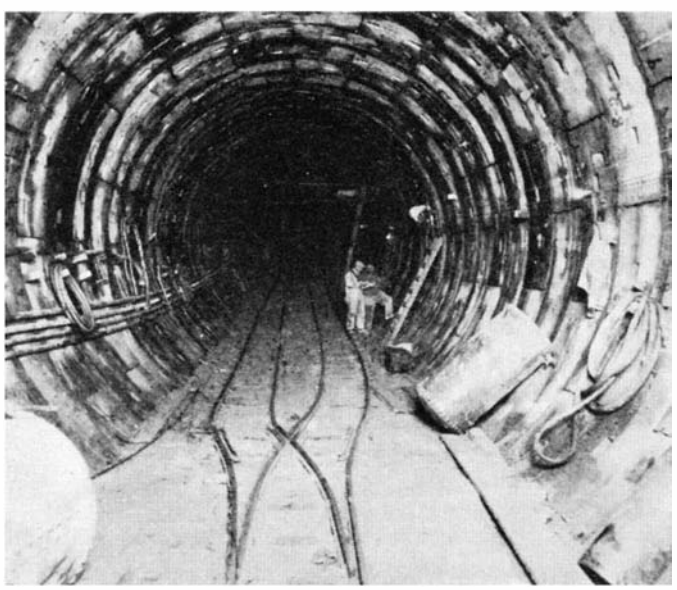
Along the southern side of the Rouge plant area runs the River Rouge which winds in a generally eastward direction to empty into the Detroit River. When the Ford Motor Company first occupied its present site, this was little more than a sluggish creek with a normal summer temperature of from 75 to 80 degrees Fahrenheit. Subsequently the stream bed was dredged for the admittance of large boats directly from the Detroit River to the Rouge plant. Water is now being drawn for plant and mill use from the upper end of a boat slip which was excavated at the edge of the plant. After passing through the condensers the water empties into the River Rouge only a short distance from the ship turning basin approximately one half mile away. In addition to this, water used for cooling and slushing in the steel mill, glass plant, and elsewhere, is also returned to the River Rouge, with the result that during summer months the stream temperature rises to between 84 and 87 degrees.

The increase in temperature over normal is only part of the difficulty, for the chief problem lies in



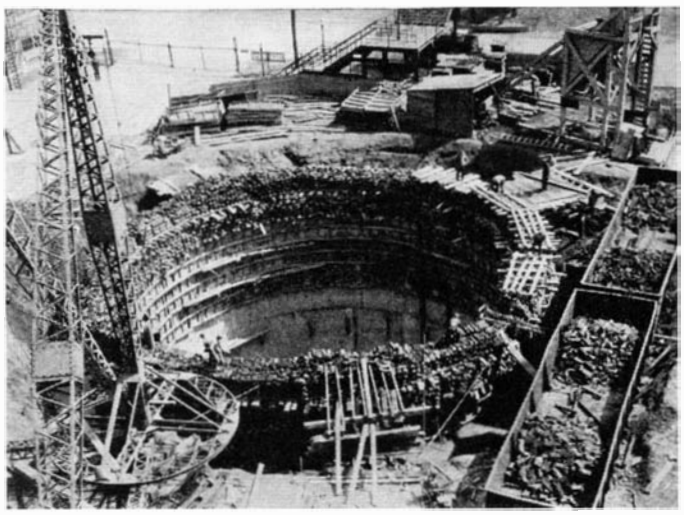
At left: **Front view of one of the hydraulic block erectors, showing the manner in which the huge blocks weighing over a ton each were placed in position**

At right: **The junction formed by shields 1 and 2 after the diaphragms were burned away. Note perfect alignment of the fin ribs resulting from underground survey calculations that are believed to be without parallel**



A vertical, eight degree curve in the new Ford plant tunnel. The curve is 160 feet long and its drop is 19 feet

the fact that the plant requirement is approximately four times the total flow of the River Rouge. This great demand results in the creation of a loop composed of an immense volume of water that is actually used over and over again. When the new tunnel is in operation it is expected that the intake water will average 71 degrees for the hottest months and range downward to a winter minimum of around 33 degrees. Furthermore, by using the present intake tunnels for the expulsion of used water



When the lower ring of the pump well reached hardpan at 80 feet, 1200 tons of pig iron were loaded on its rim to test this foundation

A total of 45,790 of these ring blocks was used in the new tunnel

the boat slip and the river will undergo a continuous flushing and the present turbid condition will be relieved.

Generally described, the new water tunnel is a true cylinder with an inside diameter of 15 feet and an outside diameter of 21 feet. Its lining is made up of two thicknesses, each 18 inches. The outer is composed of interlocking cement blocks weighing 3420 pounds each, 10 to a ring, and the sections of rings set one against the other. These blocks, curved in the molding process to conform to the arc of a cross section of the tunnel, constitute, as a whole, the entire outer tube. The inner lining is formed of monolithic concrete.

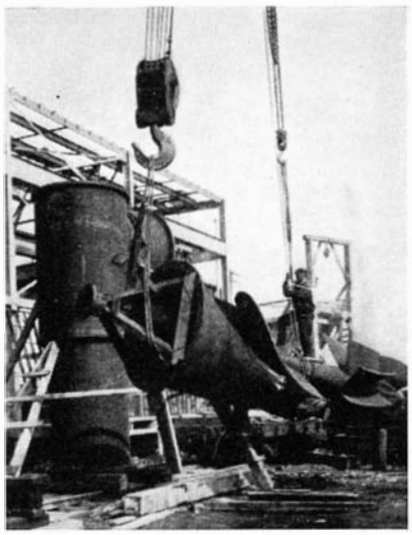
The tunnel is 12,000 feet long and is located 60 feet below the surface of the ground. It begins with an intake located on the old channel of the River Rouge at a point about two thirds of a mile from the Detroit River and ends with a pump well and house located beside the Rouge plant No. 1 power house. From the intake the tunnel passes under a dozen streets and main highways, street car and railroad tracks, bridges, a creek, and a cemetery.

The tunnel was excavated by the shield method, four of these machines working on the job. Each shield was circular in transverse section, 21 feet, 6 inches in outside diameter, 14 feet from the vizor-like cutting nose to the open tail, and built of steel with the shell 2¼ inches thick. Stepped back a distance of three feet from the cutting nose was a diaphragm placed at right angles to the axis of the shell, itself of heavy ribbed steel plates braced with angles. Six ports, or "pockets" pierced the diaphragm but these were reduced in size to an average of one square foot with the use of cross timbers. The advancing force was applied by hydraulic jacks so placed around the circumference border of the diaphragm as to push against the ring of concrete blocks last set in place. The jacks had cylinders 10 inches in diameter.

FOR the greater part of the job the work was in blue clay of the consistency of putty. As the jacks, pushing against the block ring, advanced the shield, the clay oozed through the diaphragm ports much as dental paste comes from a tube. As the clay was forced through, one of the two men stationed at each port cut off sections of it weighing from 50 to 100 pounds each. The second workman caught and tossed the severed chunks into electrically propelled tram cars.

Following the advance, the jacks were withdrawn and the next circle of blocks set in place by an hydraulic erector of the arm and ram type, with the "fingers" inserted in depressions provided in the concave surfaces of the blocks. The time required for the erecting of these rings varied but both the shove and the placing of a ring was often accomplished in 45 minutes. The rate of progress may be indicated by the month of September when, working two shifts in each of two headings, the distance covered totaled 2160 feet.

It has been stated that each ring comprises 10 blocks, but this must be qualified, for every complete circle contains nine solid blocks and a tenth of equal size but molded in two parts, and so shaped that the erection of a complete ring of blocks could be accomplished without moving the erector. In the progression of rings the positions of these key blocks were staggered.



Propeller of one of the four booster pump units for the pump well

Counting the key block and its companion unit as one, all blocks measure six feet in length, two feet six inches in width, and 18 inches thick. They were made in material plants located convenient to the job and poured at the rate of 430 every 24 hours. After pouring, every block was allowed to set for 12 hours before the forms were removed and the blocks themselves left undisturbed for a period of 18 hours. There then came a weathering outside the pouring plant. Through the next seven days they were sprayed with water 12 times every 24 hours and, following that, every four hours for a period of 21 days. After this 28-day weathering they were ready for transfer through the shafts to the tunnel floor tram cars. The number of blocks used on the entire job was 45,790, or at the rate of 3.4 cubic yards of concrete per lineal foot.

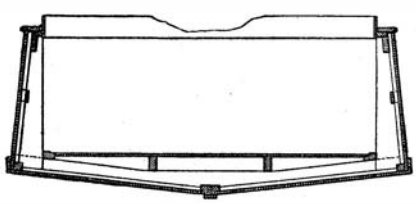
The 18-inch thick inner lining of the tunnel is of monolithic concrete throughout. Concrete used for the lining was at the rate of 2.88 cubic yards per lineal foot, or a total of 33,560 cubic yards for the job.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

What We Eat

THE Department of Commerce informs us that our per capita diet has been changing both in kind and amount. From 1899 to 1927 there was a steady decline in the consumption of flour, corn meal, and rye and buckwheat flour. Meat remained steady, although beef consumption declined while pork and veal gained. Edible fats and oils found more favor, 14 pounds of lard and 18 pounds of other fats (17.2 pounds butter) and 12 pounds of vegetable oils (largely cottonseed and coconut) being consumed in 1927, whereas in 1899 only 32 pounds were consumed. Sugar consumption increased from 61 to 104 pounds; dairy products from 800 to 1040 pounds; and fresh fruit from 169 to 192 pounds. We use 1.8 gallons of edible molasses, and about 12 pounds of coffee and 0.8 of a pound of tea, against 3 pounds of coffee and 0.5 of a pound of tea in 1830. We eat about 11.55 pounds of candy annually. We chewed 106 sticks of gum in 1927, an average of 85 in 1920-24 and 39 in 1914. Of peanuts we ate 7.98 pounds, almost twice the amount of all the other nuts together, walnuts being next on the list with less than 1 pound.—*A. E. B.*



Typical section of the shallow-V-bottom boat, other sections being identical from the bow to the stern

A Shallow-V-Bottom Boat

IN very recent years there has been a very definite back-to-the-water trend in America due to the constantly increasing traffic on our highways which, for many people, makes automobiling unsatisfactory. Boating is taking a strong hold on the nation, and the imagination of inventive genius is being turned toward the development of marine equipment and boats.

A striking example of new boat construction is the cabin cruiser designed and patented by Mr. J. H. Crary, of Westport, New York. The principal feature of this design is the convex, or shallow "V," bottom which can be constructed at much less cost than ordinary hulls. By reason of the peculiar construction, straight pieces of planking are used throughout, no bending, curving, or cutting of any nature except that of cutting to length, being necessary. At all points from the bow where the keel curves upward to meet the upper deck all the way to the stern, the "V" sections of the bottom are identical; so far as construction is concerned, they are interchangeable. The sides of the hull are perpendicular to the bottom planks which causes the sides to incline inwardly, as shown in an accompanying illustration.

Mr. Crary has built a cabin cruiser by this design, 29 feet by 9 feet, weighing 10,088 pounds, and having comfortable sleeping accommodations for four people. The maximum speed expected of this boat was 16 miles an hour but the average of 10 tests was 24 miles an hour with a figured propeller slippage of plus or minus 10 percent. She is said to be a fair sea boat and she throws water away from her sides in such a way as to reduce skin friction.

Edema

EDEMA is one of the most serious symptoms associated with various disorders of the kidney, failure of the heart, and certain forms of under nutrition. In edema, fluid collects in the tissues to such an extent that a pit made in the skin by pressure remains because of the large amount of water present. All sorts of methods have been suggested for getting rid of this accumulation of fluid. Drugs are given which increase the output of fluid through the kidney, attempts are made to influence the glands of internal secretion, and the diet is modified in various ways. Recently Drs. W. S. O'Donnell and S. J. Levin have used calcium gluconate in an attempt to control edema in a number of children. Continued administration of this drug was successfully used, causing the elimination of much of the water. Increase of protein in the diet at the same time was helpful.

The modern physician is able through studies of the blood, the body weight, the urine and other factors in the body to control, almost like a test tube experiment, most of the actions that go on in the human system.—*M. F.*

Enlist Electricity To Battle Diphtheria Germs

ELECTRICITY has been found an effective aid to combating diphtheria, according to information furnished the Society of American Bacteriologists by W. T. Szymanowski and Robert Alan Hicks of the Western Pennsylvania Hospital of Pittsburgh.

They reported that research disclosed that highly-potent diphtheria germs are greatly diminished in strength when subjected to electric waves at frequencies of 158,000,000 and 80,000,000 cycles.

American Rubber—Guayule

ABOUT three years ago—in our number for July, 1928, to be exact—the early development of a great guayule rubber plantation at Salinas, California, 100 miles south of San Francisco, was described at some length. That article, entitled "Can We Grow Our Own Rubber?" was written by our contributing editor, Dr. D. T. MacDougal of the Carnegie Institution of Washington. A follow-up on the same development may prove interesting to those who read the original article, as some of the

A cabin cruiser, 29 feet 9 inches long, built according to the design invented and patented by Mr. Crary

desert guayule shrubs which are the source of guayule rubber have now reached maturity and a factory for rubber production has recently been built.

Three years ago, 2600 acres of the guayule shrub were under cultivation. Transplanting the seedlings, cultivating them in the field, harvesting them, and other processes, all are done by means of machinery in contrast to the methods employed in the Far East where the rubber is obtained from the latex of the *Hevea* rubber tree. There one native produces 1700 pounds of *Hevea* annually. In the American guayule industry one man plus his machines annually produces 25,000 pounds. It takes the guayule rubber shrub four years to reach maturity when it is about 18 inches in height. The shrub is dug or pulled, dried, crushed, and placed in a tube-mill which extracts the rubber from it. (U. S. Patent 1671570, 1928.) The bark contains 80 percent guayule.

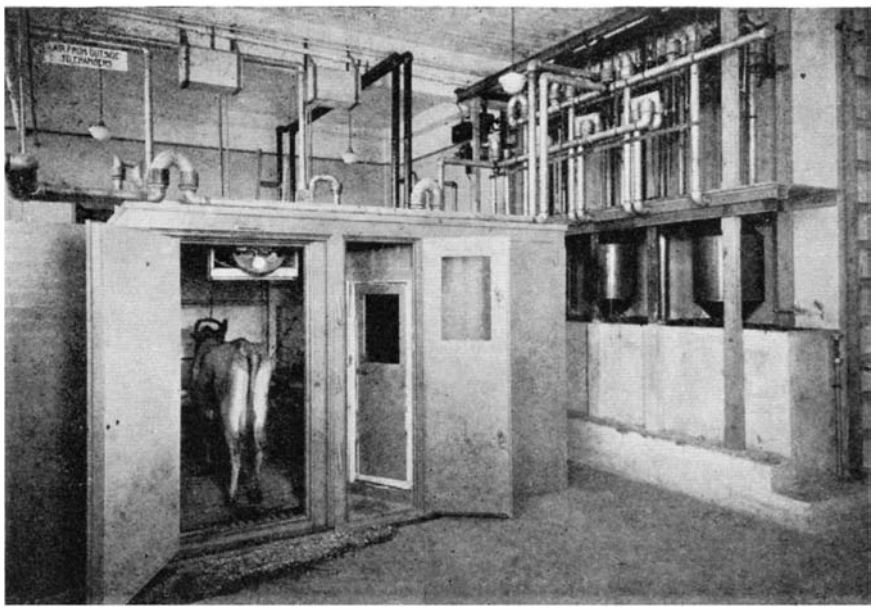
At the present time 25,000,000 guayule shrubs are growing at Salinas, a part of these having been planted each year, and it is the older shrubs which have now reached the harvesting stage. The daily capacity of the factory shown in one of the illustrations is 15,000 pounds of rubber —not a large factory, but large enough in the circumstances, the guayule industry being in its youthful stages. This factory will handle the 2000 acres of guayule shrubs which will mature each year for the next few years. The chief present use for the product has been for coating the cords of cotton used in making tire casings; also for inner tubes and as a component of tire treads. Guayule rubber is not the full equal of *Hevea* rubber, at least in all respects, but when properly prepared it "will compare favorably with it"—so says the Bureau of Standards.

In the meantime, the economics of guayule production have become partially involved, mainly through the very low present trend in prices of *Hevea* or plantation rubber. With plantation rubber at or near 6.5 cents, a very low figure, guayule has not been in so favorable a position as it might otherwise have been. The price in 1929 ranged around 20 to 25 cents; in 1930, 15 cents. According to Moody's Manual the gross income of Intercontinental Rubber Company, owners of the Salinas plantations, has fallen from half a million dollars (round figures) in 1928 to a quarter million in 1929; the earned dividends have fallen at the same time from 32 cents per share to nothing. The market quotations have ranged from 28 to as low as 2, although much of this drop may be laid to the general decline in the market. It is said to cost about 20 cents a pound to put guayule on the market. When *Hevea* is lower, guayule is in hard luck; when higher it is in good luck.

Just what this situation forbodes for guayule rubber is as uncertain as prediction always is. Whether an American rubber industry can sink or swim appears to be mainly contingent on the trend of production cost of plantation rubber. Former Secretary of Agriculture Jardine, writing in *Nation's Business*, calls guayule "the most immediately promising of all plants now thriving in the United States." But, he says, "the real botanical prize obtained by the Government is intisy, recently introduced from Madagascar." He refers to intisy as "the best rubber producer in the world." Commenting on probabilities he states that "the next few years will be interesting ones in American rubber production. Mr. Edison's machines may be developed to the stage where goldenrod will yield rubber profits for hay-fever vacations. Guayule may dominate. Intisy may develop best."

As far as goldenrod rubber is concerned, Mr. Edison has said many times that only a national emergency would permit its economical use, and that he would be satisfied if he could bring the cost of production down to two dollars a pound. But at this cost it would not be a commercial success.

It has been suggested that a reserve of several hundred thousand acres of guayule plants be created in this country, against an emergency, and left in the field. The plants grow indefinitely and their rubber does not deteriorate while they are alive. In case of war or other difficulty the nation could turn to this reserve. Just as a few extra hundreds of dollars, even if not used, "feel good" in the pocket when one is far from home, so a billion pounds of guayule rubber in this kind of live storage within our own boundaries would "feel good" to the nation.

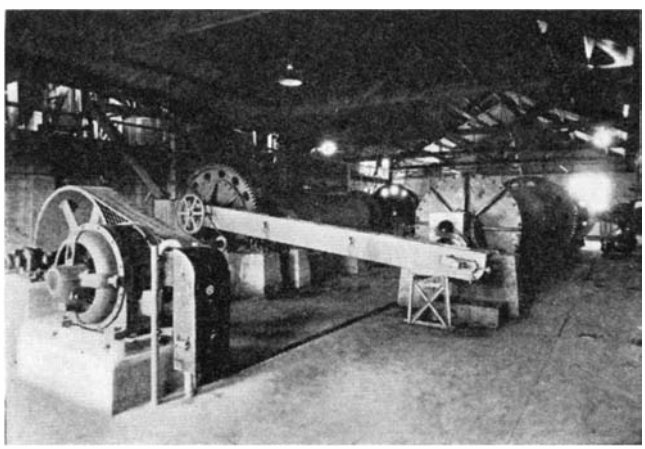


Practically everything about bossy but her smell—if she has one—is analyzed in this laboratory: the food she eats, the milk she produces, and waste products

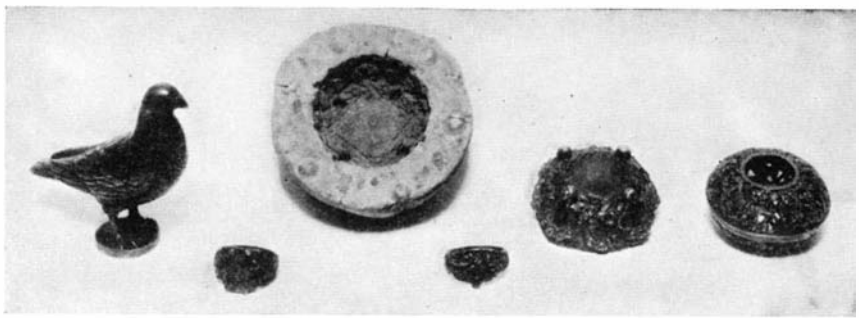
Measuring The Efficiency Of A Cow

ELECTRICITY'S latest task is a boon to the dairy industry. In the laboratories of the College of Agriculture, University of California, at Davis, California, there is a "respiration chamber" in which the input-output efficiency of a cow may be tested electrically. In fact, provisions

The factory at Salinas, California, where guayule rubber is produced. Guayule promises an appreciable supply



View of the milling department in the factory shown at the left, where large-scale production may be expected



Intricately chased small objects, rings, et cetera, may be cast by the new process described here in which a flexible molding material is used for making molds

are made for tests on two cows at one time.

The animals are provided with comfortable stalls in air-tight chambers, and are fed, watered, milked, and cleaned under careful laboratory conditions. The feed is weighed, the water is analyzed, and the air in the chambers is cooled and humidified. Attendants who enter the chamber at regular intervals must pass through an air lock auxiliary chamber to prevent air leakage.

The breathing of the animals is measured by an elaborate "mechanical lung" device called an "aspirator," designed and built by Dr. Kleiber on the staff of the college. A classifier, in the basement under the respiration chamber, separates the waste products. About the only thing which is not analyzed by this machine is the cow's moo.

The entire equipment is about three times the size of a large motor bus, and it cost nearly three times as much.

The respiration chamber is equipped with many interesting scientific instruments for carrying on research projects. General Electric motors and control devices are used to operate the "aspirator" and the classifier. Through the use of the equipment, scientists may ascertain what effect, if any, the use of treated water, variation in diet, cooled air, or other controllable conditions may have on a cow's efficiency.

Oil from Cherry Pits

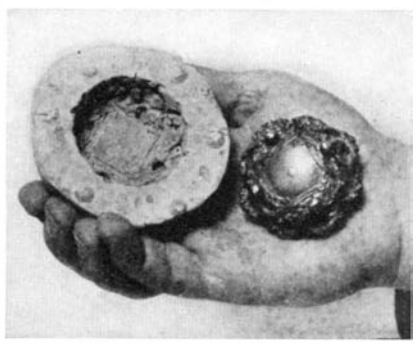
WHEN J. G. Marton, cherry grower of Sturgeon Bay, Wisconsin, stepped on a cherry pit a few years ago, he noticed the mashed seed kernel left a grease spot on the floor. Instead of canning cherries, he is now making oil out of nearly 1000 tons of cherry pits each year. The United States Department of Agriculture considered his discovery of sufficient importance to send two of its expert chemists to study the new industry, which began in a small way in 1927. The oil squeezed out of the seed kernel is used in making cosmetics, the residue of the kernel is ground up for fertilizer, and the shells of the pits are used as fuel.—*A. E. B.*

Seamless Undercut Castings Without False Cores

IN sand casting it is necessary to form the undercut places with false cores, producing seams on the casting which have to be removed by costly chiseling.

In a new German process introduced recently in this country, this work is obviated by covering the pattern with a plastic paste which will become elastic after a certain time. The pattern may then be removed from this elastic mold without spoiling it. The elastic mold is then put in its original position until it hardens. The mold is then put into an ordinary molding box, the customary inlets, pouring gullets, and vents being cut and the mold then dried and burned.

Castings made in such a way are seamless, very smooth and further finishing is seldom necessary. Very complicated castings may be made by this process and are said to be much cheaper than those produced in any other way.



The hardened mold and the model with its finely undercut details

Speeds Up Action of Yeast

PSYCHOLOGISTS tell us that music in the work-shop makes men work faster; illumination experts have proved that production is speeded up by good lighting. It remained, however, for the chemist to discover something that would speed up the action of that humble but useful organism, yeast. It has been found that rhizopin, a substance formed by the fungus *Rhizopus suinus*, greatly accelerates the growth of yeast. The effect is manifested both in greater formation of yeast dry matter and in increased conversion of carbohydrates to alcohol.

A convenient method for making rhizopin is to cultivate the fungus for six days at 35 degrees Centigrade in a liquid glucose-ammonium tartrate nutrient medium. The liquid is then filtered and sterilized in an autoclave; the resulting solution contains rhizopin. It may be used as such for accelerating yeast growth and fermentation or it may be purified by precipitation with 10 times its volume of alcohol.—*A. E. B.*

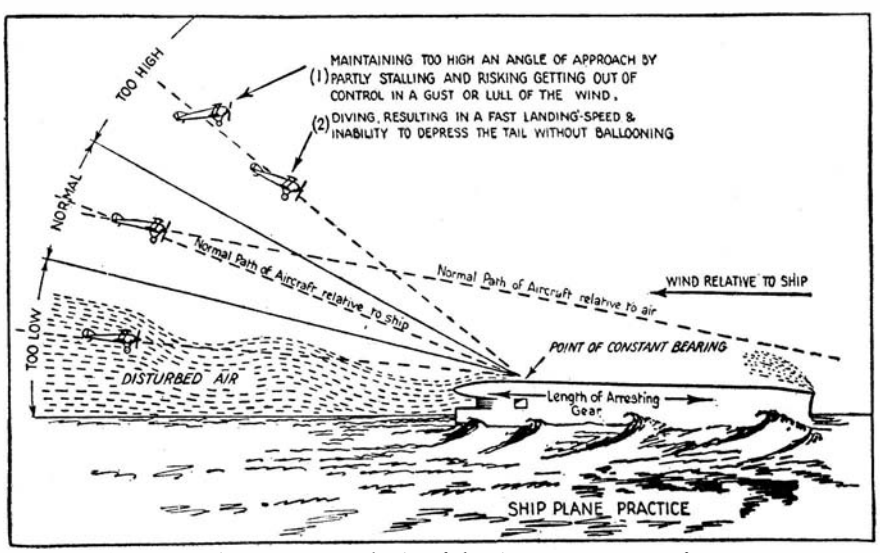
Deck Flying

THE American navy has always been inclined to great secrecy in the matter of its aircraft carriers, the methods of deck landings and the details of the arresting gears employed. So has the British navy up to recent times. Now the policy of secrecy has been broken by the British and a very full account of this important phase of aviation has been given before the Royal Aeronautical Society by Squadron-Leader W. R. D. Acland.

The early history of deck flying is a fascinating one.

The British took the old Cunard liner *Campania* and fitted it with a flying after-deck nearly 250 feet long. Seaplanes were successfully launched from this deck under conditions when it was impractical to take off from the water. An axle and wheels were attached to the underside of the floats and the aircraft was flown off like a land plane. As soon as the machine was in the air, the pilot pulled a quick release which allowed the axle and wheel to drop off. Later the seaplane was placed on a trolley. On reaching the end of the deck the trolley was arrested by two arms fitted with shock absorbers. This was fine for getting off, but it did not solve the problem of the return of the plane. Seaplanes had to alight frequently in rough water, and the process of hauling the craft aboard was always a difficult and perilous one.

Therefore the next attempts were made with land planes. The *Furious*, a British



Correct and incorrect methods of landing on an aircraft carrier

warship commissioned in 1917, was the first attempt at a floating airdrome; that is, a vessel to which landplanes could return after a flight. The flying deck consisted of the roof of the hangar, extended 200 feet and sloped downward in order to give a clear flow of air over the deck. Squadron Commander Dunning made the first British landing on a ship under way and lost his life in a subsequent attempt. He adopted the following method: The ship steamed head into the wind. This meant that the pilot's speed relative to the deck of the ship was reduced by the speed of the head wind plus the speed of the ship itself. A party of officers and men would grab the aircraft as soon as it touched. In the first successful attempt it was actually caught while still in the air. Grabbing hold in the air did not seem practical so on his second attempt Dunning gave orders that the plane was not to be touched till after he was on deck. Arriving on the deck with his engine running, he burst a tire, slewed over the side, and was drowned before help could reach him.

After this unfortunate accident it was decided that some form of arresting gear had to be devised. The first arrangement consisted of a number of fore and aft wires a few inches apart. When landing was in progress the wires were supported five or six inches off the deck by small wooden blocks. Stretched transversely across these wires at about 30-foot intervals were ropes to the ends of which were attached bags of sand. The plan was that the pilot should let down a hook which would pick up successive transverse ropes as the aircraft ran down the deck, thus progressively increasing the drag and stopping the aircraft. "Horns" engaged in the fore-and-aft wires were to keep the aircraft on a straight course.

The arresting gear worked fairly well, but there was a high wastage of equipment and many serious accidents. If the plane had a landing speed of 50 miles per hour, the vessel was steaming at 20 miles per hour, and the head-on wind was 15 miles, the landing speed relative to the vessel was theoretically only 15 miles per hour, and a 200-foot run plus the action of the arresting gear was theoretically more than sufficient. But half way up the deck the natural wind was completely blanketed by the funnel, mast, and bridge, so that the relative wind dropped by 15 miles. This was a serious matter when the aircraft was brought in during bumpy weather at considerably more than the minimum speed of 50 miles per hour. Fortunately for the pilots, a strong rope net was fixed to the forward end of the landing deck so that no plane actually hit the funnel, although many craft made determined efforts to break through the net.

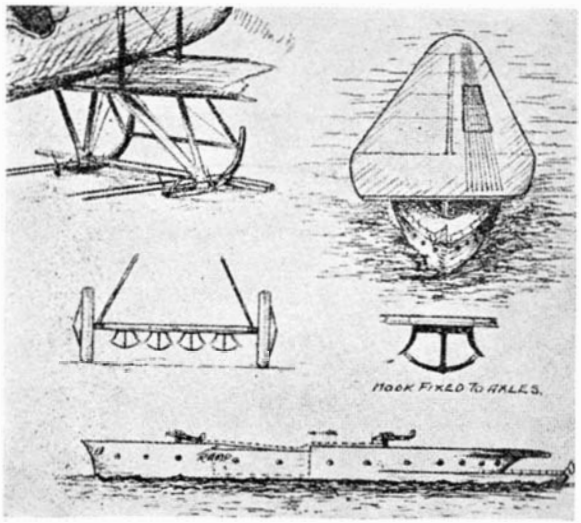
The definite lessons learned were as follows: 1; The aircraft should have a clear run so that if the pilot found he was unlikely to touch the deck until too far along, he could give her the gun, and go round for another attempt: 2; It was easier to approach from right astern in spite of bad bumps than to have to drift round the bridge and land forward: 3; That in spite of many cases of aircraft overshooting, with a clear run no arresting gear was necessary.

With these lessons in mind, came the first flush deck aircraft carrier, the *Argus*. The *Argus* was provided with an additional aid in the form of a lift, or elevator as we call it. For landing, the elevator was lowered some nine inches and a sloping ramp was fitted on the forward end. The aircraft dropped into the well, pushed the hooks on to the wires and was securely held. Subsequently with the extension in length of the gear, about 500 landings were made, of which 40 resulted in complete ruin of the plane, and 90 involved minor damage. On the whole the principle of the aircraft carrier was vindicated, and the next aircraft carrier *Eagle*, assumed the now almost standard appearance.

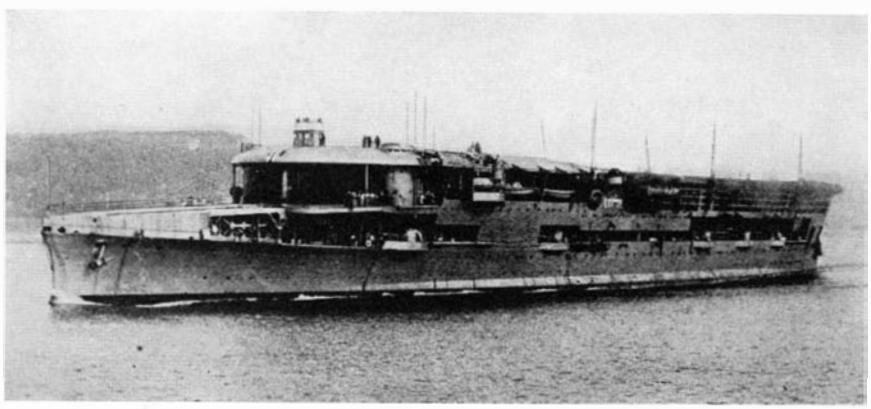
Further experience showed that, however satisfactory the arresting gear was in calm weather, it was in itself a cause of accident in rough weather. Fore and aft wires were discarded, the hooks and other gadgets on the plane disappeared. The modern wheel brakes independently applied on each side not only shortened the landing run appreciably, but also helped to keep the airplane along the center line of the carrier. There were occasions, however, when the airplane still persisted in going overboard. The idea of sloped, protecting palisades was therefore arrived at, constituting a sort of "island" on the deck of the carrier. These palisades consisted of stanchions spaced about eight feet apart with wires strung between them, and they extended for about 150 feet on each side of the deck at its forward end. The palisades sloped up at an angle of about 30 degrees, and effectively prevented the plane from going over the side, so they did restrict the landing space somewhat.

At the present time 99 percent of the deck landings are entirely successful.

One of our diagrams shows what the pilot should and should not do when approaching the aircraft carrier.—*A. K.*



Above: **H. M. Carrier *Eagle*. *At left:* Skid undercarriage with hooks. The sketch in the upper right hand corner shows arrangement of the wires along the deck and over the center lift indicated in the lower diagram. This experiment was carried out in H. M. S. *Argus***



H. M. S. *Furious*, with its flying deck

Substitutes for Ammonia Refrigerant

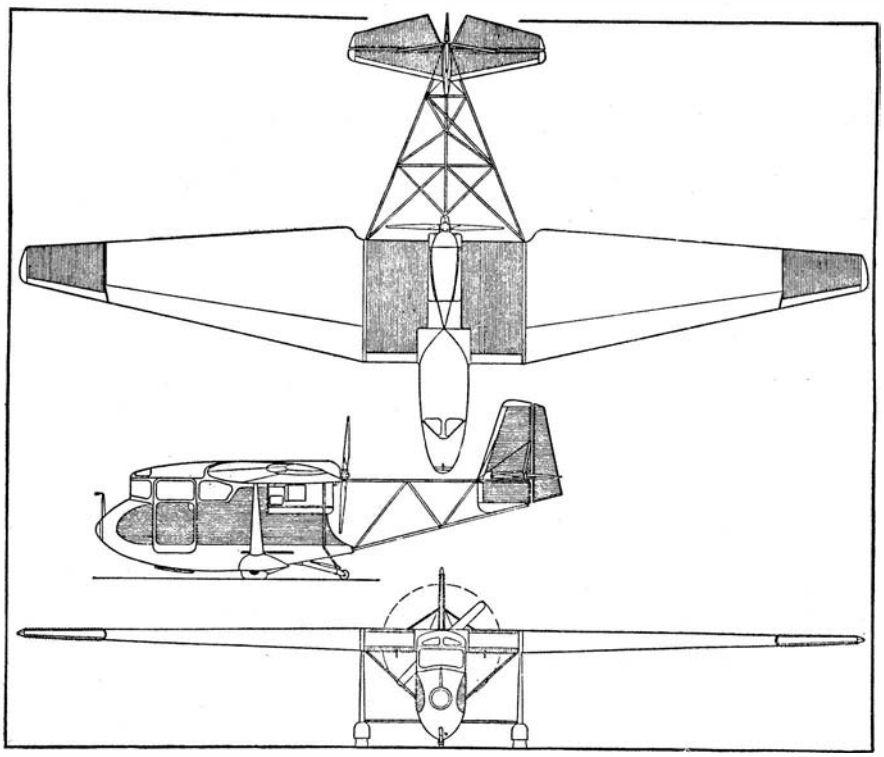
CHEMISTRY is continually penetrating further into the refrigerating industry, and recently attempts have been made to utilize the ammoniates and similar com-

pounds instead of ammonia as refrigerants. According to the experiments of R. Planck and L. Vahl in the Kaltetechnischen Institut der Technischen Hochschule Karlsruhe, calcium chloride ammoniate is especially recommended for this purpose and lithium chloride ammoniate also should be considered.—*A. E. B.*

The Sky Car

MR. WILLIAM B. STOUT, well known aircraft constructor who was originally responsible for the organization of the Airplane Division of The Ford Motor Company announces through the press a new, small, two-seater plane built in the Stout Engine Laboratories.

The "Sky Car" as it is called, is powered with a four cylinder, in-line, air-cooled engine mounted as a "pusher" in the rear of the wing and car. It is interesting to see that American airplane designers are returning to the "pusher" type.

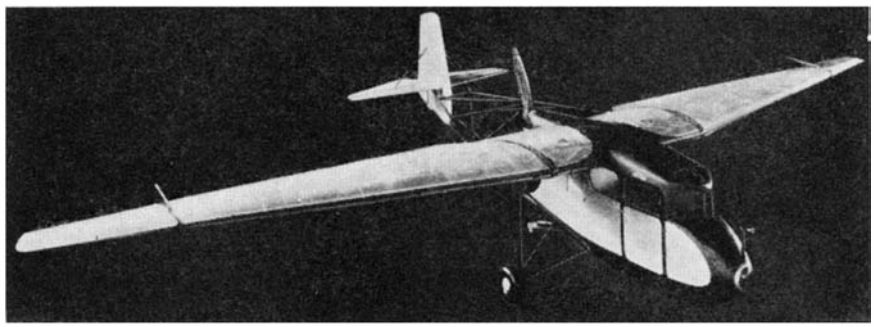


The arguments in favor of the "pusher" are that there is no propeller at the front end of the machine for anyone to wander into, and that the pilot and passengers can be seated at the very front end of the plane where the visibility is nearly perfect. The noise is reduced to a minimum because both engine and the whirling propeller are behind the occupants; the exhaust gases and fumes of gasoline and oil do not bother the occupants; the efficiency is somewhat higher because the fuselage is no longer in the slipstream of the propeller.

The main arguments against the "pusher" on small planes is that the relatively heavy engine is situated behind the occupants and that this is a source of danger in a bad crash. Some of the best engineers of the day, however, are of the opinion that the engine can be so solidly mounted that it should not break loose even in the worst landing, and if the landing is so bad as to shake the engine loose, the crash would be fatal anyhow!

Mr. Stout's design of a "pusher" is therefore in line with what other designers are thinking today; but he has taken a bold step in building an enclosed cabin for a machine with a horsepower of only 75. This is undoubtedly a step in the right direction. If small planes are to be built for private use, there is every reason why a closed cabin should also be provided. The day when the public demanded in its flying the feel, and incidentally the discomfort, of the open cockpit is gone and it is gratifying to see someone build such a small cabin plane.

It will be noted that the tail surfaces are mounted on outriggers with two upper booms going to the rear of the wing and a third, lower, boom attached to the rear end of the nacelle. Such a system of outrigger support for the tail provides ample clearance for the "pusher" propeller, and



The "Sky Car" in flight

the thrust line of the propeller need not be high up above the wing (an advantage from the point of view of longitudinal stability and trim). In the Curtiss Junior, a "pusher" propeller is also incorporated, but with a fuselage hollowed out somewhat like a flying boat hull. It is difficult to say which is the neater solution. The outrigger support for the tail surface is acceptable engineering practice and has been particularly in evidence of late in the Sikorsky amphibians.

Besides taking a bold step in providing

***At left:* Outline drawing of the all-metal, two-place, light airplane**

a closed cabin for the so-called "Aerial Flivver," Mr. Stout has taken a further step in using metal construction throughout the wing. This metal construction is similar to the corrugated metal construction of the large Ford planes. Hitherto, designers have usually fought shy of using all-metal, metal-covered wings for very light planes; wooden wings have been preferred because of weight. If Mr. Stout has succeeded in

***Below:* View of the new so-called "Flivver of the air" during assembly**

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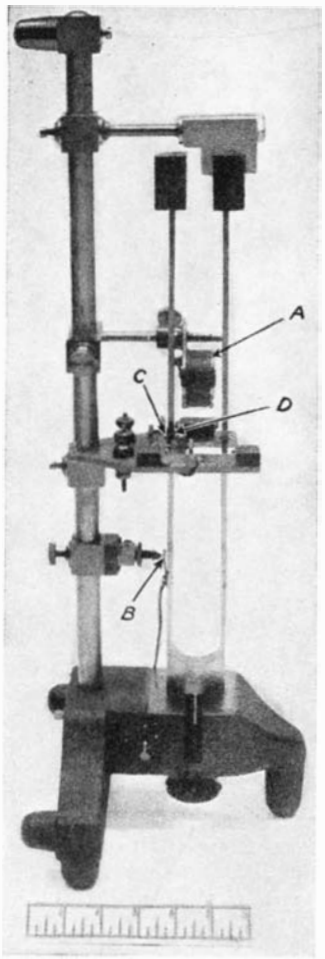


This apparatus is enclosed with a camera which sights on speed course in timing air races. Solenoid A energizes a tuning fork and maintains contact at B. The tuning fork makes alternate contact with points C and D as explained here

building a light, all-metal, cantilever wing for this size of plane, he has again made a step forward.

The tail wheel is not mounted at the end of the outrigger, but at the end of the nacelle. This is a decided structural advantage as the outriggers are thereby relieved of landing shocks. It will also be noted that the tail wheel is somewhat higher than the two front wheels. This is so that the machine may be tilted downwards at its rear to secure a large angle of incidence for the wings either in take-off or in landing.

Besides the few details we have been able to give above and the fact that the wing span is 23 feet, no technical information is yet available. Some of the fittings resemble those found in Ford cars. There is a Ford ignition switch and safety key on the dash and on the floor there is a Ford self-starter button. Another interesting accessory is a brake lever at the left of the pilot's seat which permits one-handed application of the brakes to either wheel for steering or to both wheels for braking. The rudder for directional control is operated by floor pedals similar to those used in the early Ford cars. The price is announced as under 2000 dollars. (The Curtiss Junior, with similar power and no enclosed cabin, is under 1500 dollars.)

While the plane is very neat in appearance, we are sorry to see the announcement that it is an "aerial counterpart of the famous 'Tin Lizzie,' the Model T Ford" and also that it can be landed in the space of a tennis court. The new machine is not the "Tin Lizzie" of the air since both similar and cheaper planes are available on the market nor does it embody in its design such aerodynamic improvements or novelties as to render its landing qualities very much better than those of similar machines built by other constructors. Anyone purchasing such a craft with the expectation of landing it on a tennis court might be disappointed.

We welcome the arrival of a new, well finished design highly suitable for the private owner; but it does not seem advisable to give the public statements which might raise its hopes of a back-yard flying machine too high.—*A. K.*

Timing at 400 Miles an Hour

THE traditional method of timing an airplane over a speed course is to have observers at each end of the course sighting carefully and timing with synchronized stop watches. The errors are obvious. The observers may make an error in pressing their stop watches; the stop watches may not be correctly synchronized; the observations may be in error by the interval of the stop watch.

Such methods were perfectly satisfactory in the old days when a hundred miles per hour was considered to be high speed, but more accurate methods are necessary to time the Schneider Cup racers as they approach 400 miles per hour. For these races the British have developed a remarkable system of automatic timing.

At each end of the course, a moving-picture camera is sighted on the course. Each camera simultaneously photographs the seaplane as it passes over the course and a Veeder stroke counter which is actuated by the vibrations of a tuning fork. The tuning fork is, of course, the most accurate measure of a time interval in practical use, and is made to vibrate at a frequency of ten per second. The tuning fork makes and breaks an electric circuit which connects the counter at one end of the course to the counter at the other end of the line. Therefore, by subtracting the reading at one end from the reading at the other when the seaplane is recorded on the film, time is measured correctly to 1/20th of a second. This is considered sufficiently accurate for speeds of 400 miles per hour. Over a course of two miles, the maximum error in speed measurement would be only about ½ mile per hour.—*A. K.*

The Curtiss Junior

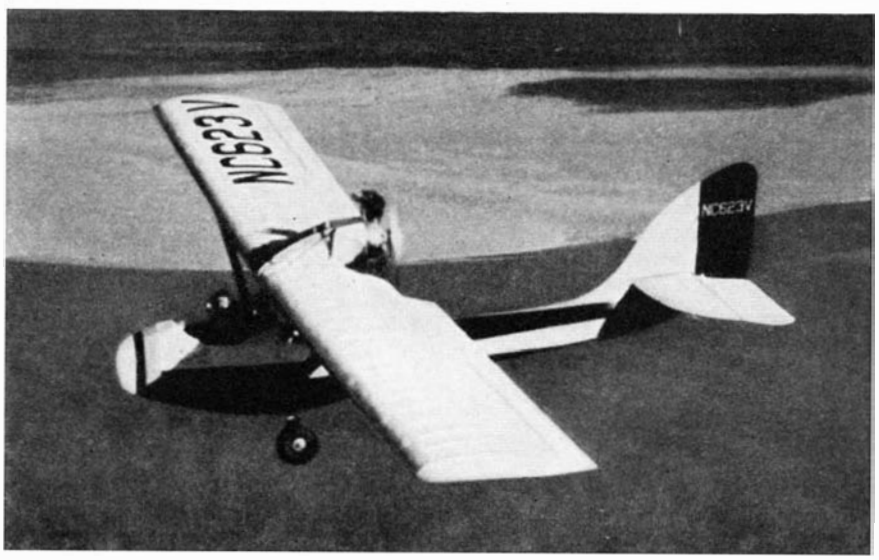
THE Curtiss-Wright Airplane Corporation has brought out a small two-seater, the Curtiss Junior, in a bid for popularity with the private flyer. The Junior is a two-place, tandem seated, pusher airplane, equipped with a Szekely, 40 horsepower, three cylinder, radial, air-cooled engine. Top speed is about 80 miles per hour and cruising speed is around 70. Enough gasoline is carried for three hours cruising. Landing speed is claimed as being only 28 miles per hour. The weight, empty, is only 510 pounds, fully loaded, 920 pounds. The over-all length is 20 feet 10 inches and the span is 39 feet.

The ideal price for a sporting two seater has always been considered to be $999.99 or just under a thousand dollars. The Junior does not meet this by several hundred dollars, yet it is a well finished, efficient, sturdy flying machine, with a reasonable top and minimum speed.

The design of the Junior seems to depart somewhat from that of the conventional airplane. The long fuselage has somewhat the appearance of a hull. The cockpit at the extreme forward point of the fuselage gives the pilot and passenger unimpeded vision. The fact that the engine is in the rear removes exhaust, oil, and gas fumes, and minimizes the noise. The likelihood of the engine crashing on top of the occupants is considered negligible by the best authorities. The plane is neither too large for cheap maintenance, nor so small as to be unairworthy. It is decidedly worth while.—*A. K.*

Drug Addiction

THE problem of drug addiction concerns the United States more than any other country. Our per capita use of nar-



The Curtiss Junior, an interesting light airplane. The pilot, at the forward end, has unimpeded vision. The pusher arrangement minimizes fumes and noise

cotics, according to Dr. W. E. Dixon, is 245 milligrams, as compared with 150 for Europe, 8 for Asia, and 24.5 for Africa. Numerous studies have been made as to the causes of narcotic addiction. The latest figures supplied by Dr. W. L. Treadway of the United States Public Health Service indicate that the main causes are previous use of drugs in medical treatment, self treatment for relief of pain, recourse to drugs during emotional distress, the influence of other addicts and the indulgence in drugs for the sake of curiosity, thrill, or bravado.

Among 1225 addicts in whom the causes for addiction were known, 23 percent were due to previous use of drugs in medical treatment, 17 percent to self treatment for the relief of pain, and 52 percent to the remaining three causes mentioned. The National Research Council is attempting to solve the problem of narcotic addiction by promoting research with a view to finding some synthetic preparation derived from opium which will have all of the qualities of opium and morphine without their tendency to establish drug addiction. The American Medical Association is trying, through its *Journal*, to decrease the amount of narcotics prescribed by physicians by educating the physicians as to the indispensable uses of various narcotics. If physicians will carefully limit their prescriptions to such indispensable uses, the total of narcotics prescribed will be decreased.

A series of studies made by Dr. A. E. Light and his associates in Philadelphia indicate that the addict who has sufficient will power can undergo the withdrawal of morphine safely because the addict can control to a large degree the intensity of the withdrawal symptoms. The Philadelphia investigators are convinced that hysteria plays a large part in determining the intensity of such symptoms.—*M. F.*

Sure-Kill Poison for Troublesome Bushes

A POISON for undesired bushes such as poison ivy and European barberry, quick and sure in its action yet clearing out of the soil after its work is through, was described recently before the meeting of the American Society of Plant Physiologists by Prof. R. B. Harvey of the University of Minnesota.

This new agent in man's chemical warfare against tough weeds is ethylene oxide, chemically related to the ethylene chloride which has been found very effective in hastening the ripening of fruits and vegetables. Prof. Harvey discovered the value of ethylene oxide during the course of experiments with various ethylene compounds. He found that the oxide killed the fruits and vegetables instead of speeding up their ripening processes.

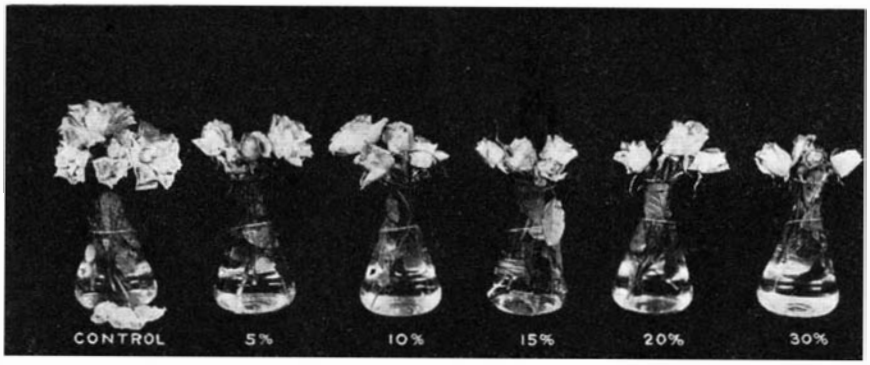
He tried the compound on some large barberry bushes, which are being harried out of existence in the great grain areas because they harbor the black stem rust of wheat. What he calls "depth charges" of ethylene oxide dissolved in water were sunk into holes pierced in the soil at the roots. A few days later the bushes were revisited, and in every case they were found to be in the last stages of the death struggle. About one and one half ounces of ethylene oxide, diluted to a 10 percent solu-

tion in water, usually sufficed for a large bush.

At present barberry bushes are fought either by digging them up, which leaves stray roots free to sprout again, or by dumping quantities of common salt into holes at their roots, which is rather hard on the soil. Other chemicals which are effective against them cannot be used because they are poisonous to cattle. "Depth charges" of ethylene oxide, Prof. Harvey concludes, seem to offer the best means so far discovered for killing these and similar noxious plants.—*Science Service.*

When Apples Breathe Carbon Dioxide

SINCE the advent of solid carbon dioxide, or Dry-Ice as a refrigerant, particularly for perishable goods, it has become necessary to determine what effect the carbon dioxide gas, liberated by vaporization, has on the products being preserved. N. C. Thornton, of the New York State College of Agriculture at Cornell University, has recently published, in *Industrial and Engineering Chemistry*, some interesting results of preliminary studies of the effect of carbon dioxide on fruits, vegetables and flowers. Dr. Thornton's work has been carried out at the Boyce Thompson Institute for Plant Research.



Effectiveness of various concentrations of carbon dioxide in retarding bud development and dropping of petals of roses held for seven days at 50 degrees

Although it is not generally realized, most fruits, vegetables, and flowers live and breathe even after they are plucked. Therefore they are known as respiring plant organs. Fruits, except citrus, are more or less affected by forcing them to "breathe" carbon dioxide, according to the concentration of the gas and the firmness and age of the fruit. The noticeable changes in most fruits as a result of exposure to an injurious concentration of carbon dioxide are the development of an abnormal flavor (insipid, bitter, or alcoholic) and a softening or browning of the tissues.

Freshly harvested vegetables vary considerably in response to the carbon dioxide treatment. Celery, lettuce, and spinach stored in carbon dioxide, became soft and took on an abnormal odor.

Flowers seem to like to breathe carbon dioxide. At least, roses, gladioli, snapdragons, and some varieties of carnations preserve their freshness longer when stored in the gas. The life of rosebuds was prolonged as much as two or three days. Seven days' storage of rosebuds at either 38 or 50 degrees, Fahrenheit, in an atmosphere of 15 percent carbon dioxide produced the best results, although 5 percent was found to be effective. When moved from cold storage into a warm room, the untreated buds opened very quickly, while those which had been stored in carbon dioxide opened slowly with good color and shape.

Dr. Thornton has accumulated accurate data on the tolerance of many different fruits, vegetables, and flowers to carbon dioxide atmospheres. In general, the results show that some plant organs are improved for consumption by proper percentages of carbon dioxide, others have considerable tolerance of the gas, and only a few require that minimal amounts of it be present. These data are being applied to the design of practical refrigerator equipment for the commercial use of solid carbon dioxide. —*A. E. B.*

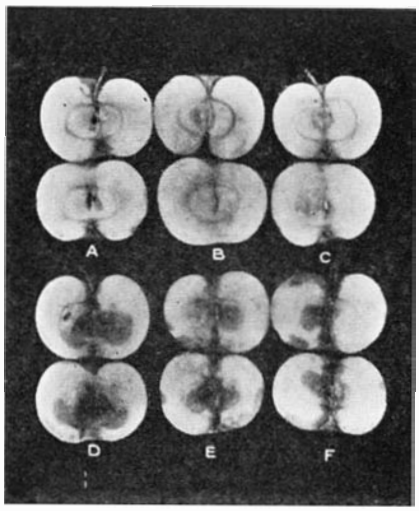
Make Alcohol from Natural Gas

A PROCESS for manufacturing industrial alcohol from natural gas waste is reported to have been developed in the laboratories of the Canadian National Research Council, according to the Department of Commerce. This process is regarded as a means of utilizing the large waste of gas in the Turner Valley oil field of Alberta.

Officers of the research council are now studying the economic possibilities of the process which has been developed. It is stated that the operating cost, excluding overhead and any other charges made for waste as required, would not exceed 25 cents per gallon. Industrial alcohol used annually in Canada at the present time is valued at more than 2,000,000 dollars.

If applied to only the so-called stabilizer gases, the process, it is estimated, could yield industrial alcohol to the extent of 10,000,000 gallons a year.

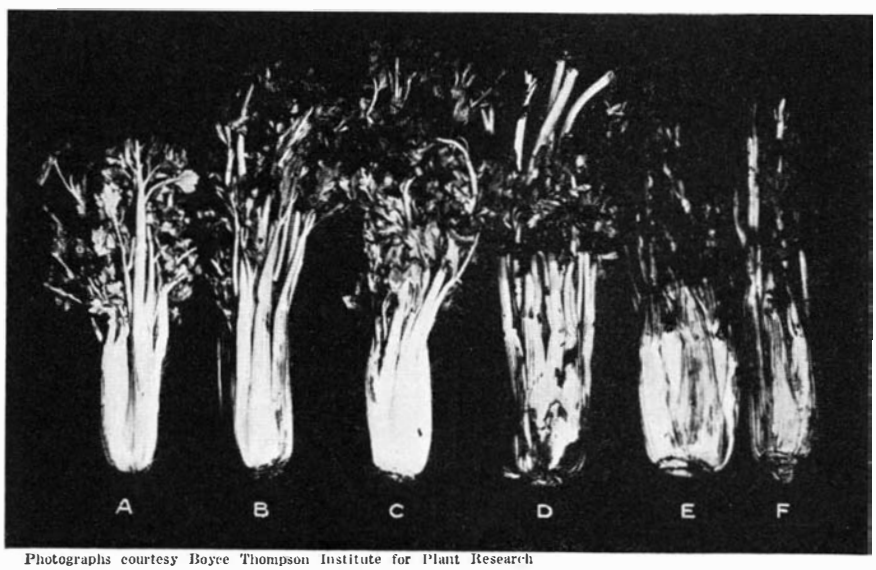
Dr. A. Cambron, senior chemist at the National Research Laboratories, is reported to have developed a process whereby the waste gas can be converted readily into ethylene, from which alcohol and other chemicals, including glycol, can be made. —*A. E. B.*



Apples held for six days in carbon dioxide at 38 degrees. A and B are controls (untreated); C, 25 percent carbon dioxide—no injury or abnormal flavor; and D, 50 percent of this gas; E, 70 percent; and F, 87 percent, these three showing injury and having abnormal flavor

Chemical Hazards to Photographers

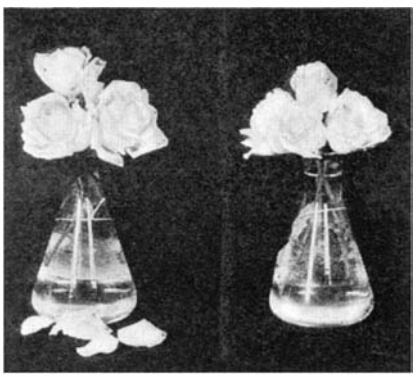
FEW people think of the photographic industry as essentially a chemical industry, but people who spend much of the time in the development and printing of photographs come constantly into contact with a great many poisonous substances, including particularly metol, elon,



Photographs courtesy Boyce Thompson Institute for Plant Research

Celery in carbon dioxide for seven days at 50 degrees. A and B are controls; C, 25 percent—no injury; and D, 50; E, 70; and F, 80 percent, all injured

chromium compounds, sodium carbonate, sulfur dioxide, and cyanides. They are also likely to be affected by manganese. Many of the substances, such as metol and elon, are cresol derivatives which can cause eruptions on the skin and it has been shown that one cresol derivative is respon-



Bud development and dropping of petals of rose at right were retarded by 5 percent carbon dioxide for seven days at 50 degrees. The control rose at left dropped petals

sible for the kind of paralysis that results following the drinking of bootleg Jamaica ginger.

The chemical hazards are beginning to be so well understood that it is advisable for all workers with chemical substances to attempt to find out the exact hazard involved before undertaking an extensive exposure to inhalation or skin contact of such chemical substance.—*M. F.*

30,000,000 Volts Are Predicted

ASPIRATION to duplicate in the laboratory the powerful radiations that hitherto have been produced only by nature, promises to lead to further discoveries by the trio of Carnegie Institution physicists in Washington, whose paper on high-voltage tubes won the 1000-dollar prize of the American Association for the Advancement of Science at Cleveland recently.

Within the realm of possibility of accomplishment in the near future is the production of voltages of 20,000,000 to 30,000,000.

At present the vacuum tubes developed by Dr. M. A. Tuve, Dr. L. R. Hafstad, and Odd Dahl in the laboratories of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington have operated reliably at potentials up to two million volts. This is a remarkable potential to be impressed upon a vacuum tube and it produces the most powerful radiations yet made by man, artificial beta rays, which are high speed electrons, and artificial gamma rays which are very penetrating X rays. Thus two of the three radiations from radium have already been duplicated.

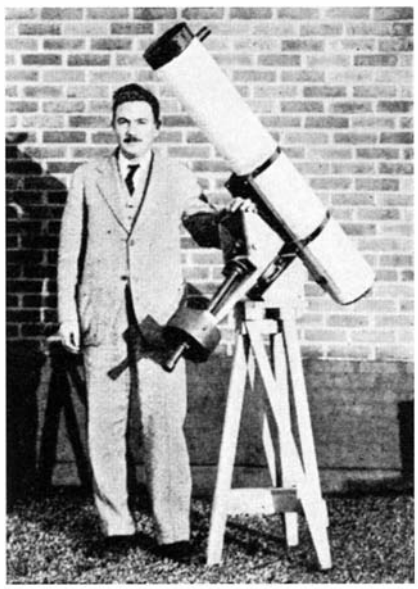
Although Dr. Tuve in delivering the prize paper at Cleveland did not discuss it, he and his associates are now at work on a new method of building up electrical voltages that should soon make it possible to impress upon gigantic X-ray or other vacuum tubes voltages much higher than the five million or so they have generated so far. Thirty million volts are theoretically possible with a modification of what is

(*Please turn to page* 419)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

THIS month our department will smack rather strongly of the campus. Professors of all kinds have now taken to making telescopes. The attentive reader may recall the hint in the preface of "Amateur Telescope Making," that it was hoped the professional would do this, thereby qualifying as an amateur in his own right. Four of these "pros" now regain full amateur



Professor Corner—anatomist

standing without prejudice. They may shake and quake in unison with the rest of the telescope fraternity.

The first professor is Dr. M. de K. Thompson of the Massachusetts Institute of Technology, an electrochemist in the Department of Physics. Here is what he writes:

"According to the invitation contained in 'Amateur Telescope Making' to those who have made a telescope, I enclose a photograph of one I have just finished.

"The mirror is a six-inch disk of Pyrex glass, one half inch thick. These cost only 95 cents each. The time required for roughing out was six hours and 40 minutes, showing that Pyrex is about twice as hard as plate glass. Fine grinding took three hours and ten minutes.

"After a total of four hours' polishing I found that the edge was turned up, with a high region in the center and a ring around this region. A six-inch stroke brought this to a sphere in one hour, and I parabolized in 20 minutes more with an overhang stroke. The shadows looked exactly like those shown on page 225 of 'Amateur Telescope Making', and the radius of curvature was one-tenth inch less at the center than at the edge.

"I had great difficulty in cleaning the glass properly for silvering. Scrubbing with cotton tied to a glass rod and wet with nitric acid did not at first leave the surface so that water drained evenly without separating into drops. This is the usual test for clean glass. Then hot caustic followed by hot chromic acid was tried. Neither produced the desired result. Finally, I got a pair of rubber gloves and rubbed with cotton and nitric acid until the surface drained evenly. Over half an hour's vigorous rubbing was required. The silvering then was successful.

"I had a wooden equatorial mounting made as described in 'Amateur Telescope Making,' and made a tripod. This is a 15-pound iron casting drilled to take a one-inch steel pipe, and three half-inch steel rods as feet. As a finder, which is quite necessary, I use a strip of brass with a V-notch at each end. The notches are painted with luminous paint. The ends of the rod are bent up so that any object in line with the bottom of the notches is in the field. I find a piece of silvered windshield, tested for flatness and ground to an ellipse by sticking on the end of a wooden rod one inch in diameter and sawed off at 45 degrees, very good as a diagonal.

"I have been using a Ramsden eye-piece of one-inch equivalent focal length from a microscope, and have had fine results looking at the moon."

Pyrex is made by the Corning Glass Works, Corning, New York. We are glad Professor Thompson rubs in well the necessity of cleaning the glass thoroughly before silvering. The criterion of "clean enough" which a male worker usually applies to dish washing (if he ever does any) won't do at all. This has been emphasized in numerous places but confirmation from outside has added weight.

A PROFESSOR of anatomy, George W. Corner, M.D., of Rochester University, Rochester, N. Y. writes as follows:

"In accordance with your request that persons who have made telescopes under the influence of SCIENTIFIC AMERICAN should send in pictures of the instrument, I enclose a photograph of a six-inch reflector which I constructed. The work was guided entirely by your book, 'Amateur Telescope Making.'

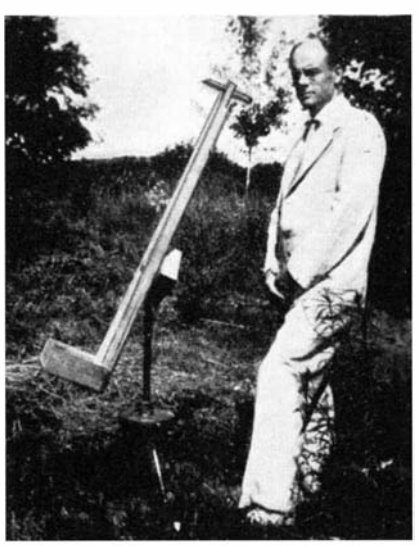
"I have been able to see two or three of the zones across the disk of Jupiter, the ninth magnitude companion of Polaris, and other objects, which makes me feel that the result is up to the average. As you can see, there is nothing remarkable about the instrument. The axes were made from two front hubs of a model T Ford. The total cost was about 30 dollars, exclusive of eye-pieces. I have used microscope eye-pieces from my laboratory for the lower powers with complete success.

"I succeeded perfectly with the silvering on the first trial for the reason that Brashear's method is quite similar to the Bielschowsky method of staining connective tissue reticulum, a technique with which I am quite familiar. It might help those who have difficulty with silvering if it were insisted, even more than in the book, that the critical point is that at which the brown precipitate of alkaline silver is cleared by the addition of more ammonia. Great care at this point is the secret of success."

Professor Corner's comment on the similarity of silvering and staining connective tissue reticulum reminds us of a recent experience at the dentist's. We discovered the dentist silvering one of our molars and, it turned out, this is a well-known dental procedure for plugging up minute cracks.

FROM Ypsilanti, Michigan, comes a letter written by F. R. Gorton, professor of physics and astronomy. No institution was named, but presumably it is the Michigan State Normal College, which is at Ypsilanti. Dr. Gorton says the telescope he describes was produced in connection with college work and, he adds, "I believe that the interest developed in the making of this mirror turned one of our best students to the field of astronomy. He has now completed his work for the master's degree in our state university and receives a scholarship for continuing work in the astronomical field.

"The photograph shows an eight-inch reflector which was made at a very low cost. The instrument is portable, and the eye-piece is easily reached while the observer stands on the ground. The mirror was ground in the usual manner from an eight-



Professor Thompson—electrochemist

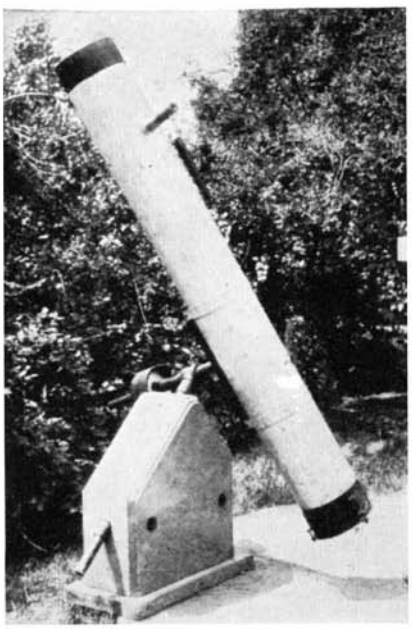
inch disk, and the polishing was carried over a long period to remove a few defects from the surface. The definition is very good.

"The sheet-metal tube and mirror cell were made of galvanized iron by a tinsmith. The cell is held securely in place by means of three screws which serve to bring the axis of the mirror coincident with that of the tube with considerable precision. Around the tube are two bands of strap iron which attach it firmly to a piece of hardwood hollowed on one side to fit the tube. The diagonal is a prism which is pro-

vided with a tilting screw for adjustment.

"The pier is made of concrete into which was set at the proper angle a piece of 1¼-inch pipe to receive the polar axis. It is also provided with two holes through which pieces of one-inch pipe are placed for carrying handles. The pier weighs over 200 pounds and was cast on a two-inch base of wood to protect the concrete. The mountings of the telescope are entirely of pipe and pipe fittings."

With a base of the kind Professor Gorton



Professor Gorton's telescope

describes it should be possible even to adjust a telescope accurately in the meridian, using a small pinch bar or pry and expect it to stay put if left out-of-doors, yet not have to attach it. This kind of base might well be adapted to flat roofs. The two holes are ingenious, permitting a pair of "pall bearers" to pick up even a heavy telescope without difficulty and walk off with it.

W. A. CALDER of Beaver Dam, Wisconsin, graduated at the University of Wisconsin and took his M. A. degree in physics, but became exposed to telescope making, and now see what has happened: the world has lost a potential physicist, but gained an astronomer, for Mr. Calder is now at Harvard College Observatory (Cambridge, Massachusetts) doing graduate work in astronomy.

"The snapshots," he writes, "show my 'Unfinished Symphony' of telescopes. The little draw telescope started the ball rolling when I was in the grades. I made an equatorial mounting for it, using an old water motor for the polar axis, and peanut butter jar covers for graduated circles. The three-and-a-half-inch Gaertner refractor was bought from the college I attended, through the help of a very kind-hearted professor. It has a fine clock and has made me partial to refractors.

"I made the six-inch mirror last winter according to 'A. T. M.', but not according to Ellison who insists on a cellar workshop or one whose temperature it not subject to rapid variations. It was made in a clothes closet so small that there was barely room to walk around the barrel. Galileo

(*Please turn to page* 425)

CURRENT BULLETIN BRIEFS

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

PROXIMATE COMPOSITION OF FRESH VEGETABLES (Circular 146-C, U. S. Department of Agriculture) gives tables including 121 varieties and classes of vegetables. *Office of Information, U. S. Department of Agriculture, Washington, D. C.—Gratis.*

MANUFACTURE OF INSULATING BOARD FROM CORNSTALKS (Miscellaneous Publication No. 112, Bureau of Standards, U. S. Department of Commerce) by O. R. Sweeney and W. E. Emley gives full information on an industry which bids fair to become of great economical importance. *Superintendent of Documents, Washington, D. C. 10 cents (coin).*

AIRWORTHINESS REQUIREMENTS OF AIR COMMERCE REGULATIONS FOR AIRCRAFT (Aeronautics Bulletin No. 7-A). *Aeronautic Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

BIBLIOCHRESIS: THE PILOT OF RESEARCH (Reprinted from *Science*, April 11, 1930) by William A. Hamor and Lawrence W. Bass. Bibliochresis, the scientific use of literature, has the pilotage of all scientific investigation. *Mellon Institute of Technical Research, Pittsburgh, Pa.—Gratis.*

THE INSIDE STORY OF ETHYL GASOLINE tells why ethyl gasoline gives the best performance of the newer cars with engines of higher compression. *Ethyl Gasoline Corporation, Chrysler Building, New York City.—Gratis.*

BIBLIOGRAPHY OF AERONAUTICS for 1929 covers the aeronautical literature published from January 1 to December 31, 1929. It contains 242 pages. *Superintendent of Documents, Washington, D. C.—35 cents (money order).*

TRAILSIDE ACTIONS AND REACTIONS (School Service Series Number Five, American Museum of Natural History) by William H. Carr, deals with the nature trails and trailside museum at Bear Mountain, N. Y., and is the fifth in a series of excellent handbooks, all copiously illustrated. *American Museum of Natural History, 77th Street and Central Park West, New York City.—20 cents.*

NATIONAL METALS HANDBOOK gives a wealth of material, published by the American Society for Steel Testing. It is a bound volume brought out in revised and enlarged form approximately every two years and it is kept up to date by loose leaves. A full prospectus is sent on request. *American Society for Steel Treating, 7016 Euclid Ave., Cleveland, Ohio.—Free to members. To non-members, $10.00.*

ARC WELDING SUPPLIES, a trade publication, gives useful information as to welding supplies. *The Lincoln Electric Co., Cleveland, Ohio.—Gratis.*

EDUCATIONAL DIRECTORY 1931—Part I.—ELEMENTARY AND SECONDARY SCHOOL SYSTEMS (Bulletin, 1931, No. 1, Office of Education, U. S. Department of the Interior) gives a valuable list of educators all over the country including parochial schools.—*Superintendent of Documents, Washington, D. C, 15 cents (coin or money order).*

INDUSTRIAL RESEARCH, BENEFICENT ARBITER OF MODERN PROGRESS (Reprinted from *Chemical and Metallurgical Engineering*, Jan. 1931) by William A. Hamor, describes the place of the Mellon Institute in research. *Mellon Institute of Industrial Research, Pittsburgh, Pa.—Gratis.*

THE CHEMICAL CONTROL OF CLOSED CIRCULATION SYSTEMS OF SEA WATER IN AQUARIA FOR TROPICAL MARINE FISHES (Zoologica Vol. IX, No. 11) by C. M. Breder and T. H. Howley of the New York Aquarium. If your hobby is marine tropical aquariums you and your fishes need this booklet. *New York Zoological Society, The Zoological Park, New York. Price—35 cents.*

THE ENGINEERING FEATURES OF "BUILT-IN" LIGHTING (Reprint from *Lighting*, November-December 1930; January 1931) by A. L. Powell and Alston Rogers, who consider that "built-in" lighting must be designed as a component part of the building, the sort which in general cannot be applied to a structure that is entirely furnished. It is profusely illustrated. *Nela Park Engineering Dept., General Electric Co., Cleveland, Ohio.—Gratis.*

THE DISTRIBUTION AND THE MECHANICAL PROPERTIES OF ALASKA WOODS (Technical Bulletin No. 226, United States Department of Agriculture) by L. J. Markwardt fills a much needed niche in the literature of forestry, for there was a lack of reliable information concerning the extent and properties of the woods of Alaska. *Office of Information, U. S. Department of Agriculture, Washington, D. C.—Gratis.*

ANNOTATED INDEX OF THESES AND DISSERTATIONS IN EDUCATION has been compiled by Professor F. J. Weersing and B. R. Haynes and the purpose of the index is to provide a guide to the formal research which has been made by students of Education at the University of Southern California. *Associated Students' Store, University of Southern California, Los Angeles, Cal.—75 cents.*

DISSTON SAW, TOOL AND FILE MANUAL describes the use of many tools and is profusely illustrated with well posed pictures. *Henry Disston & Sons, Inc. Philadelphia, Pa.—Gratis.*

THE SEARCH FOR RAW MATERIALS, THE ROMANCE OF BUSINESS AND THE LEAVENING OF COMMERCE is an interesting paper on the subjects indicated in the title. *William M. Booth, 925 University Building, Syracuse, N. Y.*

ANNUAL REPORT OF THE DIRECTOR TO THE BOARD OF TRUSTEES FOR THE YEAR 1930 (Publication 287, Report Series, Vol. VIII, No. 2, Field Museum of Natural History) gives the story of the year in the space of 522 pages. It is well illustrated. *Field Museum of Natural History, Chicago, Ill.—$1.00, postage extra.*

BIBLIOGRAPHY OF NORTH AMERICAN GEOLOGY 1919-1928 (U. S. Geological Survey Bulletin 823). The latest volume (1005 pages) of a standard key to periodical geological literature, much used by the research worker. *Superintendent of Documents, Washington, D. C.—$1.25 (money order).*

HABITS AND ECONOMIC STATUS OF THE POCKET GOPHERS (Technical Bulletin, No. 224, United States Department of Agriculture) by Theo. H. Scheffer describes this burrowing rodent which is an agricultural pest, for the animals are great eaters of roots and tubers. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

ARMCO "METALCURB" describes the latest contribution to scientific highway construction. It is adapted for bituminous and brick pavements. *The American Rolling Mill Company, Middleton, Ohio.—Gratis.*

UNITED STATES EARTHQUAKES 1928 (Serial No. 483, Coast and Geodetic Survey) gives a list of quakes in U. S. in 1928. It is an extension of the well known publication entitled "Earthquake History of the United States." *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

HOW TO JUDGE A HOUSE (Report of the sub-committee on How to Judge a House of the National Committee on Wood Utilization) by Nelson S. Perkins, C. E., is a pamphlet which should be in the hands of anyone who is thinking of building or buying and may prevent buying unwisely. The elements of value are carefully explained. The pamphlet is of extraordinary value. There are 41 illustrations. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 415)

called the Faraday cage which has been developed.

By using these voltages to accelerate the positively charged cores of hydrogen atoms these scientists will have by far the most powerful projectiles ever available to a human being, resembling the alpha rays from radium. What will happen when they are let loose is still a matter of discussion among scientists.

Some physicists have suggested in the past that if such powerful radiations were allowed to smash into the hearts of atoms, there might be a liberation of the immense internal energy of the atoms with a gigantic explosion that would wipe out the world and this corner of the universe. This idea was the theme of the Broadway success of several years ago, "Wings Over Europe" in which a scientist, not unlike the Dr. Tuve of real life, solved the secret of physics and held the fate of the nations and the world in his grasp.

But most physicists do not expect such a cataclysm. They expect the artificial radiations to be extremely useful in probing deeper the fundamental structure of matter. They expect as a by-product that the powerful radiations will be useful in the treatment of cancer and possibly put to other medical uses. They expect that the radiations will give new knowledge of the earth's magnetism and how it is caused. This latter possibility was the starting point of the whole investigation and is the reason for its support by the Department of Terrestrial Magnetism of the Carnegie Institution, directed by John A. Fleming. Incidentally, there will also come a better understanding of radio because physicists feel sure that the radio-reflecting Kennelly-Heaviside layer above the earth is affected by natural radiations that come from the sun and outer space.

Dr. John C. Merriam, president of the Carnegie Institution, expressed delight at the award of the American Association prize to the three members of his institution and explained: "Their work represents a long continued intensive study of this problem and it is a great pleasure to know of the recognition of the work at this stage of the investigations."—*Science Service.*

Tonsils and Adenoids

ONE of the most interesting medical experiments in recent years has been the careful observations of the lives of 2200 children whose tonsils and adenoids were removed ten years ago as compared with 2200 children whose tonsils and adenoids were not removed and who have also been observed for ten years with relationship to various diseases. Such an investigation has been made by Dr. A. D. Kaiser of Rochester, New York. In his report, read at the Second International Pediatric Congress in Stockholm, Dr. Kaiser drew the following conclusions:

The removal of tonsils and adenoids influences favorably the incidence of the following infections:

(1) Colds in the Head: These occur in

22 percent of the tonsillectomized children and in 31 percent of those used as controls.

(2) Sore throats: These occurred in 10 percent of the tonsillectomized children and in 35 percent of those used as controls.

(3) Cervical adenitis: This condition occurred in 7 percent of the tonsillectomized children and in 14 percent of those used as controls.

(4) Otitis media: This condition occurred somewhat less frequently in the children operated on. In these children, over a period of ten years, there was a decreased incidence of 10 percent, while in the children used as controls there was a decrease of 6 percent over the same period.

(5) Rheumatic disease: The first attack of rheumatic fever and rheumatic heart disease occurred 33 percent less commonly in tonsillectomized children. Chorea and recurrent attacks of rheumatic fever were not influenced by removal of the tonsils.

(6) Diphtheria: This disease occurred in 1.3 percent of the tonsillectomized children and in 1.9 percent of those used as controls.

(7) Scarlet fever: This disease occurred in 3.3 percent of the tonsillectomized children and in 4.6 percent of those used as controls.

(8) Nephritis: This condition occurred only one third as often in the children whose tonsils had been removed.

(9) Dental infections: Such infections occurred only half as often in the children whose tonsils and adenoids had been removed.

The following infections were influenced favorably, to a slight degree, or not at all:

(1) Chorea: This condition occurred with somewhat greater frequency in the children whose tonsils and adenoids had been removed, but the cases of chorea developing in tonsillectomized children showed a lower incidence of carditis.

(2) Measles: This infection occurred with equal frequency whether the tonsils had or had not been removed.

(3) Laryngitis: This condition developed in 5 percent of the children in both groups over a ten-year period.

(4) Tuberculosis: This condition occurred with equal frequency, as judged by the tuberculin test in both groups of children.

(5) Malnutrition: Malnutrition occurred in nearly as many children whose tonsils and adenoids had been removed as in those who had not undergone operation.

The removal of the tonsils and adenoids influenced unfavorably the incidence of the following infections:

(1) Bronchitis: This condition occurred somewhat more frequently in the children whose tonsils had been removed.

(2) Pneumonia: This disease occurred more frequently in the children whose tonsils and adenoids had been removed.

(3) Sinusitis: First attacks of sinusitis occurred somewhat more commonly in the children whose tonsils and adenoids had been removed.—*M. F.*

Pistol Holder For Automobiles

REMINISCENT of the ready-to-hand mounting of machine guns in airplanes, a new device for holding a pistol holster on the gear-shift lever of an automobile provides for greater protection than does a belt or shoulder holster. Its use injects an element of surprise into the defense of a car that is suddenly waylaid by thieves since the movement of the driver's hand to the shift lever would pass unnoticed. Instead of shifting the gears into neutral, however, the driver grips his pistol, the handle of which is directly beside the lever knob.

The new Holster Holder, which is now being patented by a former army officer, consists of three small but strong pieces of stamped metal, two of which are permanently attached to any leather holster. The third piece slips over and is clamped to the gear shift rod. A wide fin on this part slips tightly into a slot on the holster attachment, and may be inserted or removed at will. When used by anyone intrusted with the transportation of valuables, merchandise, or money, it may be detached and carried on the person when leaving the car.

A handy revolver holster that clips to the gear-shift lever of a car

This same device may be used in banks, paymasters' cages, or other places where there is danger of hold-ups. In such use, it would be attached to a rod on a flange base screwed to the woodwork. The supporting rod may be bent or curved to place the pistol in an easily accessible position.

Munchausen Outdone By Scientists Who Freeze Light

BARON MUNCHAUSEN, reputed the world's biggest liar, told a big one when he described his trip into the far north where it was so cold that the ring of a bell was frozen and the frozen sound brought back to be thawed out. However, today's scientists are actually able to go him one better by "freezing" light. One of the effects that the cathode-ray tube produces is to cause some substances to become brightly fluorescent, or to give off light even after the raying has been stopped. Different colors of light are produced by different substances, and different colors are also produced by a substance at different temperatures.

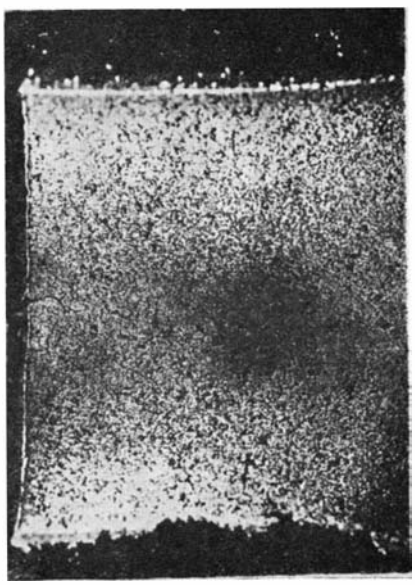
At a recent demonstration by General Electric Company research engineers, a strip of fluorescent screen material was subjected to a cathode-ray bombardment in the Schenectady laboratory. The material was then placed in a vacuum bottle containing liquid air, and in that condition carried to New York. When the screen was removed from the liquid air at the meeting, it could

not be seen in the darkened room. But as it warmed up, it began to glow with a deep yellow tint. It became warmer, and the glow became purple. As it continued to warm up to room temperature it continued to glow in different hues, with waves of colors sweeping across the small screen in much the same way as the Northern Lights sweep across the sky on cold nights. Baron Munchausen had been outdone.—*A. E. B.*

New Bearing Material is Real Metal "Sponge"

A SELF-OILING, bearing material that will eliminate squeaks and excessive wear, and minimize friction, has been found by Chrysler Motors engineers. It has been appropriately christened "Oilite" because of its properties.

"Oilite" is an alloy of copper, tin, and other metals. It is subjected to tremendous pressure, heat treated, and then impregnated with hot oil in a vacuum. It absorbs up to 40 percent of oil by volume. Its high oil content may be proved by any one of



Photomicrograph of the oil-absorbing sponge metal used for bearings

numerous tests. If squeezed in a vise, it drips oil. If subjected to a slight pressure when filled with water, oil is forced out. Even so slight a rise in temperature as occurs when it is left to stand in the sun will cause oil to seep out.

"Oilite" has a strength much greater than that of ordinary "self-oiling" bearing materials. This great strength averts the delays and expense of breakage in assembly. Due to its high oil content, a hydraulic cushion exists that permits bearing loads in excess of those carried by conventional bearing materials. The development, therefore, not only accomplishes a satisfactory self-oiling bearing, but also one superior to high-grade cast bronze, for applications where severe duty and high pressures are encountered.

"Oilite" imparts a high polish to shafts, instead of scoring or tearing them. New manufacturing processes are employed that assure a higher standard of accuracy than heretofore available in commercial bearings. This accuracy insures a greater percentage of bearing surface on the shaft.

One of the most important uses of "Oilite" is in spring shackles. The secret of perfect lubrication of these shackles is to keep oil in and dirt out. As used on many of the cars built by Chrysler Motors, the upper fitting is of rubber and the lower of "Oilite," making the car ride on oil and rubber, a perfect combination for ease and long life. A packing ring protects the shackle bearing from water and foreign matter. A lubrication fitting may be supplied on the bolt but experience has established that it is seldom necessary to refill during the ordinary life of a car.

An excellent application is on the steering gear cross shaft. Here high pressures and severe shock loads cause many bearing failures. "Oilite," however, due to the cushioning effect of its high oil content, and its unique qualities as a bearing, has proved a perfect material for this duty.

"Oilite" has passed the experimental stage. It has proved its worth in many thousands of Chrysler-built passenger cars and trucks. It stands up longer than any other bearing material, causes virtually no trouble and raises performance standards.

This material is used in the spring shackles, the front and rear water pump bearings, the clutch pilot bearing, steering gears, and other positions on Chrysler, Dodge, De Soto, and Plymouth cars, produced by the corporation. It is handled commercially by the Amplex Manufacturing Company of 7900 Joseph Campau Avenue, Detroit, a division of the Chrysler Corporation.

Mothballs Keep Mosquitoes from Descending Chimney

MALARIA-BEARING mosquitoes emulate Santa Claus in some parts of the South. When they find doors and windows screened, they come down the chimney seeking whom they may devour, and bearing unwelcome gifts of "fever 'n' ague." But you can keep them out by hanging a little basket of naphthalene, the stuff mothballs are made of, at the top of the chimney. They hate it, and will zoom out of its range as soon as they smell it, no matter how much good biting may lie slumbering below. This is one of the curious facts about mosquito behavior which have been learned by the United States Public Health Service.

Not all mosquitoes will enter houses by coming down chimneys, and it is not known whether all of them can be driven off with naphthalene. One species, however, responds in this way, *Anopheles quadrimaculatus*, the four-spotted malaria mosquito. But she is important enough to make this bit of entomological knowledge very much worth having.—*Science Service.*

"Boundary" Rays Reveal Counterfeits

IN these days when X rays are being used to look inside of golf balls and steel castings and when ultra-violet rays are being used to cure rickets and to improve the quality of everything from butter to cigarettes, it is hard to keep abreast of all the new applications of rays. Now, the situation is still further complicated by the discovery by German chemists that the so-called Bucky boundary rays which lie in the spectrum between the ultra-violet and

Roentgen rays, are well adapted for penetrative illuminating purposes, for which the ultra-violet rays have too small, and the Roentgen rays too strong, a penetration.

Experiments with therapy tubes for boundary ray treatment confirm the assumption that the boundary rays are suitable for the testing of materials. For example, in linen the course of the threads of the so-called barley-corn weave was much more distinctly recognized in photographs with the boundary rays than with Roentgen rays. This procedure is also much cheaper in comparison with the Roentgen equipment. Paper currency can also be tested much more easily with the boundary rays; they reproduce the watermarks with a clarity scarcely attainable by the ordinary penetrative illumination photography. Other applications of the boundary rays may be their use for determination of falsifications of etchings, postage stamps, documents, graphic works, et cetera.—*A. E. B.*

Above: **Pump and comparing chamber for determining the amount of sludge in engine oil.** ***Right:*** **The installation being used**

The Oil Change Problem

THE proper time to change the oil in the crankcase has been a puzzling and vexatious problem to many motorists and maintenance engineers, who thoughtfully consider proper and economical lubrication for their engines.

It has been customary in most instances to discard the oil in the crankcase after the speedometer shows a definite mileage covered or at regular periodic intervals. This practice seemed justifiable, since it was impractical for most motorists to have their oil tested by a chemist or laboratory. This procedure is, however, quite contrary to the most modern scientific knowledge of engine wear and proper economical lubrication.

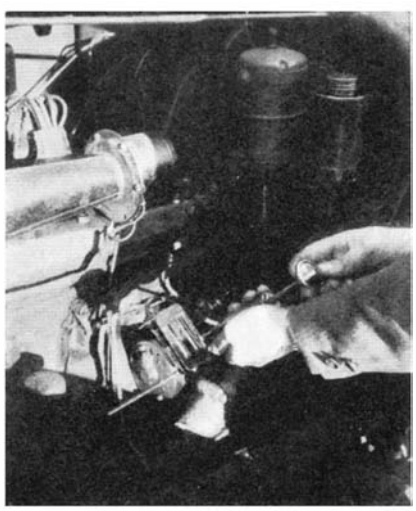
Modern information proves that oil itself never wears out. In fact, it has been very definitely shown by the Bureau of Standards that after oil has been used for a few hundred miles, it is better oil, in most instances, than can be bought. A clean used oil will cause less wear than an absolutely new oil. (S.A.E. Dec. 1930.) This is due to the super-refining in the engine. The contaminants which cannot be removed at the refinery, and the various bleaching agents, and so on, used to make the product more marketable, and the more readily oxidizable unsaturated hydrocarbons have been removed. This is accomplished by the physical and chemical activity in the engine with the available supply of oxygen.

It is therefore obvious that under the present system of judging the time to change oil by means of the calendar or the speedometer, there will be times when the motorist is throwing out oil which has been so super-refined by his engine that it is better oil than can be bought.

The S & S Research Laboratory started work a few years ago upon the belief that when the sludge begins to accumulate in appreciable quantities, the colloidal carbon particles and the larger conglomeration of dust, metal, and carbon are the factors determining the color of the oil by transmitted light since all these particles are opaque and will therefore tend to darken the film. The principal color would therefore be an indication of the sludge content. This made it necessary to determine the relationship between the change of color of an oil and the percentage of sludge which it contained.

It was found that, by using the device shown in our accompanying illustrations, there is a direct correlation between the color of an oil, after use, and the percentage of sludge it contains.

After careful measurements and testing, it was determined that if the oil would be exposed to the tester in a film 1/32 of an inch in thickness, with the proper illumination behind it, then this film by transmitted light would appear black if it contained excessive sludge. The device pictured herewith was the outgrowth of this conclusion.



With this instrument, a sample of oil is picked up right from the crankcase by means of a simple suction pump. It is exposed to the tester in a test tube, the walls of which are 1/32 of an inch apart. A light from behind, of the proper intensity, illuminates this film. The oil will then be seen by transmitted light, and as noted before, this will indicate the sludge content of the oil. The condition of the lubricant is immediately obvious at the first trial. Its color is an accurate indication of its condition. If the oil is any shade of brown, it is still good, and should be used regardless of the mileage or time it has served. If, however, the oil is black, it is a warning to change or it will cause excessive wear. The entire test takes but a moment. A slight pull on the pump—the oil comes up, one glance and you know—no guess

work. The whole problem has been carefully worked out and simplified. In order to facilitate the judgment as to the color of the oil, a small triangle of glass matched to the color of an oil which is just turning bad, is inserted right next to the test tube. This increases accuracy and helps judgment. A second test tube, of the same dimensions as the first is just to the side of it. In this tube is placed a pure sample of new oil. By means of this comparison, the tester may keep before him a gage of new oil, bad oil, and the oil he is using.

Garagemen, operators of fleets of trucks or buses and many others have adopted this device for constant use.

CLEMENCEAU AND FOCH

By Captain W. D. Puleston

(*Continued from page* 400)

Foch believed that "only the advantages gained by the Armistice would be permanent"; he wanted to establish a buffer Rhineland state between France and Germany, and he wanted to include among the provisions of the Armistice, terms that would facilitate the creation of this state.

Foch also suggested that the French Foreign Office should detail an attaché to keep in close contact with him, so that he would be kept "fully enlightened on all necessary points. For the armistice, from political and diplomatic aspects as well as from the military point of view, bears in it the seeds of the ensuing peace."

Clemenceau interpreted this suggestion as a request to "assign to Foch an official from the Quai d'Orsay to enable him to discuss the question of peace direct with the Germans." He regarded the communication as "an invitation to relinquish in Foch's favor the authority vested in his office"; and professed to believe that Foch wanted to reduce the statesman's role "to communicating to the Allies the decisions of the soldiers put into proper terms by a diplomat subordinate to him."

Clemenceau misjudged the motives of Foch, who was sincerely convinced that France needed both security from Germany in the future and reparations for the ravages of the World War; Foch steadily refused to consider those two essentials separately. During the Peace Conference he pointed out that England had insisted upon: The removal of the menace of the German fleet; possession of captured German colonies; and acquisition of a large amount of German merchant marine, and had obtained her demands at once. France's part in the war was no less worthy than England's and he felt France should be no whit less insistent upon her demands than England.

Foch said that if Clemenceau had employed him oftener in the negotiations with the Allied statesmen, they would have listened to him because he was the Allied Commander-in-Chief, and that he could have convinced them that the security of Western Europe, as well as France, depended upon France holding the line of the Rhine. As a last appeal, Foch suggested that Clemenceau could say to the Allied chiefs that the French people agreed with Foch's views and the French Government must sustain these views. If the Allies were persuaded to insist upon these terms, Foch guaranteed that he could impose them upon the Germans.

In the military situation existing during the Peace Conference, Foch could have imposed any terms upon Germany. But his ardent temper caused him to overestimate his influence upon the Allied statesmen. He knew that the Allies had been held together only by the German menace; that once it was removed, they would pursue their own national interests; and he realized as well as Clemenceau, that the British Government was even then intent on restoring the balance of power on the European continent.

Clemenceau appraised the Allied statesmen more precisely than Foch. In his innermost soul the old Vendean probably longed for the Rhine boundary as eagerly as Foch, but he quite accurately emphasized to Martet "that if the treaty was not so grand neither was the war so grand. It took four years . . . and many nations to bring Germany to her knees." Clemenceau knew that all the other Allied nations, except Belgium, were quite unwilling to extend the French frontier and perhaps create another Alsace-Lorraine; and every one knew the French Army unaided could not extend French boundaries. President Wilson said, "The question of frontiers is no business of soldiers." On Armistice Day Lloyd George was already seeking a formula to re-establish the balance of power.

FOCH could be satisfied with nothing less than confining the Germans to the east bank of the Rhine, with a buffer Rhineland state between France and Germany on the east, similar to Belgium on the northeast. Clemenceau knew neither Great Britain nor the United States would support these French claims. In lieu of security by a strong frontier, Wilson and Lloyd George promised Clemenceau security by a treaty that pledged both Great Britain and the United States to come to France's help if attacked by Germany.

Foch had no confidence in these treaties, remonstrated orally and in writing with Clemenceau, and, when Clemenceau was unmoved, insisted upon appearing in person before the Allied chiefs in his capacity as Commander-in-Chief of the Allied Army.

Before this Foch had hinted that as Commander-in-Chief of the Allied Army he was not responsible to Clemenceau but to the Allied Governments and was partly sustained in this position by Poincaré. This claim was indignantly denied by Clemenceau; however, he permitted Foch to present his views to the Allied Premiers, who listened attentively to Foch's carefully prepared statement but were entirely unmoved. So determined was Foch that, when he failed to convince the Big Four, he insisted upon appearing before the entire French Cabinet to restate his views, and to warn them that, having finally won a desperate war, they were throwing away the fruits of victory and compromising the future safety of France. Poincaré certainly and many of the French cabinet probably sympathized with Foch, but were bound to agree that Clemenceau had obtained as much for France as was possible under the circumstances and probably more than any other Frenchman could have obtained.

Foch still believed that if Clemenceau had made more use of his prestige and position as the Allied Commander-in-Chief,

the Allied statesmen would have made a larger effort on behalf of France. But Clemenceau knew that England would not make France the overlord of the continent, that Italy was only intent on her own future, and he vaguely dreaded the idealism of President Wilson more than the well-known national motives that he knew actuated European rulers which he could readily predict and guard against.

These foreign statesmen were overwilling to pin medals on Foch and to acclaim him as the greatest soldier since Napoleon, but they were unprepared to accept his proposals regarding the peace terms, and had they done so they probably would not have been supported by their own states. Unquestionably Clemenceau was nearer correct than Foch in what was attainable at the peace conference.

On this rock the failing friendship between the two gallant Frenchmen, who together had saved France, finally foundered, and though for a while certain outward forms were preserved, it was well known in France that the two great war chieftains were no longer comrades. Eager partisans widened the breach during the few years left to these tired giants, and embryonic biographers sought future fame for themselves as well as their subjects by preserving, perhaps exaggerating, every difference of opinion until each bitter thought was barely uttered before recorded.

THE death of Foch released his intimate conversations with Recouly that contained severe strictures on Clemenceau, who deferred his preparations for the grave long enough to counter-attack his old colleague with the same youthful vigor that formerly terrified the Chamber of Deputies.

Biographies of great men have a continuing fascination for most people. It is the form of literature that continually inspires the ambitious to attempt to escape from present obscurity and future oblivion. The generation of the war, eagerly waiting to read of Foch's activities, could not avoid hearing the criticisms that he, descending into his tomb, hurled at Clemenceau.

While distant admirers of Clemenceau might hope he would disdain to answer Foch, none acquainted with his savage spirit expected him to fail to return the blows with usury. The priest-like Foch and the philosophizing Clemenceau were both too ardent to refrain from one last bout as the curtain of life descended. They were animated by passionate convictions and while this fight between former colleagues, carried on by one in grave clothes and the other in his dressing sack, has some very unedifying features, they would have been untrue to type if they had stifled their beliefs to insure a peaceful earthly exit.

They both had labored for France from their youth; they both were conscious of their own ability with no false modesty, the statesman was sustained by a fanatical devotion to certain political principles, the soldier by the enviable faith that his ancient religion inspires in its devout believers. Neither disdained popular applause, but both looked to their inner consciousness for their real rewards, and yet neither could bear to depart this world until he had laid before future Frenchmen the reasons for his conduct in the critical days of the war and the first trying days of peace. Living, they strove mightily for France; dying, they yearned for her approval. Surely France can be proud of her two sons who could not bear to die and then perhaps suffer her displeasure; probably only France could raise such an unlike couple and unite them by a fiery courage and a burning love for country. Future generations of Frenchmen should struggle to be worthy of them. In a sense they both deny their country's desire for strong frontiers, for if French civilization continues to produce Clemenceaus and Fochs, France needs no other guarantees for her security.

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The books listed below are available for those who desire to peruse in more detail the lives of the two fearless Frenchmen on which the foregoing articles were based.

"Foch" by Maj. Gen'l. Sir George C. Aston, K. C. B. The English viewpoint.

"Life of Marshal Foch" by Capt. B. H. Liddell Hart.

"My Conversations with Foch" by Raymond Recouly.

"Grandeur and Misery of Victory" by Georges Clemenceau.

"In the Evening of My Thought" by Georges Clemenceau.

"Georges Clemenceau" by Jean Martet, his secretary and personal friend.

"The Tiger: Georges Clemenceau" by George J. Adam.

DIESEL VERSUS GASOLINE-ENGINED PLANE

(*Continued from page* 401)

Both engines, of course, must have oxygen for the burning of their fuel. The advantage held by the Diesel engine enters at this point for the Diesel engine starts out at ground level with a great excess of oxygen beyond that which is needed to burn the fuel.

This excess in the Packard Diesel engine apparently was maintained in the test until after the plane had passed the 8000 foot level, for there was a steady increase in speed of the plane and the speed of the propeller, due to the lessened resistance as the air grew rarer, up to and including the altitude of 8000 feet.

Neither of the two engines in the tests was equipped with a supercharger such as is used to allow an airplane to climb to record heights.

Through these test results there exists a basis for the interesting speculation of what the Diesel engine, when supercharged, may be able to accomplish toward allowing man to climb still higher toward the stars and to obtain great speed, miles up in the air. New possibilities that aerial combat of military planes may be carried to even dizzier heights open up also.

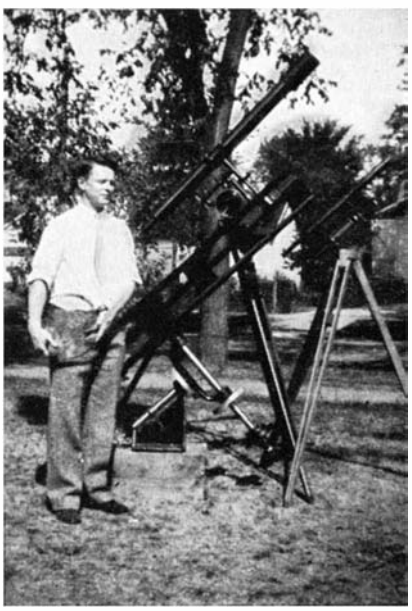
Diesel engineers say a supercharger on the Packard Diesel engine, by restoring the excess of oxygen the unsupercharged engine has at the ground or sea level, should restore or perhaps even increase the performance, starting at the unsupercharged engine's absolute ceiling and gaining speed and performance with increased altitude, just as with the unsupercharged Diesel engine, until the supercharged engine's absolute ceiling also is attained.

THE AMATEUR ASTRONOMER

(*Continued from page* 417)

said, "Give me a lever long enough and strong enough and I can lift the world." I would like to add, "Give me a pound of optical rouge and I can paint it red." Those were happy evenings of grinding, with the radio going and the recently acquired wife helping by furnishing popcorn and lemonade.

"After finishing the six-inch, I began the twelve-inch mirror shown in the picture. I



Mr. Calder and his collection

never had much more than an hour and a half at a time. Gordon Harder, who became interested in telescope making while I was working on my six-inch, volunteered to finish the job. The equatorial head, shown holding the six-inch reflector, deserves special mention. I was fortunate in being able to get Mr. Henry Harder, an expert machinist, to make this. The castings were made to order and I believe the job beats Ford axle, or pipe-fitting jobs. The polar axis turns on ball bearings, so that the motion is very smooth."

IN the April number mention was made of the aging of reducing solution. Later the following statement was made by Mr. Ferdinan Ellerman, astronomer on the staff of the Mount Wilson Observatory, who has charge of silvering the 100-inch mirror. "While the solution needs to age after mixing, in a similar manner to dry plates, the aging process improves both. But the dry plates reach a maximum sensitivity and after that begin to deteriorate. The silvering solution seems to reach a maximum and remain in that condition. As a rule we do not keep our reducing solutions more than two years, but we have a test bottle which is five years old and appears to be in as good condition as it was two months after it was made."

So that seems to be that. From the final clause of Mr. Ellerman's letter it may perhaps be deduced, incidentally, that he regards two months as about the right time to age the reducing solution before it is used.

No one has advised us yet concerning any accidents due to the explosion of spent silvering solution. It will be remembered that we commented on the recent Circular of the Bureau of Standards No. 389, "The Making of Mirrors by the Deposition of Metal on Glass," in which the risk involved in silvering without protective goggles was emphasized, and requested any amateur who knew of such an accident to advise us. It would seem that, with several thousand amateurs of all shades of experience working on the silvering of mirrors, a few at least ought to get their heads blown off if the risk is more than a minimum. It may be, however, that several hundreds have suffered this form of inconvenience without informing us, as a man without a head would tend to write fewer letters than one with head remaining in normal attachment. Once we interested one of our readers in amateur archeology and he ventured into the open places of Nebraska in search of ancient man. A blizzard came up and he froze to death. What share of responsibility for this sad accident we must shoulder is a question, but we should feel as bad if some amateur telescope maker were to be injured by an explosion of spent silvering solution, unless he had been warned in advance. On the other hand it ought not to be necessary to chase everybody out of the house and warn the neighbors before starting to silver a mirror, as we recall doing some years ago after taking the usual warnings very much to heart.

THE amateur telescope makers and users who constitute the Astronomical Section of the Academy of Science and Art of Pittsburgh have revealed to us that the First Annual Assembly of Amateur Astronomers and Telescope Makers of the Pittsburgh District will be held Saturday and Sunday, August 8 and 9. The program of activities includes a visit to the optical shops of J. W. Fecker, successor to John A. Brashear, where will be seen, among other interesting things, the 69-inch mirror cast at the Bureau of Standards for the Perkins Observatory of Ohio Weslyan University which is there being figured. Also an evening will be spent at the Allegheny Observatory where Director Jordan has granted permission to use the 13-inch refractor. By way of "trimmings" there will be a dinner in a park near the Observatory and a visit to Valley View Observatory, headquarters of the local organization just mentioned. (This homemade observatory is scheduled to be described in a special article in next month's number.)

Anyone interested in attending this new gathering of enthusiasts can obtain further information by addressing the Secretary of the Astronomical Section, Valley View Observatory, 106 Van Buren Street, Observatory Post Office, Pittsburgh, Pa. It will have much in common with the informal gatherings annually held at *Stellafane*, near Springfield, Vermont. Everybody comes that wants to, and all have a good time and a fine chance to swop experiences with other telescope makers and users. Better plan to drive to Pittsburgh for the August 8-9 week-end.

This announcement has no known bearing on the annual get-together held in Vermont. No announcement has been made with regard to the exact date of the latter. Why not take in both shows?

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY
Member of the New York Bar
Registered Patent Attorney

"Finesse" Allowed as Soap Mark

IN the case of Marshall Field and Company *versus* Betts and Mumpeton, Inc., Trademark Interference No. 1742, First Assistant Commissioner Kinnan held that Betts and Mumpeton, Inc., of New York, New York, is entitled to register the term "Finesse", as a trademark for toilet soaps, although it did not commence the use of the mark on those specific goods until after its use on such goods by Marshall Field and Company, of Chicago, Illinois.

The ground of the decision is that, while Betts and Mumpeton, Inc. were the later of the two parties to adopt the mark on facial soaps, it had used the mark long prior to that time on various other toilet articles including face powder and cleansing creams, foundation creams, lip sticks, and so forth.

In his decision, after noting the facts as above and stating that Marshall Field and Company would be entitled to registration only if the goods upon which registration is sought were of different descriptive properties from those upon which Betts and Mumpeton, Inc. had previously used it, the First Assistant Commissioner said:

"It is believed clear enough that toilet soaps belong in the same class and possess the same descriptive properties, as these terms have been interpreted by the courts, as the goods upon which the appellee first used the mark. It is deemed obvious confusion in trade would result if this mark appeared in the same market upon the cosmetics to which the appellee first applied the mark and the toilet soap to which the appellant applies such mark."

Dry Ice Suit Lost

THE United States Supreme Court, on Monday, March 9, 1931, handed down its decision in the suit brought by the Dry Ice Corporation against the Carbice Corporation of America for infringement of Letters Patent No. 1595426, for refrigerating apparatus using solid carbon dioxide as a refrigerant. In the suit the defendant, Carbice Corporation of America, a manufacturer of solid carbon dioxide, was charged with contributory infringement because it sold its product to customers of the Dry Ice Corporation, with knowledge that the refrigerant was to be used by the purchaser in transportation packages like those described in the patent. The Carbice Corporation challenged the validity of the patent and denied infringement. The Supreme Court held that it need not determine whether the transportation package described in the patent was a patentable invention, for even if it was a patentable invention, no relief could be granted plaintiff. The court held in part as follows:

"The invention claimed is for a particular kind of package employing solid carbon dioxide in a new combination. If the patent is valid the owner can, of course, prohibit entirely the manufacture, sale, or use of such packages; (Continental Paper Bag Co. *versus* Eastern Paper Bag Co., 210 U. S. 405). Or it can grant licenses upon terms consistent with the limited scope of the patent monopoly; (United States *versus* General Electric Co., 272 U. S. 476, 489). It may charge a royalty or license fee. But it may not exact as the condition of a license that unpatented materials used in connection with the invention shall be purchased only from the licensor; and if it does so, relief against one who supplies such unpatented materials will be denied. The limited monopoly to make, use, and vend an article may not be 'expanded by limitations as to materials and supplies necessary to the operation of it.'"

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

Belgian Rayon Merger Planned

MOVED by keen international competition and increasingly high customs barriers in certain foreign markets, Belgian financial institutions are said to be contemplating concentration of the rayon industry in that country as a preliminary to a large European rayon trust, according to a report from Consul Walter H. Sholes, Brussels, made public by the Department of Commerce.

The Societe Generale de Belgique is reported to be particularly interested, and it is estimated that the capital immediately involved is about 28,000,000 dollars. No increase of capital would be contemplated inasmuch as the various firms appear to possess large reserves.

Among the immediate objects of such a concentration of rayon interests would be a thorough rationalization of production methods and also of distributive functions. The creation of a central export office is mentioned as a possibility in the latter instance. The constitution of such a trust, it is stated, would be facilitated by the fact that the Belgian rayon groups have agreements with other international firms.

Film Device Does Not Infringe

THE United States Circuit Court of Appeals for the Third Circuit has just ordered the dismissal of the patent infringement suit brought by the General Talking Pictures Corporation and DeForest Phonofilms, Inc., against the Stanley Company of America for alleged infringement of patents on devices used in the reproduction of talking motion pictures.

The machine which was held not to infringe the patents is made by the Western Electric Company, the opinion of Judge Buffington explains, the company having assumed defense of the case.

Judge Buffington called attention in his opinion that the patents involved are not "the foundation stone, so to speak, of the 'talkie-movie' art," since they involve only the utilization of the sound-picture films after they are made, and only in one respect, the reproduction of sound.

Concerning the method used in reproducing the sound films, the opinion states:

"In the already made photographic film which the patent in suit uses, the sound vibrations have been photographed on the sensitized film and without entering into details, it suffices to say the photographed modulations are evidenced by differences in film translucence. Such being the case, it follows that as such film is moved past an effective line of light, these variations in translucency vary the quantum of penetrating light and so vary the degree to which the light cell is illuminated. This results in corresponding electrical vibrations which in due course are translated by a loud speaker into sounds which correspond to and are in reality replica or re-creations of the sounds which had made the original sound record."

The principal patent sued on, No. 1607480 to Reis, relates, according to the opinion, to "the narrow, sharply-defined line of light penetrating the film, and to the means of obtaining and using it." The Western Electric machine was found by the court to embody a different kind of slit, differently located, than the Reis patent, and therefore not to constitute an infringement.

The other patents, No. 1693071, No. 1466701 and No. 1695414 to DeForest, pertain to minor details of attachments of the apparatus, and likewise were held not to be infringed. The structure of two of these patents, it was stated, was never used in the art.

Case Review Refused

THE Supreme Court of the United States recently declined to review the case of Pacent Reproducer Corporation v. Western Electric Co., No. 390, in which was submitted a question of a patentee's rights to grant licenses of a patent monopoly for different uses or fields of business for the invention. The review was sought by way of petition for a writ of certiorari to the Circuit Court of Appeals for the Second Circuit, which the court denied.

The suit was one for patent infringement and it was declared in the petition to be of wide and general interest to the public because of the recent efforts of "American Telephone and Telegraph Company, General Electric, Westinghouse, Radio Corporation, and others to subdivide the monopoly granted by a patent."

The suit, according to the opinion of the lower court (V. U. S. Pat. Q. 105)

was instituted by General Electric, Electric Research Products, and the American Telephone and Telegraph Co. charging the present petitioners with infringement of the patents. The patents were owned by the American Telephone and Telegraph Company, the two other concerns having been granted nonexclusive licenses. By subsequent agreement the patent owner conveyed what the lower court held to be a license in specified fields of use which was exclusive in these fields except as to the licensor itself and its previous licensees.

The petitioners contested the right of all three companies to sue as parties plaintiff, one being the patent owner and the others being licensees. The Circuit Court of Appeals, however, overruled this contention, declaring that under the construction of the licenses the joint action of the parties was proper.

By so doing, the petitioner claimed, the lower court rendered a decision that by the grant of an exclusive license limited to particular fields of use the monopoly conferred by letters patent for inventions and the right to sue as co-plaintiff with the owner of the patent for infringements thereof may in effect be divided into parts according to particular fields of use, although this is alleged to be without warrant or statute or judicial decision.

Will End Delay in Patent Grants

AN end of the delay in granting patents and considering claims for patents was promised by Thomas E. Robertson, Commissioner of Patents, in a radio talk recently broadcast.

"Following the World War," he declared, "the Patent Office, by reason of the increase in the number of applications and the large number of resignations from its trained examining corps, fell grievously behind with its work. For years extraordinary efforts were made to obtain increased personnel and increased salaries to cope with the situation.

"The efforts to obtain relief, made much greater by reason of the rigid economy imposed upon the government after the War, resulted in various increases and finally in a large additional force made available last Summer. This new force is being rapidly trained and its efforts are apparent since the accumulated work has already been reduced by 22,000 applications, or nearly 25 percent. Inventors and manufacturers have reason to be very hopeful that within about a year there will be no prolonged delays in obtaining actions upon their applications."

Plant Patents Sought

ABOUT 30 to 35 applications for patents on new kinds of plants have been received by the Patent Office, and the Department of Agriculture has started the difficult task of studying them to determine if the plants described are actually new, according to a statement by James A. Brearly, chief clerk of the Office. The law providing for patents on plants became effective May 23, 1930.

Both the Patent Office and the Department of Agriculture are proceeding carefully under the new law, Mr. Brearly said, since the field is entirely new and practices and principles must be developed without any foundation of experience.

Difficulties in formulating procedure and rendering decisions on the patentability of plants are numerous. Since the methods to be used are new, it is expected that early decisions on applications will in many cases be taken to court.

An instance of the difficulties encountered is in the hypothetical case of a flower having a new odor. It is very difficult to describe an odor in writing, and the difficulty would be much enhanced if the odor were not closely comparable with some other well-known odor. It would prove to be impractical to keep a flower of the new type available at the Patent Office to compare its odor with that of a later flower for which a patent might be sought.

The law providing for plant patents excludes tubers from its scope. Irish potatoes are tubers, but sweet potatoes are not, being considered a root crop. Whether this view of botanists would be acceptable to the courts is a point which probably will have to be decided by them.

Vacuum Tube Patent Decision

THE Circuit Court of Appeals for the Third Circuit, sitting in Philadelphia, recently affirmed a decree of the District Court of Delaware holding that the Radio Corporation of America, the Westinghouse Electric & Manufacturing Company, The American Telephone & Telegraph Company, and several of their subsidiaries had by their agreements with their licensees attained a "patent pooling" monopoly on the sale of vacuum tubes to dealers and radio set manufacturers in violation of the Clayton anti-trust act.

The original injunction ordered against the Radio Corporation by Judge Morris was sustained by the Circuit Court of Appeals to which the Radio Corporation of America had appealed. After a trial of the case, Judge Morris granted a permanent injunction, and the recent decision of the said Circuit Court of Appeals, written by Judge Buffington, senior member of the Court, sustains the District Court and terminates the litigation unless the United States Supreme Court consents to review the decision of the Circuit Court of Appeals on a writ of certiorari.

The DeForest Radio Company claimed it had been frozen out of the tube market by the patent pool intended by the Radio Corporation to give it a monopoly in the sale of tubes to its licensee radio receiver manufacturers and dealers. The Radio Corporation countered that in effect no monopoly had been created, as shown by the increased sales of the plaintiffs. In treating this question Judge Buffington in his decision said, "There is nothing in them (the facts brought out in final hearing) which would lead us to the conclusion that the objectionable contract has not resulted in a monopoly."

Printing Must Not be Called "Engraving"

MISREPRESENTATION of a printing process as "Engraving" will be discontinued by Walter Howton and Max Leonhart, doing business in Chicago as Frank W. Black & Co., and Griffitts Engraving Co.

Howton and Leonhart are ordered by the Federal Trade Commission to cease and desist from representing by means of a firm or partnership name or otherwise that they are engravers, unless and until they actually do an engraving business, and from using the word "Engraved" or "Engraving" to describe products which they offer for sale, when all of the words and other figures on such products have not been produced from metal plates into which the words and other figures have been cut.

This proceeding is dismissed by the Commission in so far as it relates to Frank W. Black, who owned the business in question prior to his sale of it to Howton and Leonhart in November 1927.

The Commission found that the respondent's so-called "Nu-Process Method" is not a method of engraving but of printing. It does not require engraving, incision or cuts upon metal plates. The raised letters resulting from the firm's method are produced by the application of a powdered chemical to type printing, while the ink is wet. Heat is then applied to the chemical causing it to melt and fuse, producing a raised letter effect simulating engraving so closely that even experts cannot easily detect the difference.

Marks Must be Compared in Entirety

IT was recently held by Assistant Commissioner Moore that the Westinghouse Electric and Manufacturing Company, of East Pittsburgh, Pennsylvania, is entitled to register the term "Adjust-O-Matic" as a trademark for electric sadirons, notwithstanding the prior adoption and use by the Williams Oil-O-Matic Heating Corporation, of Bloomington, Illinois, of the terms "Oil-O-Matic" and "Dist-O-Matic" as trademarks for oil burners and the term "Ice-O-Matic" as a trademark for refrigerators.

The grounds of the decision are that the marks are not confusingly similar and the goods not of the same descriptive properties.

With respect to the marks, the First Assistant Commissioner stated that opposer's contention amounted to the claim that it was entitled to prevent others registering any mark containing the suffix "O-Matic", and said:

"Such a contention, carried to its logical conclusion, would prevent the other party from associating with any of its automatic household utilities the word 'Aut-O-Matic.' Obviously such contention is too broad and untenable."

With respect to the goods, he said:

"As to the properties of the respective goods, it is observed that oil burners and refrigerators obviously have not the same descriptive properties as electrically heated sadirons. They are classified in different classes in this Office."

He further said:

"In conclusion, it may be noted that confusing similarity between marks may not be determined by comparing only parts thereof. When the respective marks of the parties are compared in their entirety, and considered in connection with the respective goods with which they are used, it is believed that the dissimilarities of the marks and the different descriptive properties of the goods are such as would not be likely to confuse the public mind as to the origin of the goods."

Books SELECTED BY THE EDITORS

RADIO HANDBOOK

By J. A. Moyer, Mem. Fed. Com. on Radio Education, and J. F. Wostrel, Inst. in Radio Engr.

ALTHOUGH the authors of this 886 page volume have, in many cases, included fundamentals of radio principles, the book is one that will interest mainly radio engineers and advanced radio experimenters and students. To absorb the greatest value from this work presupposes a background of physics, electricity, and mathematics; this of course is true of any radio book that attempts to get to the bottom of things. The authors have gathered between one set of covers a vast array of data covering every conceivable phase of modern radio technique. Here will be found information on apparatus and accessories; circuits, both fundamental and applied; commercial and broadcast equipment; laboratory materials—the list is far too long for the space allotted to this review. Vacuum tubes are treated extensively, both in their radio rôles and in their other industrial uses. This naturally brings one to the consideration of talkies and so a chapter is devoted to them. Photo-electric cells come in for their share of attention, and the chapter on television, while short, is comprehensive. It deals in main with the work of Dr. E. F. W. Alexanderson of the General Electric Company.

Well done line drawings and halftones illustrate the text. A number of tables are noted for reference; this reviewer foresees that this handbook will serve to settle quickly many a moot question in the future.—$5.20 postpaid. —*A. P. P.*

PREPARING FOR AVIATION

By V. C. Finch, Lieut. U. S. N. (ret.)

BRIDGING the gap between the many primary books and those written for engineers with an advanced knowledge of mathematics, this text is based greatly upon the questions asked by students during the author's many years of active flying and flight instruction, together with an extended knowledge of airplane and engine design. The arrangement of subjects gives unity and continuity, and the engine data is as comprehensive as any we have seen.—$4.20 postpaid.

STANDARD WIRING 1931

By H. C. Cushing, Jr.

COMPLETELY revised and checked to date from most authoritative sources with a number of new chapters and sections, this pocket book of 504 pages covers the entire subject conclusively, both inside and outside wiring, street and highway lighting, illumination, together with the installation and care of storage batteries. Tables and illustrations in abundance complete the most useful book we have seen along this line.—$3.15 postpaid.

PRELIMINARY MATHEMATICS

By Prof. F. E. Austin

INTENDED for self help as a connecting link between arithmetic and algebra, and as an auxiliary with other textbooks, this little volume of 170 pages covers many points passed over in ordinary texts. It shows by numerous examples the practical application of each theory discussed. A splendid reference, too, for those who wish to brush up on some long disused method of calculation as we all find a need once in a while.—$1.40 postpaid.

THE REALM OF THE AIR

By Charles F. Talman

AS Librarian of the U. S. Weather Bureau the author has been custodian of a nearly exhaustive collection of literature which he has frequently drawn upon for articles in a popular vein that have appeared frequently to a wide circle. Added to this is a most happy style of writing in an entertaining and informative manner which transmits to the layman an understanding of this intricate and tricky subject. Weather is the most common topic of conversation and here you will find a lot to set you thinking. It will give you something with which to supplant the usual banal remarks.—$4.20 postpaid.

ACOUSTICS

By G. W. Stewart, Prof. Physics Univ. Ia., and R. B. Lindsay, Prof. Theoretical Phys., Brown Univ.

A NEW textbook on the theory of acoustics, with such practical applications as acoustic measurements, architectural, physiological, and atmospheric acoustics, also sub-aqueous sound ranging and others. The authors rightly say that "the theory of acoustics has great beauty," but if, as happens even in the best regulated families, one's calculus has become a trifle dim this beauty may prove elusive. It is not at all an elementary book.—$5.20 postpaid.—*A. G. I.*

THE STARS IN THEIR COURSES

By Sir James Jeans

WHOEVER wishes to get a good authentic picture of the science of astronomy as it stands today without going into all of its agonizing details or making a business of it may depend upon this book to give him such a conspectus in an evening or two. Jeans, the famous astronomer-cosmologist, usually writes profoundly and has an immense following, mostly among intellectuals. Here, however, he does not essay to fly high but comfortably—how comfortably may be judged from the fact that the book is a series of radio talks he recently gave in England and is therefore suited to a wide audience of average human beings.—$2.65 postpaid.—*A. G. I.*

BUSINESS ADRIFT

By W. B. Donham, Dean, Grad. Sch., Business Admin., Harvard.

WITHOUT resorting to alarmist tactics the author frankly presents all the facts which threaten the economic well-being of America and the world. The challenge of Russia, the fallacy of excessive dependence upon foreign trade, the need for foresight and an intelligent plan to meet changing business conditions are among the outstanding features of the author's discussion. A business man of wide experience looks squarely at our disorganized business structure and analyzes the problems we must meet and solve during the coming generation.—$2.65 postpaid.

AUTOBIOGRAPHY OF AN ENGINEER

By William LeRoy Emmet

THERE is nothing so inspiring or so full of romance as a simple well-told story of the life of such an eminent engineer as this. It should take rank with the "Letters of an Engineer

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Lack of space makes it impossible to give many cross-references or to enter a given reference in more than one place. Each article is therefore entered where it is believed it will be most easily found. In every case, the general subject should be sought rather than the supposed specific title of an article. We call special attention to the classifications "Aviation," "Engineering," "Medicine," Miscellaneous," etc., under which many items will be found, the location of which otherwise would be very puzzling.

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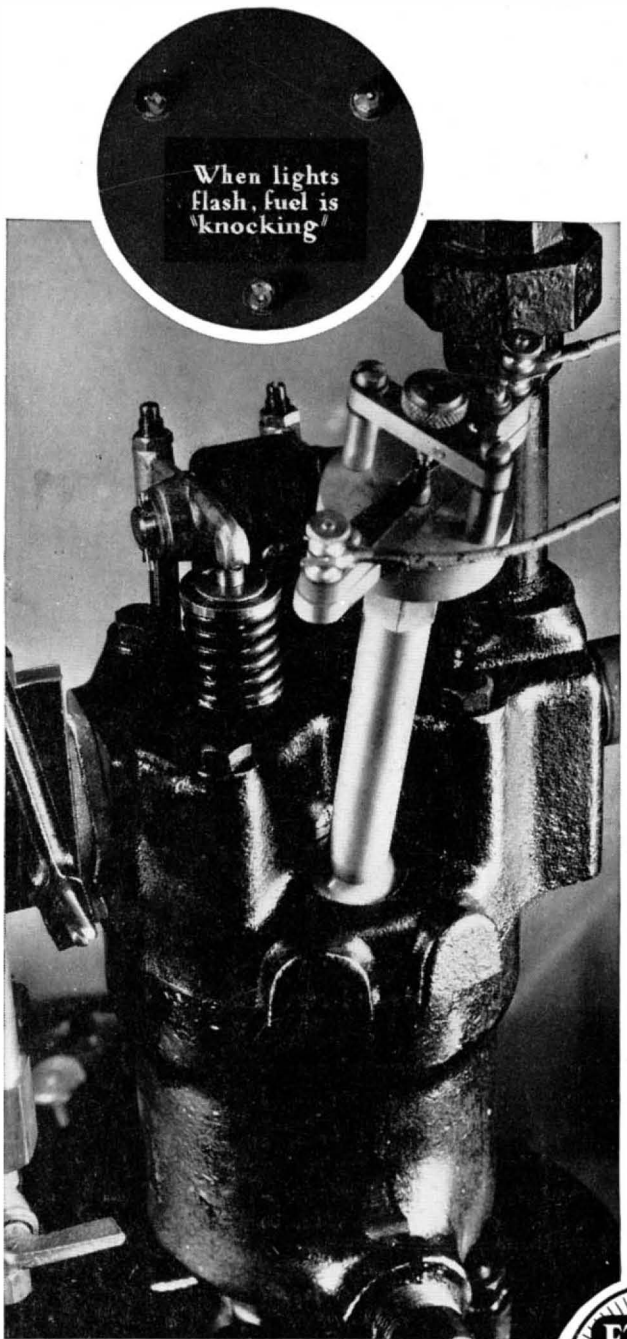

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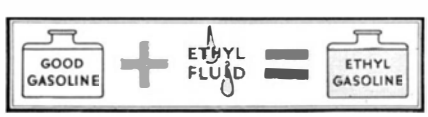

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