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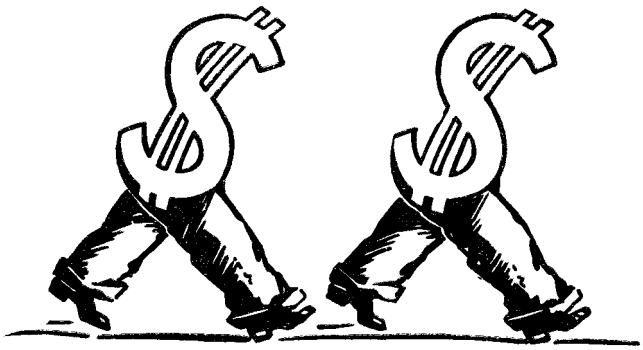

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Every dollar has to *work* its way these days, penny for penny. Overalls have taken the place of swivel-chairs—thinking caps have replaced silk hats.

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B. C. Forbes, Editor

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EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

CONTENTS • JULY • 1931

THIS MONTH'S COVER

In the cover picture we find ourselves looking into that holy of holies beloved of all small boys—the cab of an engine. The engineer and the fireman wigwag to each other whenever a signal is sighted, so that the alertness of the enginemen is never a matter of guesswork. When snow, sleet, rain or fog obscures the vision, the train must run under diminished speed unless the engine is equipped with some form of cab signal which duplicates the wayside signal. The article on page 14 tells how the invisible signals are picked up electrically so that indications in the cab notify both enginemen as to the condition of the track ahead.

SCIENTIFIC AMERICAN DIGEST

Of General Interest

Aviation

Chemistry In Industry

Medical Science

WHAT A WORLD OF TROUBLE IT SAVES YOU!

WE KNOW a seed house that proves each season's crop of seeds in their own trial gardens before they offer them to the public. Flowers and vegetables grown from these seeds must measure up to definite standards, or else the entire crops from which the samples were taken are burned.

We know a manufacturer of dry batteries who tested a new product two years before he sold a single battery.

We know a manufacturer of an anti-freeze solution for automobile radiators who spent two years testing his product under all conditions before he said a word in advertising about the merits of his goods.

We know a manufacturer of household pharmaceutical products whose self-imposed standard of purity and efficacy is even higher than that laid down by the United States Pharmacopoeia and the National Formulary.

If we mentioned their names you would recognize them immediately. You probably would say, "I plant those seeds," "I use that battery," "I use that anti-freeze."

The four instances cited are typical of every reliable manufacturer in America. Millions of dollars are spent annually to develop and improve merchandise. Other millions are spent in advertising to tell you about them.

All of which is to say that in putting your trust in advertised merchandise you save yourself the bother, the expense, the disappointment—yes, the danger—of experimenting for yourself.

The advertisements in this magazine keep you informed of the newest and most advantageous merchandise that America's most progressive makers are producing.

ACROSS THE EDITOR'S DESK

A RARE—a highly rare—honor has come to one of our contributing editors, Professor R. W. Wood of the Johns Hopkins University, whose researches in physical optics are world-famous. The University of Berlin has conferred on him the honorary degree of Doctor of Philosophy. Some institutions confer so many honorary degrees that these carry little weight, but an honorary degree from the University of Berlin really "means something." The recommendation was given unanimously by the Faculty of Philosophy—Einstein, Planck, von Laue, Schroedinger, Nernst, and others. It is believed that no other physicist has received this honor from Berlin and it once more singles out Professor Wood as one of the world's foremost physicists. Further details are cited in the Scientific American Digest in this issue.

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Our August issue will contain so many articles of general and special interest that it is difficult to decide where to start in presenting a taste of the high-lights. Our tentative schedule, in its present form, shows an article on railroad dispatching as the "lead" story. In this article, prepared at our request by a railroad man who is thoroughly familiar with the ins and outs of the work, is told the story of time and its relationship to good railroading. The railroad dispatcher works hand in hand with time—accurate time—and the work he does results in the safety in which you travel when you go by rail. A series of especially made photographs illustrates various phases of the work.

•

Mathematical physics, an offspring of astronomy, teaches us that the average weight of the earth, volume for volume, is 5.6 times that of water. But geology informs us that the bulk of the surface rocks, volume for volume, weighs only half as much as the earth as a whole. What then may we expect to find below the surface, beyond the greatest depth to which man has as yet penetrated? How can we investigate "The Earth Beneath"? Earthquakes and earthquake records give us something on which to work, and man-made "earthquakes" have produced still more data. The connection between the earth's composition and earthquakes is clearly drawn by the author of an article scheduled for our August number. He says, "The present theory is the latest model. . . . It may be traded in as soon as suggested improvements have been found worthy of adoption. All may rest assured that when better theories of the internal structure of the earth are built, seismology will build them."

•

From time immemorial one of man's major battles for existence has been with the insects. In fact, so serious is the situation that L. O. Howard, recently Chief of the United States Bureau of Entomology, asks, "Which shall inherit the earth—man or the insects?" and answers with an article to be published soon. He points out that the insects have a great advantage, in their bodily structure, over the mammals, especially man, and that it is only man's mind and his ability to use to his own advantage nearly all other forms of life that have so far kept the balance in our favor. But we must do more than has been done to date and, with this in mind, the author reviews past accomplishments and outlines what must be done if the future rulers of the earth are to be men and not insects.

•

From your loudspeaker comes the roar of an approaching train, the rattle of a dilapidated motor car, the steady clop-clop of a horse-drawn buggy, the cacophony of a thunder-storm: you know that these sounds do not come from original sources, but you may wonder how they are produced so that they sound so natural. A short article soon to appear will tell how the production of such incidental noises is a specialized art in radio land; several photographs will illustrate the equipment employed for producing these sound illusions.

•

Over all the battlefield into which the world has been turned, with commerce and industry fighting for their lives against economic forces but little understood, there stands the spectacle of one mighty corporation that expanded tremendously during 1930. In point of gross income during that year, the American Telephone and Telegraph Company stands above all other corporations, private, state, or corporate, in all the world. One reason for this great income is that, in the United States, rapid communication in business and in the home has become almost as important as speech itself. Another reason is that the company spent 15,000,000 dollars for research—progress insurance—and nearly 600,000,000 dollars for maintenance, new equipment, and so on during the year. Other astonishing facts about this great company are coming in our August issue.

Number— The Language of Science

By Tobias Dantzig
Prof. Math., Univ. Maryland

THIS work has had an unprecedented reception. It seems amazing that so many people would delight in delving into the origin of things, yet when one reads the book itself the answer is very evident. No special background is needed, only the desire to seek back of the commonplace for the derivation or the common stem. You will find something new or something interestingly explained on every page. $3.70 postpaid

Finger Print Instructor

By Frederick Kuhne

SCHOOLS of fingerprinting are springing up all over the country. Crime detection study is progressing along scientific lines. Fingerprinting of adults and footprinting of babies in hospitals are widely extended and those of employees in hazardous occupations and many unskilled trades are increasing rapidly. This book is the one authoritative treatise on the subject. $3.15 postpaid

Amateur Telescope Making

Albert G. Ingalls, *Editor*

Now is the time for the most enjoyable study of the heavens. Build your own telescope and get that thrill which comes from the contemplation of the vast galaxy beyond the reach of your naked eye. Thousands have done it from this book which gives all the necessary instructions on just how to go about it, where to get the materials and many "kinks" developed from the experience of amateur and professional astronomers. $3.00 postpaid

Guide to the Constellations

By Barton and Barton

TO GO with your telescope one of the most essential and useful books you could possibly have is this guide which shows by maps and descriptions just where to find the wonders of the heavens. By eliminating so much that usually confuses the seeker, one can more readily find quickly the particular star sought. This is one book that every amateur astronomer should have in his library. $2.65 postpaid

Inventions and Patents

By Milton Wright

PITFALLS and stumbling blocks which waylay the prospective inventor have been carefully outlined in this comprehensive manual of the necessary things to observe in taking out a patent. That there was a real need for such a book is attested by the very large sale which is continuing, showing that it has been a real contribution to the art. Everything from inception to royalties is amply covered. $2.65 postpaid

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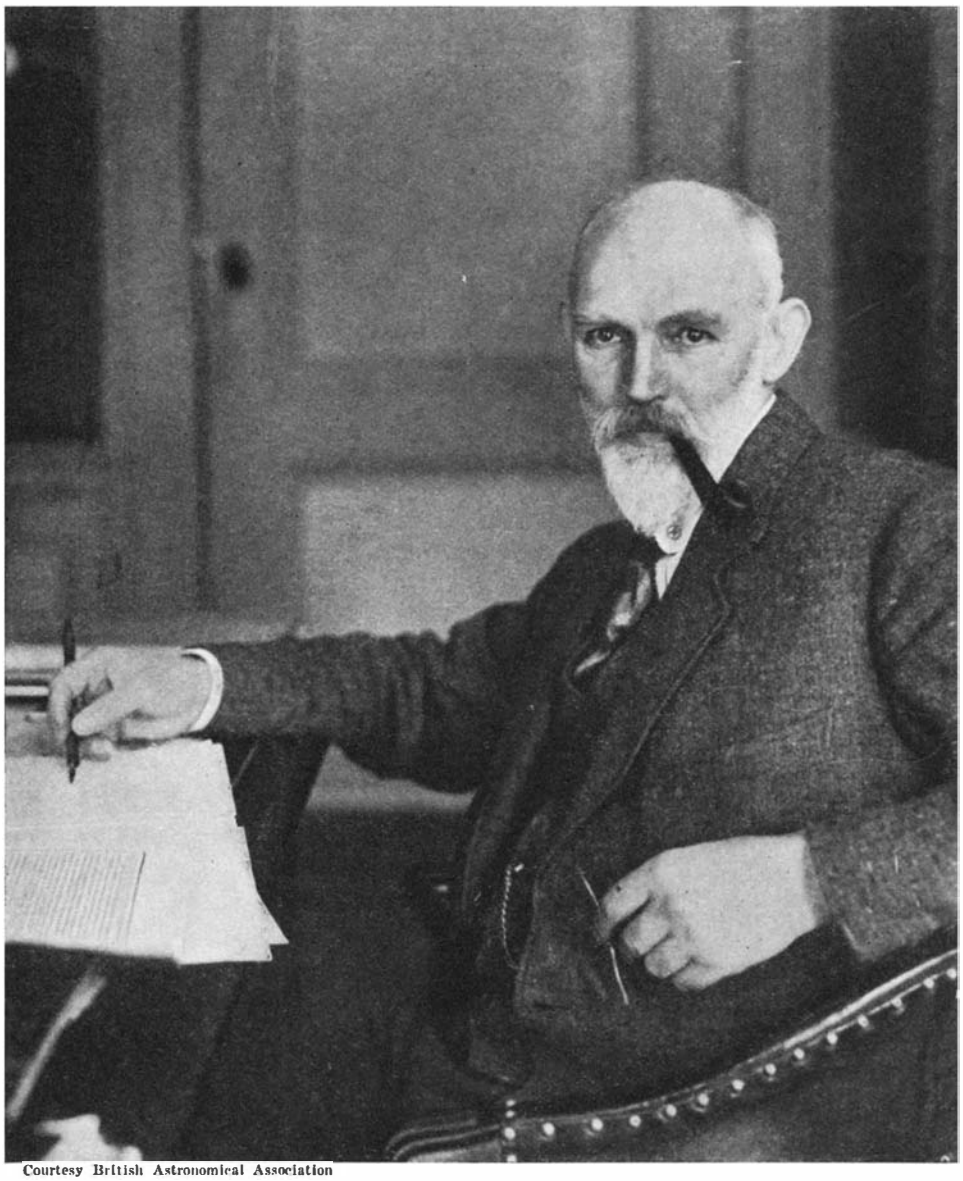
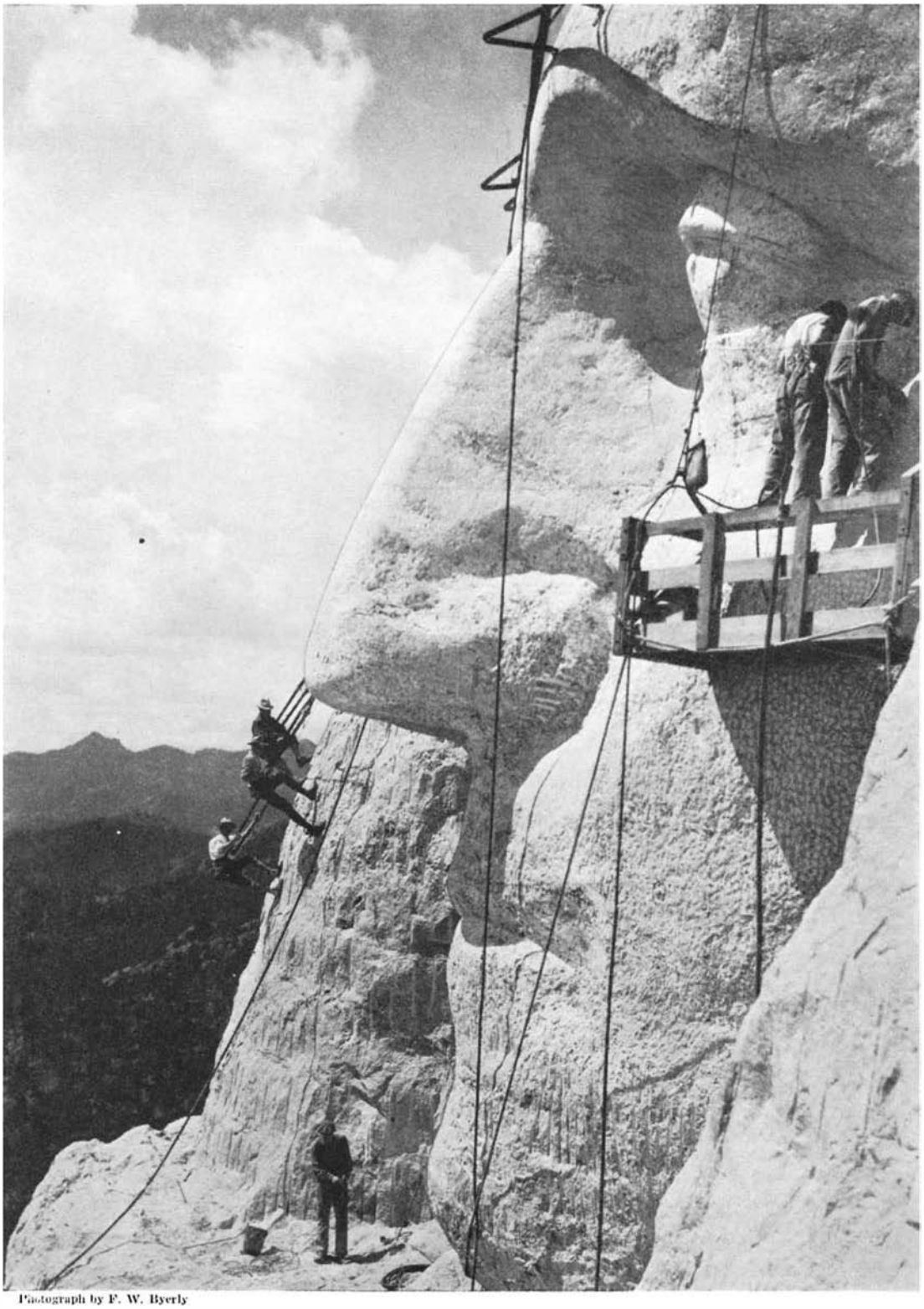


Courtesy British Astronomical Association

WILLEM DE SITTER

THE world at large is not so familiar with the name of de Sitter, the Dutch astronomer-cosmologist, as that of Einstein, but within the realm of science his fame is comparable with that of the great relativist—his name generally being included in lists of the world's half dozen greatest living scientists. In the *Journal of the British Astronomical Association*, Mr. Frank Robbins characterizes de Sitter's career as "one of the most astonishingly fertile of the century," while the American astronomer Leuschner, speaking for the National Academy of Sciences, "doubts his ability to do justice to the greatness of the man."

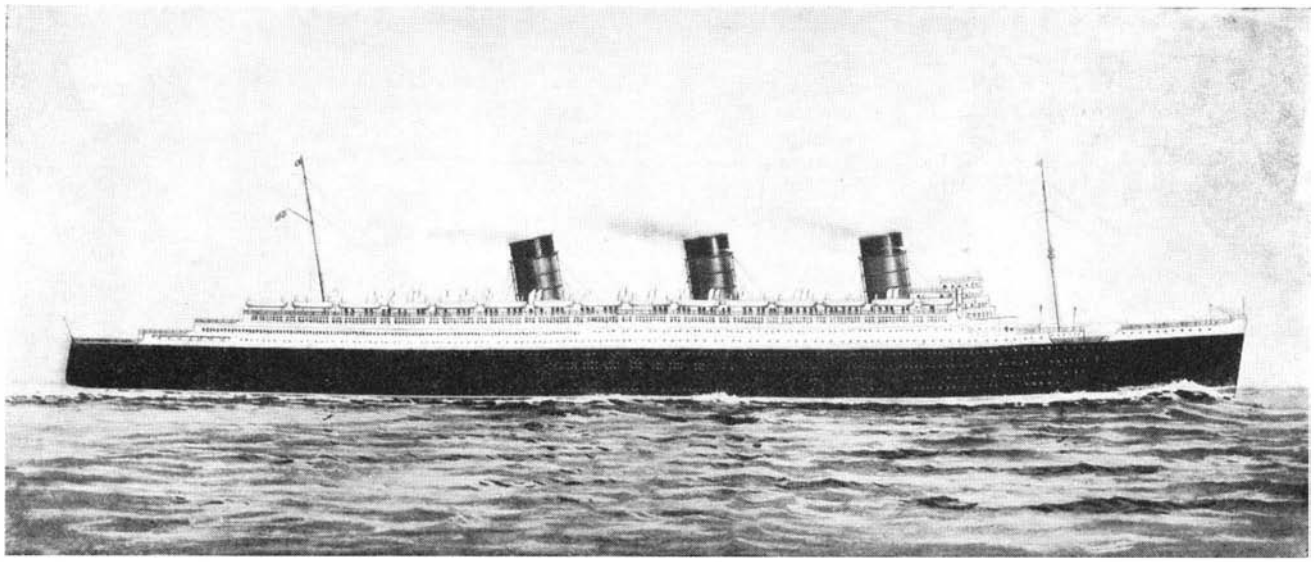
Readers of science often encounter the term "the Einstein universe," "the de Sitter universe," and so on. Such expressions refer to these thinkers' concepts of the size, shape, and general nature, also the finiteness or infiniteness, of the totality of things. Of course, no existing telescope can penetrate the whole extent of the universe and therefore these concepts are based partly on inference. In de Sitter's universe, which is finite, space is curved or bent, not so much because of the presence of matter, as in Einstein's universe, but inherently. It is an unstable universe, expanding or contracting. Recent research by Hubble at Mount Wilson Observatory, actually indicating an expansion, favors de Sitter's concept and has caused Einstein to revise his own concept of the universe since he last came to America.



Photograph by F. W. Byerly

A MAJESTIC MOUNTAINSIDE MONUMENT TO FOUR PRESIDENTS

THE 60-foot head of George Washington nears completion—the nose tip must be rounded—in the gigantic group which is being cut into a 300-foot cliff on Mount Rushmore in the Black Hills of South Dakota by Gutzon Borglum. The heads of Jefferson, Lincoln, and Roosevelt, and a condensed history of the United States will complete the group. The surface is first cut back 40 or more feet to a seamless face. Measurements are then transferred from plaster models to the stone, and the figures are roughed out by careful blasting, often with blasting caps only. Finishing is done with pneumatic tools.



The new 73,000-ton Cunard liner as she will appear when completed in the fall of 1933. She will be launched in 1932. Great Britain pins her hopes of regaining the "blue ribbon" of the Atlantic on this ship, which will be 1018 feet long

CUNARD'S BID FOR OCEAN SUPREMACY

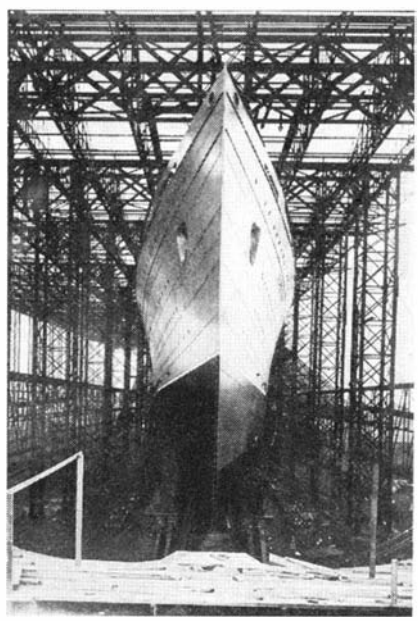
By DAVID MASTERS

WHEN the Cunard built that wonder ship of the seas, the *Mauretania*, the British Government provided a sum of 2,600,000 pounds at 2.75 percent interest and paid an annual subsidy of 150,000 pounds, in return for which the State was to acquire the services of the *Mauretania* and her sister ship in the event of war. That agreement, signed in 1903, concerned the building of two ships "capable of maintaining during a voyage across the Atlantic a minimum average speed of from 24 to 25 knots in moderate weather." For 20 years the *Mauretania* was queen of the Atlantic, faster than any other liner afloat, and then in her old age she beat all her own records and just failed by three hours to beat the record of the newly-built *Bremen* on the homeward trip.

FEW expected that Cunard would rest content with the record in German hands; and their decision to build a liner costing 6,000,000 pounds, with a length of at least 1000 feet, accommodation for 4000 passengers, a displacement of 73,000 tons, and a minimum speed of 30 knots is the best of all replies to the German challenge.

Behind the scenes, the world's greatest scientists in shipbuilding are now concentrating on their tasks. The fastest ship in the world springs into existence out of the combined work of many mathematicians and naval architects, and before the first girder of her keel was laid a fortune went into experiments and preparation.

When 6,000,000 pounds belonging to shareholders are being spent, a company cannot afford to make a mistake. It is much better to spend 60,000 pounds on experiments to ensure accurate results than to spend a niggardly 6000 pounds and make a sad blunder; for, large as the sum of 60,000 pounds seems, it is only 1 percent of the total cost. And before daring to risk capital, shareholders must be protected against loss by insuring the ship. Even the underwriters at Lloyd's would not carry the whole of such a risk, for they had to pay 900,000 pounds when the *Europa* was burned out on the Elbe. So after long negotiations the British Government has agreed to carry part of the risk on the new Cunarder—I should think about 4,000,000 pounds. Whether the Cunard company will pay its insurance premium to the State, or whether the premium will be reckoned as part of a new subsidy, in return for which the Government will have a call on the vessel, I do not know.



Before launching the *Mauretania*, fastest on the Atlantic for years

It is unlikely that the German ships will do very much better than they have already done, and whereas the *Mauretania* proved in practice to be 20 years ahead of her time, the German ships should not be more than three years ahead—if that much.

ALWAYS, of course, the Cunard company has its staff of marine architects working in its office at Liverpool. Then John Brown and Company, who are building the new liner on the Clyde, have their own staff of naval architects busily preparing plans. Moreover, the Admiralty architects will probably be consulted in the matter, if the procedure followed in the case of the *Mauretania* is carried out on this occasion.

Plans for the new ship have actually been under consideration by the Cunard company for a long time. For the *Mauretania*, the first plans were submitted by the builders, Swan, Hunter and Richardson, in 1901 and left until September 1902, while the liner herself did not start on her trials until October 1907. Vickers also submitted plans for her, as did John Brown. All these were duly considered before the Cunard architects drew up their specification

plans; so for the new ship there may be several sets of plans in which are embodied the finest ideas of the shipbuilding geniuses of Great Britain before the final specifications are decided on. And these final plans in their main particulars will have to be agreed upon by John Brown, Lloyd's, the Admiralty, and the Cunard company.

Building the biggest and fastest liner in the world may seem a simple task, once the money is provided, but there are so many interests involved that it is extremely complex. There is, for example, the vital question of docking her. She must go into dry dock now and again for repainting and cleaning. The mammoth floating dock of the Southern Railway (of England) is powerful enough to lift the *Mauretania*, the *Bremen* or any ship up to 60,000 tons, but it could not lift a 70,000 ton ship. So the Southern Railway has now decided to build the biggest dry dock in Great Britain to accommodate the new Cunarder.

It is equally necessary to ensure that there is a quay long enough to provide a berth for her, so while the ship is being built, the present landing stages of the Cunard company on both sides of the Atlantic will have to be lengthened several hundred feet. There was mention of some alteration in the Cunard landing stages in New York over a year ago, and it was rumored then that Cunard was preparing to build something big.

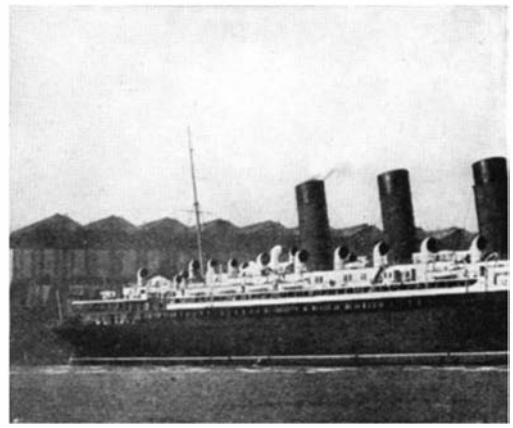
HAVING settled docking and berthing facilities, there is another important question—the depth of the channels which the ship will use in and out of her ports of call. The depth of water drawn by the ship must be less than the depth of the channels; otherwise this ship may sail the oceans and never make port. Therefore to build the world's biggest ship, long negotiations with harbor authorities in several countries may have to be conducted.

When the *Mauretania* was about to be built, the New York harbor authorities decided to go to the expense of increasing the depth of the New York channel, which enabled the Cunard company to increase the draught of the *Mauretania* from 32 feet 6 inches to 33 feet 6 inches— a most useful gain. The authorities on the Clyde also agreed to increase the depth of the river to allow John Brown to build a ship as big as or bigger than the *Mauretania*.

The Clyde authorities unluckily have in the bed of their river the famous Enderslie Rock, 900 feet long by 300 feet wide. As ships have grown, this has been blasted to increase the depth from 8 feet to 20 feet, at a cost in 10 years of 86,000 pounds. Further sums have since been spent, otherwise John Brown would not be able to build the new giant ocean liner for Cunard.

To enable the Swan, Hunter company to build the *Mauretania* on the Tyne, the river had to be dredged to a greater depth and the other bank had to be cut back a considerable distance to allow the ship to be safely launched. All these things, of which the average man never thinks, must be dealt with before a ship like the new Cunarder can be put in hand. It is not just a question of the Cunard company deciding to build; they have to arrange technical matters with many authorities so that the new mammoth can pass from the slipway down to the sea and use her ports freely and without danger. Think of what a pretty mess it would be if a firm built a ship with a draught of 40 feet and then found the extreme depth of the channel to the sea was no more than 38 feet! I need not add that such a thing could never happen, for our ship-builders know their jobs and take everything into calculation, even to the weight of the last rivet.

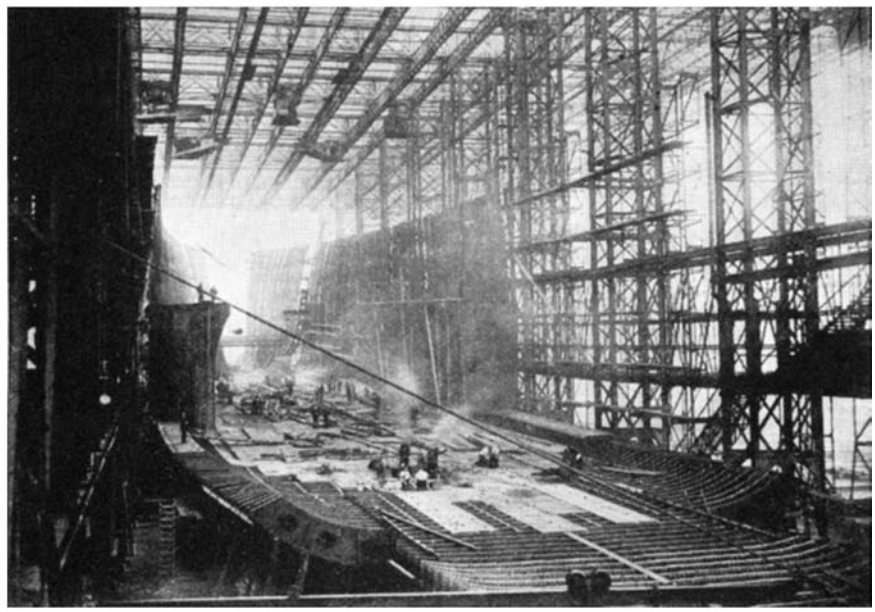
THE sea acts as a cushion to a 73,000 ton ship afloat, but on the slipway there is no cushion, and if the greatest foresight and care were not exercised she might be wrecked before ever she took to water. While this enormous weight is being gradually piled up a few tons at a time upon the earth, it might cause a subsidence that would strain the ship beyond the point of safety. The preparation of the slipway is thus of supreme importance and it has to be so solidly constructed of steel and concrete that it will not sink a fraction of an inch anywhere. It must be so tied together with girders that it forms a solid raft of concrete resting on the underlying earth, and if it reacted to the pressure at all, it would react as a whole, exactly as though it were afloat on the sea, so that the giant resting on it would not be injured.



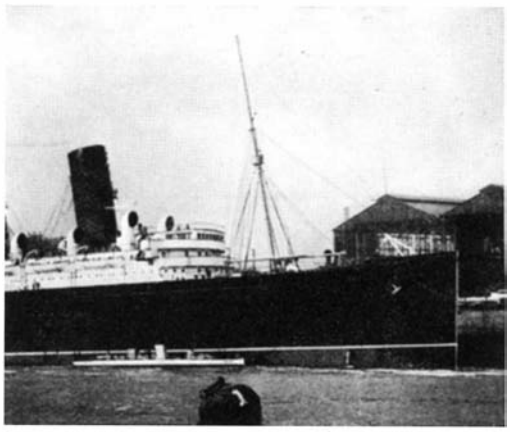
The *Mauretania* and, beside her,

Everything down to the minutest thing is being worked out mathematically and experimentally: the depth and width of the main girder forming the keel, the depth of the double bottom, how many cells it will have, the thickness of the steel, the particular kind of steel that will stand up best to the strain, the size of the rivets and the distance apart, the thickness of the plating in various positions, and the strength of the frames forming the skeleton of the ship. The very rivet holes will be beveled so that the sharp edges cannot cut off the heads of the rivets! The amount of work done by the most brilliant men before anything is seen on the slipway is incredible.

The designers seek to allow for the worst possible conditions that the ship could meet with at sea, and then give her a good margin of safety. With a ship 1000 feet long, they estimate the stresses she will have to stand if she is caught in the hollow of a wave the same length as herself with crests towering upward for 50 feet. Then they will cal-



Methods of building giant liners have been refined since this old photograph of the *Mauretania* on its slip was taken, but have not been radically changed



the experimental yacht *Turbinia*

culate the strain if she is caught on the crest of such a wave. In the hollow, she is being supported fore and aft, and the tendency of her big weight pressing downward is to make her sag in the middle; on the crest the tendency is for the unsupported bow and stern to press downward and break her back.

With the *Mauretania*, they found that the greatest stress worked out at 10.3 tons per square inch on the top part of the girder, but since the steel used possessed an elasticity of 20 tons to the square inch, and a breaking load of 36 tons, the designers made her three times as strong as was necessary. Then for the first time silicon steel, invented by Sir Robert Hadfield, was used for a large portion of the hull, thus adding strength and reducing weight.

Even the matter of dry docking the ship will be gone into most carefully so that she may not suffer the slightest injury or strain. For such a monster, cast steel blocks will not be used alone, as they do not give at all to the enormous pressure, so they will be surmounted by blocks of elm, which is very hard and yet elastic, and on top will be placed caps of a softer wood, of a carefully calculated thickness, that will yield more to the pressure and act as a cushion.

When the plans are in the last stage, an exact model will be made for research in an experimental tank—probably that of the Admiralty at Haslar. For the *Aquitania*, the model was first shaped in clay and then cast in wax. As it was pulled up and down the tank, the power needed to draw it through the water was carefully measured by scientific instruments. The disturbance of the water was observed, and the wax of the hull was pared away by a machine which ensured absolute accuracy on both sides, until the designers found the type of hull which passed through the water with the least possible resistance.

FOR the *Mauretania*, a launch was built—just over 49 feet long—to one sixteenth the size of the liner, and named the *Turbinia*. Electrical machinery was installed; the wooden hull was so constructed that its shape could be altered at will; and experiments were carried out for two years with it in the Northumberland Dock on the Tyne. There were 500 speed trials for testing 12 different types of propellers; the builders sought the best position for placing them; whether three or four would prove more efficient; whether they should turn inward or outward; the best shape of blades and the correct angle at which to set them to the shaft. They found out how to cut away the hull of the ship at the stern to enable her to turn in the smallest space, they tested methods of steering by propellers and with the rudder. They proved that if she faced a 25-knot wind she would want 12 percent more power than when she steamed in a calm, that traveling with a similar wind she would require 4 percent less power. The performance of this small craft led to the installation in the *Mauretania* of the steam turbines which enabled her to hold the record for 20 years.

Calculations showed how much she would be slowed down if some of her propellers went out of action, and proved that simply by altering the position of the propellers they could attain the same speed and save 5000 horsepower. The experimenters even dealt with the power that might be lost by encrustations on the ship's bottom. There were the questions of water-tight compartments to ensure safety, of the best type of propelling machinery, and many other problems; and before some were settled the hull was actually being built, allowances being made for any modifications in design.

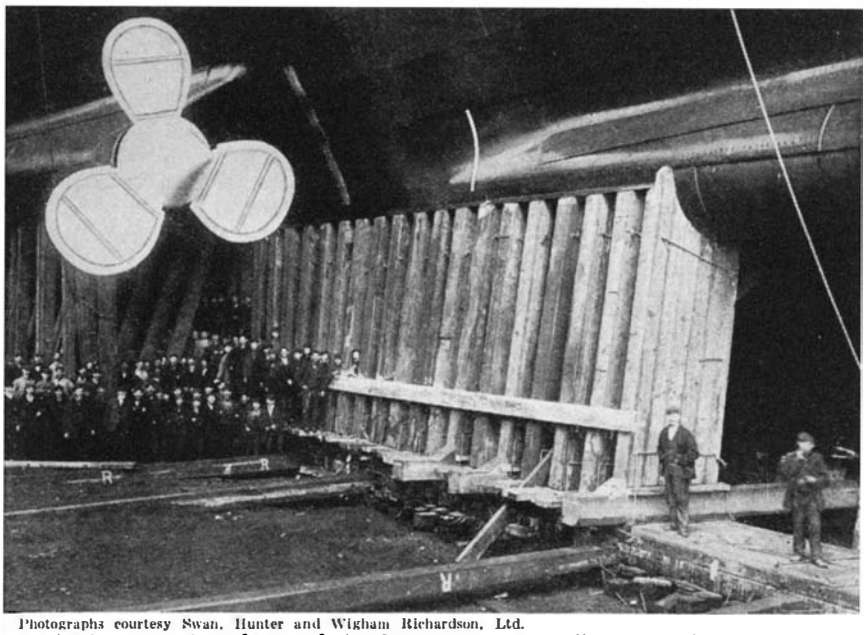
They arrived at the length and depth of the bilge keels which have made the *Mauretania* one of the steadiest liners at sea; they found out how she would behave when fully loaded, when half loaded, and so on. They left nothing to chance; everything that human sagacity could foresee was worked out.

EXACTLY the same processes are being followed in building the new Cunarder. She, too, will have expansion joints which will enable the upper decks to contract and expand slightly to ease the strain on her skin, for a ship 1000 feet long, however rigid she seems to be, is bound to give a little in stormy weather. The joint is covered by a brass plate which is fixed on one side and free on the other to move on a bed of greased leather which enables it imperceptibly to adjust itself to the expansion and contraction brought about by the huge seas.

While the marine architects and mathematicians are carrying out their endless experiments, the steel works are busy making those thousands of tons of girders that will become a ship, artists are designing schemes of decoration to make her the most beautiful thing afloat, furnishers are submitting schemes that aim at the maximum of comfort—shops, cinemas, a daily paper: there will be no end to the wonders of the new Cunarder, and it will certainly tax other designers to the utmost to outvie her in luxury or in speed.

●

(Since the foregoing was written the keel of the new Cunarder, which will be 1018 feet long, has been laid down at John Brown and Company's shipyard on the Clyde, and the river authorities have decided to spend a sum of 80,000 pounds in deepening and improving the channel so that ships of this size may float safely down to the sea.—Author.)



Photographs courtesy Swan, Hunter and Wigham Richardson, Ltd.

The immense size of one of the *Mauretania's* propellers. Note how carefully the edges of the propeller blades are protected by guards during construction

OUR POINT OF VIEW

Albert A. Michelson

IF, as appears to be true, the only eternally permanent entity in the whole universe is light, then Michelson, who hitched his wagon to a beam of it and clocked it almost to the breadth of a hair, identifying himself so intimately with it that the one can scarcely be thought of without the other, has won immortality.

We may attempt to isolate Michelson's major achievements, summing them up broadly as the perfection of the Michelson interferometer for the measurement of the diameter of the stars, and the high refinement of the determination of the velocity of light—not to speak of the famous "Michelson-Morley" experiment whose unanticipated by-product was the Einstein theory of relativity. But when we have accomplished that much, Michelson's major contributions to science and to the world have little more than been touched. Everyone who has been in close touch with the inner world of physics and its personnel knows that Michelson's real contribution to science was simply in being Michelson, Michelson the leader, Michelson the teacher, Michelson the inspirer—especially the inspirer. To this a host of Millikans and Comptons who grew up under his tutelage will testify, as indeed they have on many occasions. He sensed which problems were big problems and not only directed the energies of his best workers toward them but knew how to keep them there. He made these men.

Here was a man who sought no limelight—though the limelight sought him. He cared not for riches—except those of an intangible sort. Fame never haunted him; in all his long career he wrote only two meager books and even these were largely pieced together, more or less as an afterthought, from short papers previously published. There is thus a kind of irony in the fact that Michelson's fame doubtless will live when the wealth of the richest has been wholly dispersed, when the world celebrity has been forgotten by a fickle public, and when most of the extant books long since have passed into the sad category of books of the hour. A man does not need these props to attain greatness—unless he does need them.

One wonders, too, just why it was that Michelson's chosen pieces of research seemed to lie so close to fundamentals. He tackled really basic problems—not that they were more difficult for that reason. Did he consciously choose to make sure that he touched only important things? Those who knew him doubt it. What dictated the man's choice of some of the more significant things in science as an outlet for his investigative urge doubtless was something wholly unconscious—we cannot define it, cannot describe it or isolate it, but all recognize it when they see it. It is simple greatness. Michelson was great.

Of personal reminiscence regarding Michelson we can relate but little. He was not very approachable because he knew we sought what he was not disposed to surrender—the time and energy required to write popular articles when he was aware that he had but little time left. He was old and had done enough hard work and now he intended to play. Taking time out to write articles would be like giving up little pieces of his life. He proposed to play, and play he did to the very last. Though described as "work," all his recent series of redeterminations of the velocity of light were play. When he worked hard on them he was playing hard. To him the problem was one not merely in physical optics but in esthetics. The refinement was not yet complete, the picture lacked necessary detail and precision, and his nature forced him to perfect it. This he finally did and in his 79th year he died. But Michelson the measurer lives on; it is the rest of us who die.

Above and Below the Arctic Sea

SHOULD nothing happen to interfere, the old submarine which was rented by Sir Hubert Wilkins from the United States Navy for one dollar a year, reconditioned and specially fitted, and renamed the *Nautilus*, will be on its way to the North Pole by the time this is in print. A prodigious amount of effort was expended to put this ship into first class sailing order and to render it as safe as human ingenuity and foresight could possibly make it. The *Nautilus*, nevertheless, will meet with obstacles to success such as no other submarine has ever encountered, for it must travel most of the way under the ice. The hardy souls who are risking their lives in this ship for the sake of science, will, therefore, be deserving of the laurels of pioneers should success attend their undertaking.

A recent press dispatch from Berlin says that Dr. Hugo Eckener plans a flight of the dirigible *Graf Zeppelin* to the arctic this summer for the purpose of contacting the *Nautilus*. Presumably the submarine and the dirigible would find each other by means of radio, and then the one would come down to the surface while the other bored its way up to the surface of the ice. The project is most ambitious but then both Dr. Eckener and Sir Hubert are the sort of men to carry it out if anyone can. Professor H. U. Sverdrup, famous Norwegian arctic explorer, doubts the possibility, however, for he says that July is a bad time of the year for an airship in polar regions, due to the fog and low clouds.

Whatever the result of the effort to make contact between the two ships, the world will watch with interest every mile of progress made by both. History of a kind unprecedented in the annals of science will be made by the *Nautilus* whether it attains its polar goal or not, and the *Graf Zeppelin's* flight will forge another link in the growing chain of conquests of the poles by air. Bon voyage and success!

Wages and Prosperity

AS business and industry begin gradually to adjust themselves to present conditions and to plan for the future, the controversy over the possibility of wage reductions is becoming more serious. President Hoover has consistently fought against such a step although many executives, bankers in particular, have as strenuously favored it. Mr. Mellon has said that recovery must come without it but the president of Europe's steel cartel recently declared that the theory that high wages are a guarantee of prosperity is a "mirage."

What is one to think? Statistics prove but little, if anything, in such a question and it is worse than useless to take the word of any man or group of men. There is much to be said on both sides, always considering, of course, the wage-earner himself. Those who are against wage cutting may be entirely correct in their theories as they affect the American working man, while Mr. Meyer, the European, may have precisely the solution for his side of the Atlantic.

There is no question but that the American working man is our biggest customer. He knows that his net income is very much higher under the high wage system than under the other; his percentage of "luxury" or "pleasure" cash is much greater under the former than under the latter. He has, accordingly, adjusted his standard of living

to a scale higher than Europeans know or have known. He has a car with all the necessary or foolish gadgets, a six- or eight- or ten-tube radio, good clothes, plenty of good food, and more comforts than a medieval king.

It is true that the cost of living in the United States has steadily declined during past months until it is now very near the pre-war, 1913 level. This being the case, some will say that it should be a simple matter to reduce wages in proportion. We think differently. Labor is against it. In fact labor has shown its determination to maintain, if possible, the basic rate of wages by co-operating in the reduction of weekly working hours, and by voluntarily adopting other compromises. Indirectly, such action means the lowering of the weekly payment temporarily, but it helps to insure the retention of the basic rate until the return of prosperous times. Should wages be sliced horizontally, there is almost sure to be an impairment of efficiency; and furthermore, it might result in formidable strikes such as have characterized similar attempts in the past.

Labor is going to hold on as long as it can. It is going to be no easy matter to adjust wages to a lower level even if, in time, that is shown to be the only feasible thing to do. Nevertheless, others besides the working man have felt the depression, and on a stupendous scale. If, therefore, the restoration of economic balance can be effected in no other way, it may finally be necessary to reduce wages, in certain lines at least, and labor must be prepared to make that sacrifice in order that the nation may continue to make progress toward a new era of high wages and prosperity.

Down With Crooks!

GANGDOM isn't having such a pleasant time of it at present. The federal government has recently jailed several "public enemies" in Chicago for failure to pay income taxes; and is now invoking the same weak process for eliminating a few New York criminals from the scene of action. In Chicago, Mayor Cermak promises a widespread cleanup of crooks, and in New York, Police Commissioner Mulrooney is doing exceptionally good work both in capturing criminals and in giving them a dose of their own hot lead medicine. Other cities are doing good work but not in so spectacular a way; and foreign-born outlaws from all over the country are being deported in large numbers.

In this fight against a menace to society, there is one bit of knowledge that is not used to advantage and that is that the criminal is, first of all, an egomaniac. He sees himself pictured in the newspapers as a "king of this or that racket," a "two-gun gangster," or a "dangerous desperado," and his ego is inflated to the dimensions of an over-size rubber balloon. He swaggers among his crowd and boasts of his cleverness. He even sneers at the police. "You ain't got nuthin' on me," he chants every time he is picked up—so often has he said this, in fact, that it has almost become a litany of crookdom.

To make our fight more effective, the balloon should first be pricked. This could be done to some extent by coining a word that will describe the crook for the leper, parasite, thief that he actually is. This word should have none of the glamor of the pirate or the western six-gun man of fiction but should, instead, be comparable in its implication to the crook himself with the word "stool-pigeon." Having coined such a word, opprobrious to the n-th degree, someone—a reporter perhaps or a popular writer comparable, we'll say, to Edgar Wallace—should give it wide currency. Perhaps it would not cause the crook to reform, but it would so tarnish the luster of his notoriety that youths would hesitate to follow in his footsteps. Newspapers could help much in thus debasing criminals.

Another thing to take some of the bravado out of the physical coward that every crook is, would be to give him the lash. One state which we won't name does this and it is said to "degrade" the criminal so much in the eyes of his fellows that that state has very little crime. It would seem, therefore, that public spanking of habitual criminals is indicated for other states. At any rate, there are many people who would like to see this method tried out. Thieves and murderers might thereby be shown that they are not the desperate he-men they think they are.

Human Engineering

STEVENS Institute of Technology is continually surprising conservatives with far-sighted plans for choosing and training engineers. The latest is a summer camp in northern New Jersey where students from preparatory schools will be judged as to their fitness to enter the engineering profession. Leaders in science, engineering, architecture, and education will constitute the faculty.

Science and engineering are exerting a stronger appeal on the youth of our land than ever before; and yet the simple desire to enter these two interwoven fields, no matter how strong it may be, is no criterion of fitness or promise of success. Very often, in fact, such desires, unanalyzed, lead to tragic failures. If, however, prospective engineering students can be given an actual taste of the work they think they desire—a bit of surveying, some miniature engineering problems, and lectures and movies on mining, building construction, machinery design and operation, and so forth—they will begin to get a clear-cut conception of engineering as a career. All this the Stevens summer camp this August proposes to do and more: it proposes to analyze these youthful would-be engineers, discover the brilliant ones, and weed out the misfits.

Stevens should have a large degree of success with this first camp. The plan seems to have great possibilities, and is worth, we believe, the careful consideration of other institutions of learning.

Television Makes Its Bow

WE were intensely interested in the recent television demonstration, described on page 33 of this issue, not so much for the sake of the apparatus involved, which was essentially old, but because it represented the first attempt to place television on a commercial scale at the command of the public. Whether this "sight broadcast" station will succeed or fail we do not know—certainly we wish them well, if for no other reason than as recompense for their resourcefulness.

Frankly, it is our opinion that television systems based on mechanically operated parts—scanning disks and the like—are not the ultimate solution to the problem of placing in every home a "talking motion picture." But they serve as a starting point, just as the crystal detector and head-phones of 1921 served to whet the public appetite for radio to such a degree that the way was opened for the multi-tube receiver and powerful loudspeaker.

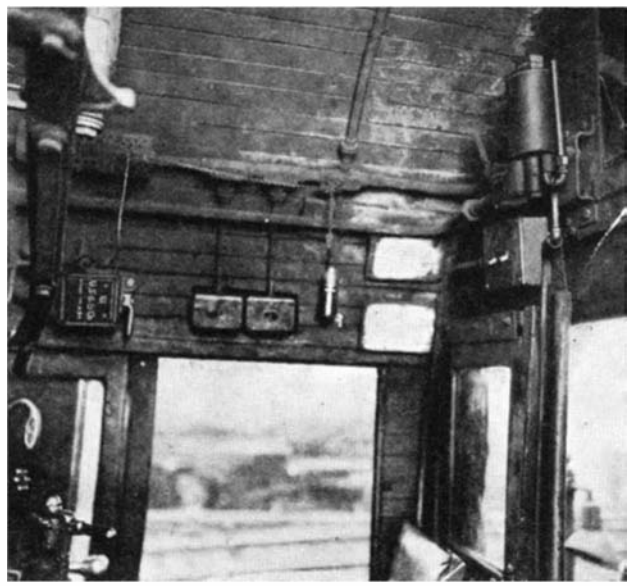
Although none has as yet come to our attention, it is wholly probable that in the wake of public interest in this initial sight broadcasting service will come many other systems, among which there will be some that are proposed for no other reason than to take the public's money. Certainly, with the many experimenters that are working on television today, the art is going to suffer from a plethora of methods and from the growing pains of financing problems. But from the chaos there may emerge something new, something so startlingly simple that it will place television on the basis that it deserves. We hope that when this time comes, those who have so ably pioneered in the field will be in a position to reap the benefits that should accrue to pathfinders.

RIDING WITH THE SIGNAL IN THE CAB

RAILROADING is much safer today than it was even a decade ago. Some of the brightest minds have devoted their best efforts to this end. The automatic train stop was a great milestone on the road to railway safety and now we have a tested system which reproduces in the cab of the locomotive the indications of the wayside signal and also tells of track conditions ahead. One of the great handicaps with which the engine crews have always had to contend is an obscured view of the signals caused by fog, rain, or smoke from passing trains. All these factors play an important part in curtailing the enginemen's view of the signal which is fleeting at best, even in fair weather. However, the cab signal duplicates the signals themselves, according to the system in use—color signals, position signals, et cetera. These cab-duplicated signals, when unfavorable, or in other words indicating danger, if unheeded by the engineer, result in blowing a whistle in the cab which will cease only when the engineer turns the acknowledging switch, showing that he is alert and at the throttle.

These signals may be combined with automatic train control which lays a heavy hand on the air brake valve if signals are unheeded. In other words what happens in effect is that as an engineer sees a wayside signal, it is picked up and placed alongside his gages. The cab signal is weird in its operation, for the signal currents are picked up through space while traveling at high speed without physical contact of any kind. This system increases track capacity, warns of broken rails, and saves the coal pile. A poll of enginemen running between New York and Washington with both types (that is, the automatic stop and forestaller and the cab signal with whistle and acknowledger) showed that they voted 449 for the cab signal and eight for the automatic control. The saving in mental wear and tear on the crew is also very great.

The mechanism on the locomotive is controlled by energy from the track circuit in which a code transmitter is connected across the rails at the exit end of the block. The track current is interrupted by means of the code transmitter situated at the signal, the number of times per minute depending upon the condition of the track in advance. The codes used are 180 per minute for "clear," 120 per minute for "approach restricting," 80 per minute for "approach" and a steady current or absence of current for "caution slow speed."

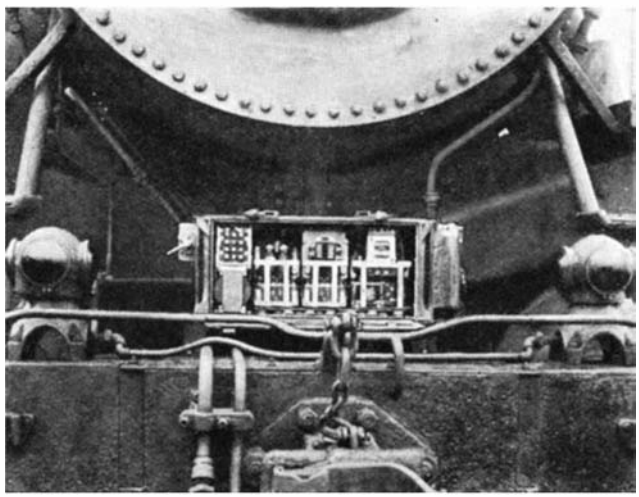


At "caution slow speed," the cab signal is supplemented by a warning whistle which the engineer acknowledges

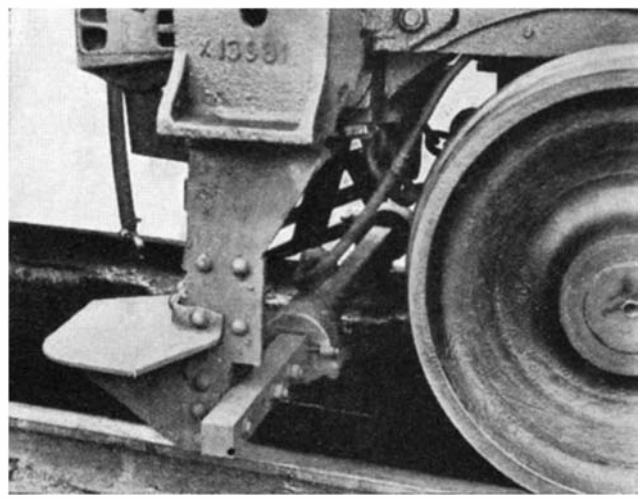
ON the engine are the receiver, the amplifier set, the acknowledging and decoding relay group, and the decoder (all contained in the equipment box), the cab signal, the warning whistle, the dynamotor or dual-voltage headlight generator, the acknowledging switch, and the main switch.

The receiver is the means by which the control is transmitted from the rails to the apparatus on the engine. It is made up of a laminated iron bar on which are two coils connected so that the voltages induced in them by the normal 100-cycle track circuit currents are additive. It is mounted six inches above the rails, ahead of the front truck when the engine is equipped for forward running; when it is desired to equip an engine for reverse running, all that is required is another receiver back of the last pair of wheels on the rear of the tender, and a reversing switch, operated by the reverse lever on steam locomotives or by the plug switch on multiple unit electric cars.

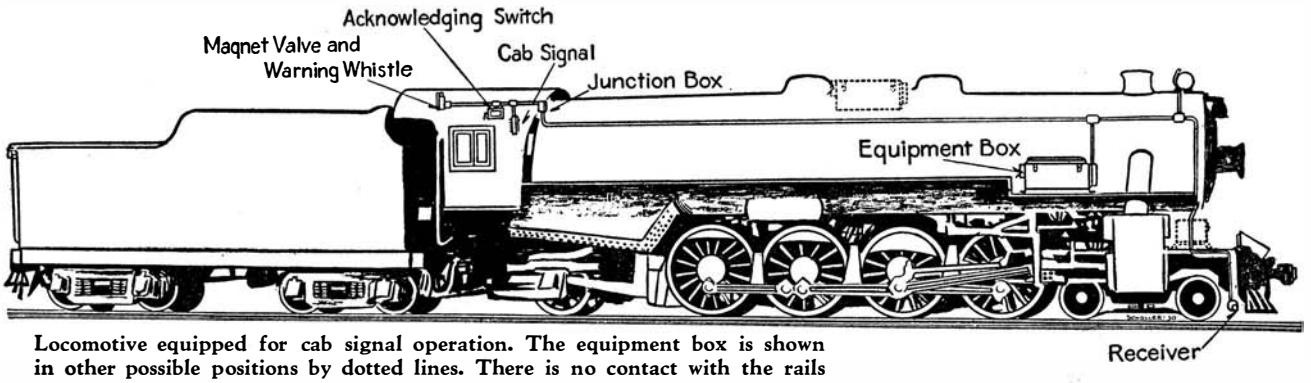
The equipment box is usu-



Front end mounting of equipment box which contains the amplifier set, acknowledging relay, and decoder



The receiver, an iron bar and two coils, is mounted ahead of the forward wheels and picks up the control current



Locomotive equipped for cab signal operation. The equipment box is shown in other possible positions by dotted lines. There is no contact with the rails

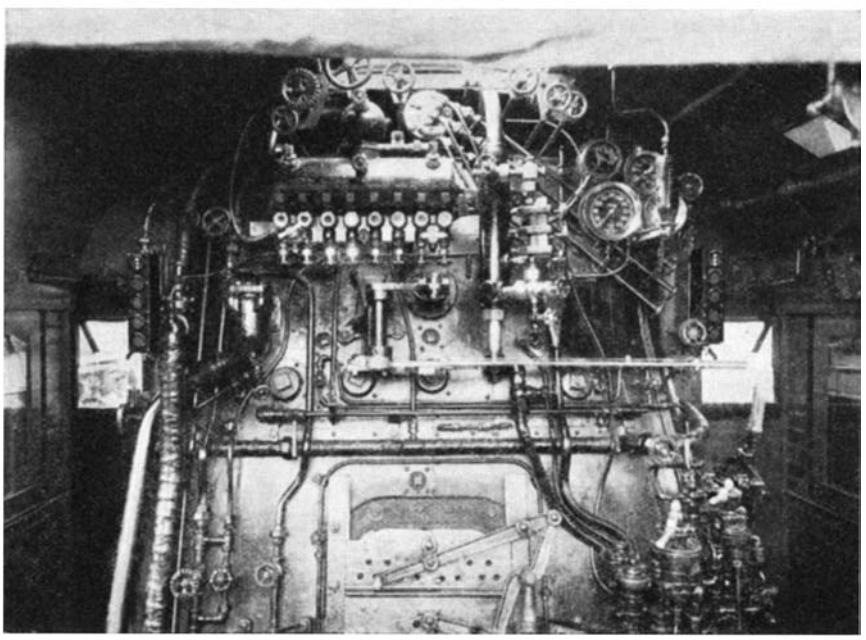
ally mounted on the pilot deck of the locomotive, although it may be mounted elsewhere, if more convenient. It is equipped with shock-absorbing platforms to eliminate the effect of vibration on the apparatus. The various parts of the equipment contained in the box are so mounted that any part may be removed without handling the others. The external and local connections are made by means of plugs and cables, the male and female connections of which are arranged in such a manner that the proper connections are guaranteed.

THE voltage induced in the receiver coils is delivered to the amplifier which in turn delivers to the electrical apparatus on the engine a greatly increased amount of electrical power for its reliable and safe operation. The amplifier is provided with two vacuum tubes similar to those used in radio, but sturdier and adapted to higher current values. The master relay and the master relay transformer are built into the amplifier unit. The master relay transformer transmits power at the proper code frequencies to the master relay. The master relay, which changes at code frequency the polarity of the 32-volt direct current that is supplied to the primary winding of the decoding transformer, is operated by the master relay transformer. In order to provide protection against arcing at the master relay contacts, a condenser is placed across them to act as a spark arrester.

The decoder comprises a decoding transformer with the reactors and condensers necessary to tune the decoding relay circuits to their proper code frequencies. The cab signals, controlled by the decoding relays, indicate the track conditions ahead. These signals may be provided for both engineman and fireman. The cab signal is placed in such a position in the cab that it is in line with the engineman's vision as he watches the track ahead. If the signal indication is ignored a warning whistle sounds. An acknowledging switch is located within convenient reach of the engineman. Reversing it causes the warning whistle to cease sounding and shows that the engineer is alert, but it sounds again on any subsequent change to a more restrictive indication and must again be acknowledged.

The Union Switch and Signal Company of Swissvale, Pennsylvania, have spent years of experimenting and immense sums in perfecting cab signaling. Over 18 roads have adopted cab signaling in one form or another and as time goes on vast installations will probably be added to those already in being. The track milage equipped for continuous cab signal operation, if connected, would provide for a three track road from New York to Omaha and for a double track road from Omaha to San Francisco. The locomotive milage protected by continuous cab signals exceeds 5,000,000 per month. Over 6700 miles of track and 4243 locomotives and multiple unit electric cars are equipped with these systems.

A four indication position signal in the engineer's line of vision



Four indication position light cab signals are duplicated so that both the engineer and fireman are continuously informed of the condition of the track ahead

It is interesting to note that inventors here and abroad have been attempting to solve the problem of the cab signal since 1850 and some of the devices have considerable merit, but they practically all depended on some form of contact while the successful system we have described depends on a receiver mounted above and out of contact with the rail or any other object. Therein lies its great merit.

QUICK-FREEZING SOLVES FOOD PROBLEMS

By D. H. KILLEFFER

A FRESH peach in New York's mid-winter stood in one of O. Henry's short stories as the sign and symbol of high adventure and attainment. A bare 20 years ago that was, yet today the finest of peaches are ceasing to be more than a table delight and the seasonal adventure has been taken out of them forever by the modern processes of "quick-freezing." Were it not now mid-winter in New York and were the writer of this piece not an incurable admirer of the Caliph of Bagdad-on-the-Subway, peaches would not be so prominently mentioned here. The story properly begins with a fish instead of a peach, but where (if ever) it will end, no one in this year of unemployment and investigations can tell.

A DEAD fish that swam about in flat denial of its demise is credited with having set in motion the whole train of things which has resulted in a method of food preservation so far superior to anything we have ever known that it threatens to upset the whole human dietary. Whether the fish really was the cause of it, need not concern us now. At least it is an interesting story and may very well be perfectly true. The scene of the story is the northern ice in winter and it relates how a fish caught through a hole in the ice froze very suddenly when he was drawn from the water into the below-zero atmosphere. Stiff and hard with all the customary evidences of death, the fish was taken to the camp and thawed as a preparation for the frying pan by being put into more or less warm water. Many hours had elapsed since the wintry wind had frozen it to death, but in spite of that it swam contentedly about the tub of water just as if nothing had happened!

No one knows how often a similar resurrection has been witnessed by fishermen. At least we may assume that it was a commonplace since no one had taken pains to write of it in a book. It is told that this wonder so struck a scientist one day, that he fell seriously to thinking about it. From it he evolved a theory and from the theory has come an industry which today promises marvels in allowing all of us to enjoy all of the kindly fruits of the earth whenever and wherever we choose. The result is already a living, growing reality. Many have contributed to materializing this dream and barely enough has so far been accomplished to whet one's curiosity and to stir one's imagination about what it may do to our future.

Now it is perfectly plain that any treatment which allows the fish to recover all of its functions later does not in any way impair its value for food purposes. After such a sudden freezing, the fish is without question quite as good to eat as if it had just come out of the water. And that is just what is accomplished by the modern processes of so-called "quick-freezing."

Peaches and fish have been mentioned as subjects of the new art, but these merely suggest its possibilities. All manner of fruit, flesh, vegetable, animal and fish food-stuffs lend themselves readily to this method of preservation. Even the family quart of milk which everyone knows is injured by the cold of a winter's morning retains every characteristic of fresh milk after it has been "quick-frozen" and thawed again!

Courtesy Dry-Ice Corporation

Fish, maintained at a low temperature, is delivered just as fresh as when caught

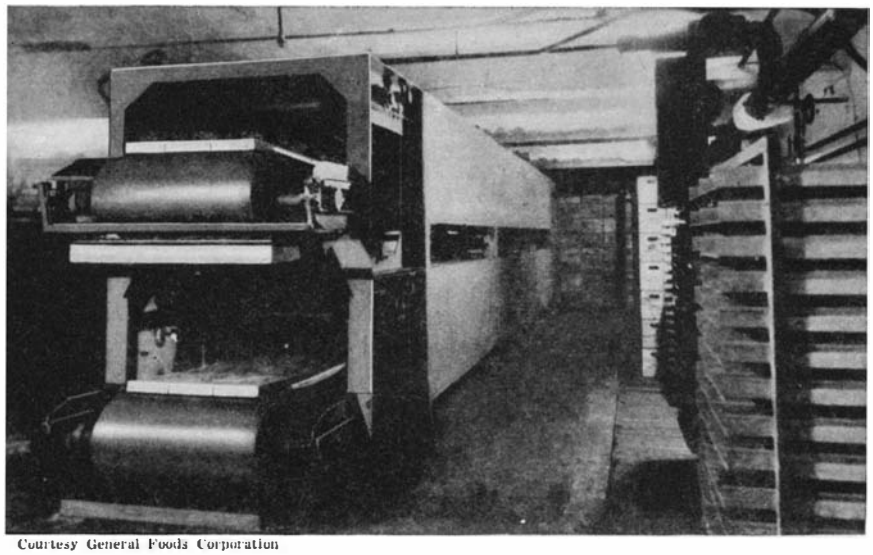
THE first serious effect of this process on the business of feeding the world has been an investigation of our facilities for the production and maintenance of the comparatively very low temperatures required to keep such frozen foods in proper condition on their way to the ultimate dinner table. The second, no less important in its effect, has been an extension of the modern idea of branded individual packaging to perishable foodstuffs in a way otherwise impracticable. So fundamentally important are both of these that one cannot overlook them when considering the major economic forces today at work in our civilization.

An eminent authority has recently stated that 16 cents of every dollar of value in perishable foods, consumed in New York City, is lost between the time these are landed at the piers and the

This truck and trailer highway transportation unit has a total capacity of 20 tons. Six hundred pounds of Dry-Ice maintain a constant temperature. If a similar unit were designed for ice, about 6000 pounds of ice would be required

time they are utilized by the ultimate consumer. Obviously here is an opportunity for tremendous saving by the "quick-freezing" method of distribution.

Although the art of cold production has been developed rapidly in the last decades, the present impetus given its development is likely to push it still faster ahead in the coming few years. The reason for this lies in the important difference between ordinary refrigerator or even cold storage temperatures and those now imperatively necessary to meet the needs of "quick-freezing." It is essential that the freezing process itself be accomplished with the utmost speed and this can only be done if the freezing medium is at a very low temperature. (For further details see page 250, March 1929 SCIENTIFIC AMERICAN. *Ed.*) As cold as 35 or 40 degrees below zero is considered by many to yield the best results although others perform the operation at as high as ten degrees below zero. At any rate the temperature is far below any required for other refrigeration purposes and hence has necessitated serious revisions in the machinery used.



Courtesy General Foods Corporation

A quick-freezing unit in operation. The pans of material to be frozen are placed on the endless belts and passed through a low-temperature refrigerating system

AFTER the freezing operation the product must be kept cold, much colder than ordinary refrigerators, until it is ready to be consumed. Any slightest thawing or even approach to it is fatal to the quality of the food and hence cannot be tolerated. This means that from the instant of freezing it must be maintained somewhere near zero for complete safety and this is thirty to fifty degrees colder than customary refrigerators. The problem thus presented is really different only in degree from ordinary refrigeration but this difference is actually great enough to suggest a total difference in kind. Whereas one may ordinarily utilize any temperature near but not below freezing for preserving perishables, "quick-frozen" foods must be continuously kept far below that point not only in storage but in transit as well, for the reason that if the temperature rises considerably the conditions of the tissues of the frozen food, which are inherent in "quick-freezing" as already described, become those of slow-freezing and all advantage of the former method is thereby lost.

An experimental quick-freezing cabinet in which Dry-Ice is used. With this unit, fish can be frozen solid in 20 minutes

To meet this situation every effort is being made to develop and perfect means for solving the new problems faced in the growth of this lusty infant industry. The ice cream industry has met and solved a host of similar problems but on a less grand scale, and from its practices in the use of solid carbon dioxide (well known by the trademark "Dry-Ice") and mechanical refrigeration much is adaptable to the new needs. However, ice cream has always been drawn out of hidden storage and food purchasers have always insisted on seeing what they were soon to eat. This has complicated the refrigeration problem seriously, for it is one thing to produce cold in a tightly insulated box and quite another to accomplish the same result in a glass show case.

Undoubtedly the final outcome will be something resembling an ice cream cabinet much more closely than it does a present day display case but that will take time. At present the big problem is to provide retailers everywhere with sufficient refrigeration safely to keep "quick-frozen" foods. The effect of this on the business of building refrigerators may very well be the leading factor in bringing the world from its present slough of economic despondency for literally billions of dollars must be spent in equipping hundreds of thousands of retailers with an amount and a quality of refrigerated equipment never before dreamed of to complete the development already under way. This process of revising retail food store equipment will require years for its completion and in the meantime drug and confectionery stores will probably be the first in the field with the new products because inadequate though it is their present equipment will better handle them than that of any present food store.

IN this process of re-equipping retailers many mistakes will naturally be made in adapting conflicting ideas of what people want to the essential requirements of "quick-freezing." However, the possibility of branding a beefsteak, a mess of fresh peas, or a portion of spinach, so that the responsibility for its excellence is definitely fixed, points directly to a public confidence already built up around advertised brands. It is quite unnecessary for a housewife to see the actual contents of a tin can bearing a familiar label, and the same will hold true of the products of the new process after it has gained public confidence.

Incidental to the matter of individual packaging, but fundamental to the economics of the new era in foods, is the fact that preparing food for "quick-freezing" definitely prepares it for the cook. This allows all the offal, bones, fat, skins, seeds to be removed mechanically at a central point where sufficient quantities of wastes are collected to allow their profitable utilization for purposes other than food. Not only do these wastes have value when thus collected in quantity, but the reduced weight and bulk of the prepared food effects a considerable saving in handling costs. These combined savings are enough to offset nearly, if not completely, the additional costs of the processing so that

A package of ice cream, kept cold with Dry-Ice, needs no bulky packing of ice and salt

the ultimate result of the new procedure will be to provide the housekeeper with higher quality food at no increase in the customary stretching of the kitchen budget.

WHILE we have used the term "preserve" to designate the result of the process, we must carefully point out that its product is kept over an indefinite period in *exactly* its original state without change of any sort. It requires no imagination for the eater to believe that "quick-frozen" Georgia peaches in January were picked the day they were eaten and brought by some strange magic from a far-off origin to one's own dinner table in the twinkling of an eye. Nor need a Kansan or a resident of the desert country have any strain put upon his credulity to believe the fish on his plate to have been whisked by some fairy charm from the depths of the sea within the hour. It is scarcely thinkable that one who has tasted the delicacy of "quick-frozen" foods will be guilty of comparing them with "canned" stuffs, but rather he will realize that this method of food preparation yields a product directly comparable with a garden, a fishing bank, an orchard, or an abattoir directly at hand. Like our cave-dwelling ancestors, we of the modern world are limited in what we eat by what we can get, but unlike them our reach has been enormously extended beyond the length of a skilfully wielded club or an accurately aimed arrow. And now our dinner table reach can go around the world.

Great improvements in the methods of cold production, and particularly the general application of solid carbon dioxide (it is more familiar under the trademark of the pioneer in the field) to transit refrigeration, are rapidly minimizing the effect of distance as a limiting factor in perishable food distribution. The adoption of "quick-freezing" methods is similarly operating to nullify the effect of time. It is quite unnecessary, to return to our original statement, that a Georgia peach be plucked before it is completely, lusciously ripe in order that proper refrigeration can get it to market within a few days, when by "quick-freezing" at its delightful best it can be transported safely unchanged to the ends of the earth and eaten months, if not years, later by a Hindu or an Eskimo in his own house.

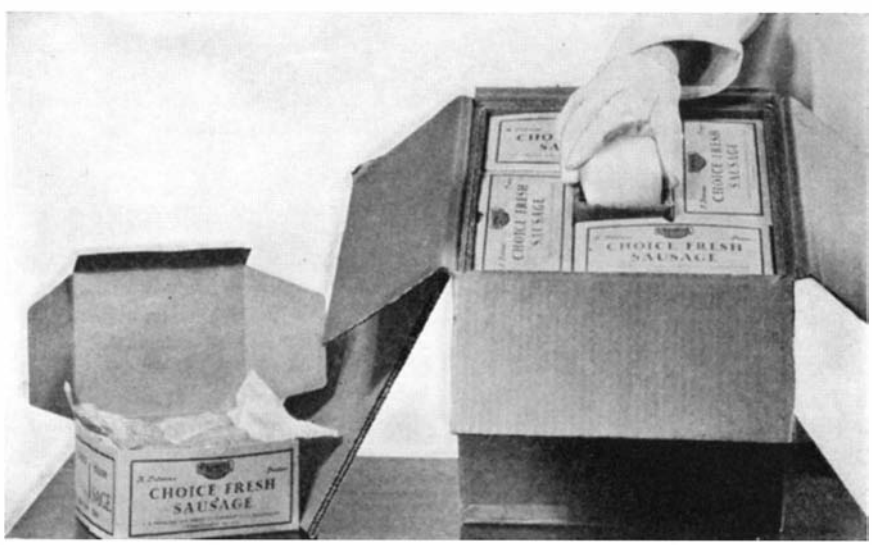
In other words, this newest development in food handling makes all of the most perishable foods and fruits of every land and clime possibly available to anyone anywhere at any time. That statement is almost too startling to be believed, but it has been proved unquestionably true. Its ultimate meaning cannot be realized today, but even a scant glimpse of its potentialities staggers one. To consider only one phase of it, recall that practically a third of the orange crop in the United States is wasted because it becomes too ripe for shipment and that in this state it is at its prime best. By "quick-freezing" the juice of this ripe fruit, it can be marketed anywhere at any time in exactly its original condition. This will relieve the grower as well as the consumer of an expensive waste and probably will do more to make that kind of farming, and others like it, profitable than reams of legislative enactment could possibly accomplish. All kinds of perishables now available in limited territories or for short seasons can be similarly saved.

For the consumer this places at his beck and call anything, however rare and perishable it may be, which can be grown anywhere; and what may be quite as important, it promises a decrease rather than an increase in the cost of delicacies now beyond the reach of the average purse. Indeed, with that other modern wonder, home-made sunshine, it promises to do away in a great measure with the necessity for travel into far lands to cures of one sort or another. After all, the advantage of a winter in the South for the relief of rheumatism, for instance, is compounded almost equally of energizing sunbeams and a healthful diet. If these can be had at home, the urge to changes of climate for health vanishes.

THERE is another broad outlook into the future which it is permissible to deduce from past history. Every business depression has had some particular advance in industry upon which to build and hasten prosperity. In one case it was the automobile, in another the war, and for the last depression it was the airplane. With all the additional machinery necessary to maintain the lower temperatures—where, in an established refrigeration system, it will require a machine of practically three times the old capacity—the special display fixtures, and the entire change in the aspect and furnishings of the places of distribution, is it beyond acceptance to prophesy that "quick-freezing" will be the stepping stone to new prosperity?

●

One of the many feature articles scheduled for our August issue deals with railroad dispatching; it brings out many facts hitherto unknown to the general public.—The Editor.



A specially designed shipping carton for, in this case, packages of sausages, wherein the central compartment is designed to hold the Dry-Ice refrigerant

KEEPING THE STOCK EXCHANGE FIT

THE New York Stock Exchange seems to be a queer place to be taken sick. Still when a member is taken sick he should be treated so that he may be returned to the trading floor without loss of time, for a broker is a pretty valuable piece of human machinery, if the cost of a member's seat is considered. Realizing that the great organization has an obligation to its employees, the Stock Exchange gave up a valuable floor in one of its buildings for a Medical Department which is designed not only to deal with emergencies but to oversee the health of the

Tickers in member's room

Admission room

employees, of which there are 2444 of the Stock Exchange and affiliated companies, and 2250 telephone operators. This department also gives service to the employees of member firms and to brokers if they desire. In the case of member firm employees, an annual fee

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under a group plan is provided and the service is offered to smaller concerns on a fee basis. In either case the fees are designed to cover only the cost of operation. The equipment of the Medical Department cost 125,000 dollars and

A doctor's office

Physio-therapy department

was installed under the able direction of Francis H. Glazebrook, M. D., F. A. C. S., as Medical Director.

All employees are examined when they enter the service of the Stock Exchange, with annual examinations thereafter. The same advantages are offered the member firms. The plant includes a chemical laboratory, X-ray laboratory, electro-cardiograph, physiotherapy, and dental departments. Dr. Glazebrook has six associate physicians, including an eye and ear, nose and throat specialist, pathologist, and dentist, also nurses and technicians—23 in all besides 11 consulting physicians and surgeons.

AIRPLANES LAND BLIND— GUIDED BY RADIO*

By H. DIAMOND and F. W. DUNMORE

WHILE scheduled air transportation has been immeasurably aided by the provision of radio direction facilities on the fixed airways, interruption of scheduled flying is still the rule whenever the landing field lies in an area that is blanketed by fog. The results secured by the development of instrument flying and of radio navigational aids to point-to-point flying are then nullified through the lack of means for safe landing under adverse conditions of visibility. The rigorous maintenance of scheduled flying by day or night requires the removal of this last great hazard to the reliability of air travel and transportation.

A radio system of blind landing aids, developed in the aeronautics research division of the Department of Commerce at the National Bureau of Standards, gives good promise for the solution of this difficult problem. The results already obtained with this system indicate that it will soon be ready for use under the severe conditions encountered in commercial air transportation. The system has been developed to be adaptable for use in conjunction with the radio navigational aids already being provided for point-to-point flying on the civil airways of the United States.

This system includes three elements in order to indicate the position of the landing airplane in three dimensions as it approaches and reaches the point of landing. Lateral position, given for the purpose of keeping the airplane directed to and over the desired landing-field runway, is secured through the use of a small directive beacon, of the same type as the visual radio range-beacon provided for point-to-point flying on United States airways but lower in power and using small loop antennas. Longitudinal position, to inform the pilot that he has arrived within the boundaries of the landing field, is given by a boundary-marker beacon operating on the same radio frequency as the runway localizing beacon. Vertical guidance is given by an inclined ultra-high-frequency radio beam. This landing beam operates on a frequency of the order of 100,000 kilocycles (three meters), and is directed at a small angle above the horizontal. It is used in such a way as to provide a very convenient gliding path for the landing airplane.

A general idea of the use of the complete system may be had by reference to Figures 1 and 2. Figure 1 is a plan view showing the location of the ground transmitting equipment for orienting a pilot along the desired landing runway, while Figure 2 illustrates the function of the landing beam when used in conjunction with the other elements of the system.

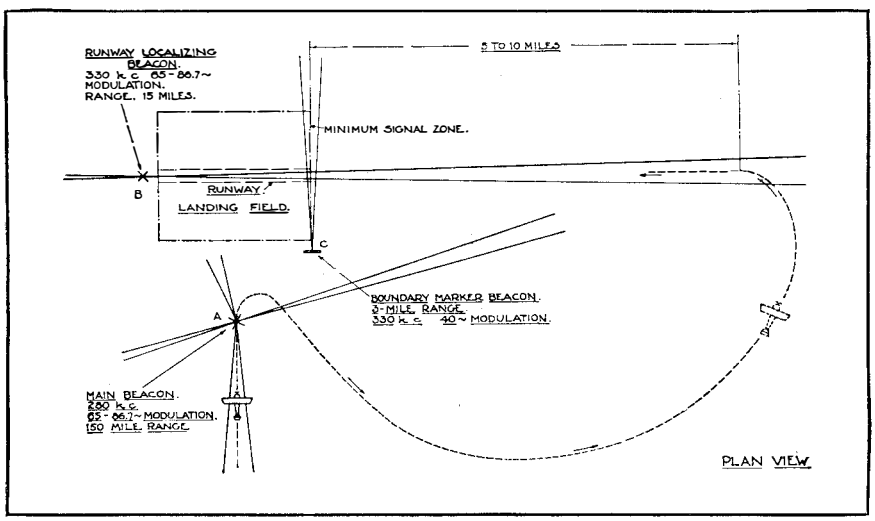


Figure 1: **Layout of ground radio equipment for system of field localization**

REFERRING to Figure 1, the two-kilowatt directive radio beacon with large loop antennas, shown at A, is the main radio range-beacon provided for point-to-point flying on the fixed airways. This beacon is normally located just off the airport (so that the large loop antennas may not constitute an obstruction to flying), and serves to direct an incoming airplane to the vicinity of the airport. A medium-frequency receiving set is used on board the airplane for receiving the course indications from this beacon. Utilizing a sudden cessation of received signal which occurs directly over the beacon tower, it is possible to locate this beacon to within 100 to 1000 feet, depending upon the altitude of the airplane.

Before reaching the beacon tower, the pilot has learned the wind direction at the landing field either through the Government weather broadcast or by two-way radio communication with the ground. Upon receiving the zero-signal indication, directly over the tower of the main beacon, the pilot retunes his medium-frequency receiving set to the frequency of the low-power (200-watt)

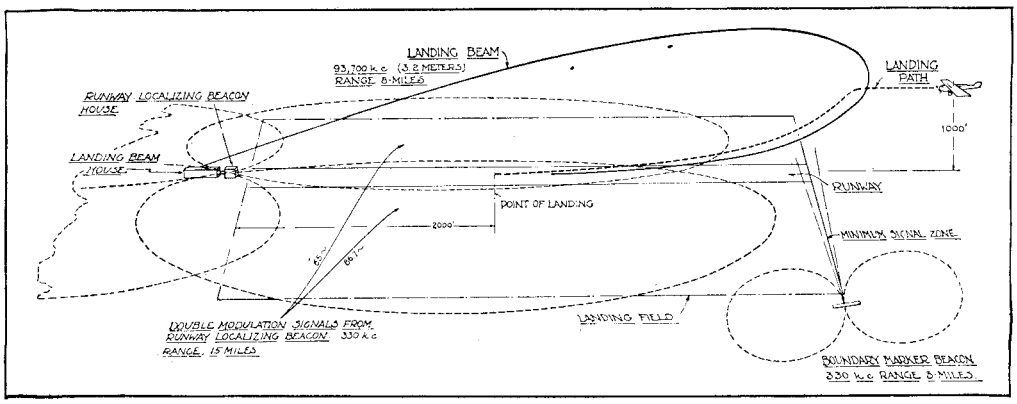


Figure 2: **A three-dimensional view of the system of blind-flying aids**

*Publication approved by the Director of the Bureau of Standards of the United States Department of Commerce.

runway localizing beacon B. This localizing beacon, using small loop antennas so that it may be located at one edge of the field without constituting an obstruction, directs a course along the runway most suitable for landing, under the particular wind conditions then existing.† Knowing the geography of the field, that is, the location of the main beacon relative to the desired runway, the pilot then uses his navigational instrument (such as the magnetic compass) for orienting himself along that runway. The course indications received from the runway localizing beacon greatly facilitate this maneuver. When crossing the boundary of the landing field, a signal from the marker C, operating on the same radio-frequency as the localizing beacon B, is obtained.

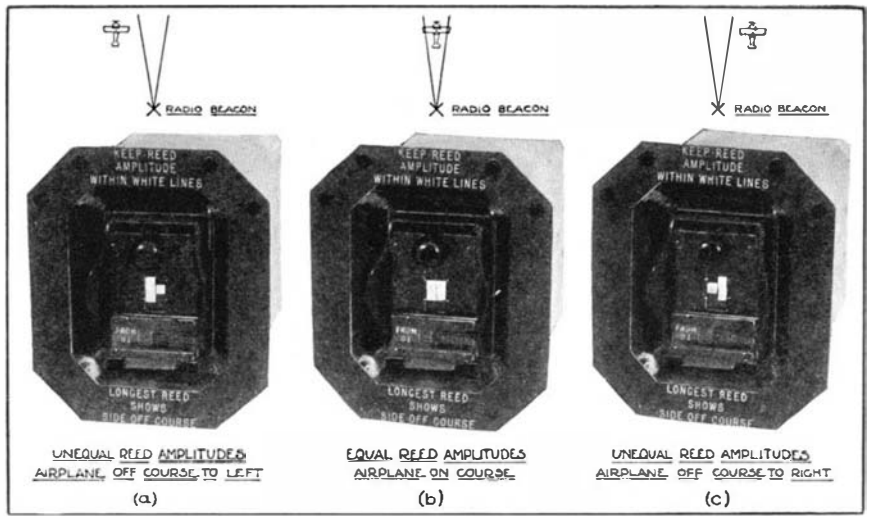


Figure 3: **The tuned-reed visual indicator**

REFERENCE to the three-dimensional illustration in Figure 2 will show how suitable indication of absolute height above ground is secured. The vertical space pattern of the inclined ultra high-frequency landing beam is clearly indicated. The polar pattern in the horizontal plane is about the same as that shown in the vertical plane. The airplane is readily directed approximately along the horizontal axis of the beam by means of the course indications from the runway localizing beacon. It does not, however, fly along the inclined axis of the beam but on a curved path, the curvature of which diminishes as the ground is approached. This path is the line of equal intensity of received signal below the vertical axis of the beam. The diminution of intensity as the airplane drops below the inclined axis is compensated for by the increase of intensity due to approaching the beam transmitter. Thus, by flying the airplane along such a path as to keep constant the received signal intensity, as observed on a meter on the instrument board, the pilot comes down to ground on a curved line suitable for landing. If the airplane rises above this line of equal intensity of received signal, the meter deflection increases, while if it drops below this line the meter deflection decreases.

Several important advantages result from this method of furnishing altitude indication. The pilot following the landing path is automatically kept above obstructions and no longer needs a thorough knowledge of the terrain in order to effect a safe landing. Secondly, the landing path may be of different shape to suit different landing fields. This is of particular importance in getting into a small field. A third advantage lies in the fact that in the act of following the landing path, the pilot automatically "levels off," thereby facilitating a normal landing, albeit somewhat fast.

In following the landing path prior to entering the marker beacon zero-signal zone, the pilot maintains an air speed somewhat above the landing speed of the airplane, insuring complete controllability with some margin to spare. Upon receiving the marker indication that he is passing over the boundary of the field, the margin over the landing speed may be reduced. The landing is therefore made at a speed more nearly approaching the normal landing speed of the airplane. A fourth advantage is that the landing glide may be begun at any desired altitude, within a rather wide range (within 500 to 5000 feet). Thus, referring to Figures 1 and 2, once the pilot has oriented himself in a direction along the runway, at any distance from the landing field, he flies at a convenient altitude, say, 1500 feet, until the landing beam indicator shows a predetermined deflection, at which point he begins the landing glide.

As has already been pointed out, the medium-frequency receiving set normally employed for the reception of the weather broadcast and radio-beacon services is also used for receiving the signals from the runway localizing and marker beacons. The localizing beacon is of the visual type, permitting the use of automatic volume control in its reception. This is quite essential, since the pilot, in making a landing, is con-

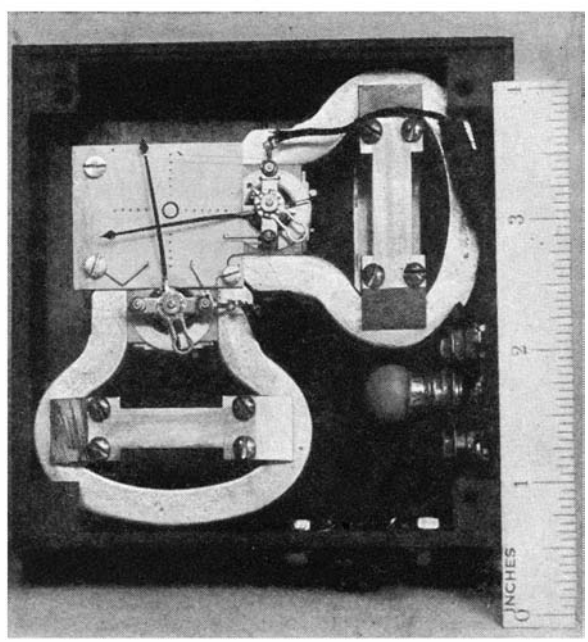


Figure 4: **Combined landing-beam and runway-course indicator; note crossed pointers and lines**

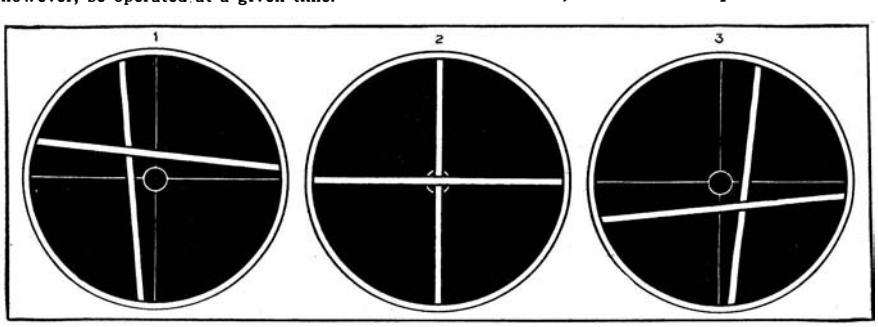


Figure 5: **Diagram of three indications given by the combination instrument shown in Figure 4 above. These show three different positions of plane. See text**

†At a landing field having two runways, perpendicular to each other, two localizing beacons are necessary so that the pilot may always land into the wind. Only one runway beacon will, however, be operated at a given time.

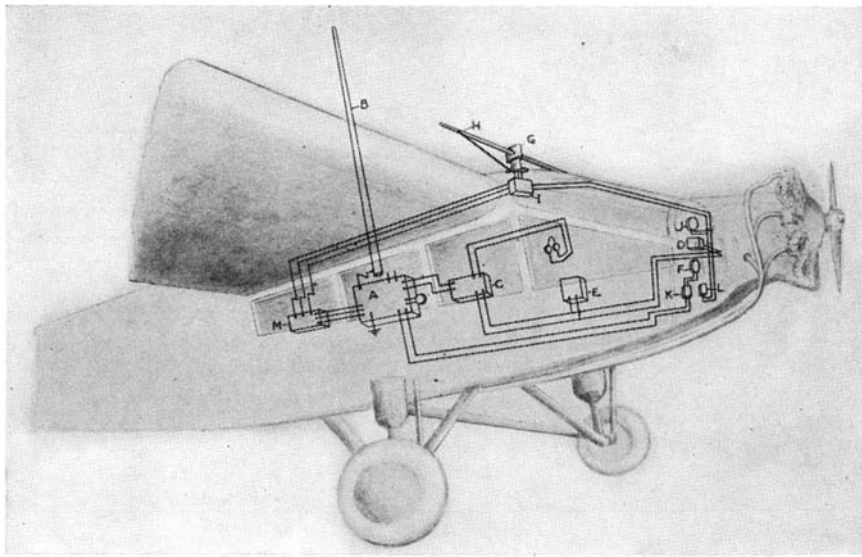


Figure 6: **Complete receiving apparatus for blind landing of airplanes. *A:* Medium-frequency receiving set for voice and beacon signals. *B:* Six-foot vertical pole antenna. *C:* Filter unit for separating voice and beacon signals. *D:* Tuned-reed visual course indicator. *E:* Automatic volume control for beacon signals. *F:* Rough distance indicator. *G:* Landing-beam receiving set detector unit. *H:* Horizontal doublet antenna for landing-beam receiving set. *I:* Landing-beam receiving set amplifier unit. *J:* Landing indicator meter. *K:* Pilot's control unit for medium-frequency receiving set. *L:* Pilot's control and test unit for landing-beam receiving set. *M:* A, B, and C batteries for operating the vacuum tubes**

cerned with so many things that the burden of close manual adjustment of receiving set sensitivity must be eliminated.

Automatic volume control also permits the use of a distance indicator. This instrument consists of a milliammeter in the plate circuit of the radio-frequency tubes of the receiving set, and corresponds to the conventional tuning meter in broadcast receiving sets employing automatic volume control. As the intensity of the received signal increases, the plate current decreases. This instrument may therefore be calibrated approximately in miles from the runway localizing beacon station. Its operation is of considerable assistance to the pilot when circling the localizing beacon (during the process of finding the desired runway), and also in giving the pilot a sense of approach to the landing field, once he has oriented himself along the runway.

AN electrical filter circuit is connected in the receiving set output to direct the 1000-cycle aural signal received from the boundary marker beacon to the pilot's head-telephones, and the double-modulation signal received from the runway localizing beacon to the visual-course indicator. The course indicator may be either the reed indicator type, as shown in Figure 3, or the zero-center pointer type operated by a reed converter in which the deflections of the zero-center instrument are in the direction of deviation of the airplane from the course.

A special ultra high-frequency receiving set is required for the reception of the landing-beam signals. No manipulation of this set on the part of the pilot is required: the tuning is fixed. Since a line of constant intensity of received signal is followed, no control of volume is necessary. The rectified output current from this set is fed to the meter constituting the landing-beam indicator. To facilitate its use, this instrument is mounted on its side so that the pointer moves vertically instead of horizontally. The deflection to be kept constant (corresponding to the desired glide path) is chosen at half-scale reading, the instrument pointer being then in horizontal position. A rise of the pointer above this position indicates that the airplane is above the proper landing path, while the reverse is true if the pointer falls below its horizontal position.

Assume now that the zero-center pointer type instrument is employed for securing runway course indications. This instrument may be combined with the landing beam indicator into a single instrument (see Figure 4), which is much simpler to use than the two separate instruments. Two reference lines are provided on the face of the combined instrument, the vertical reference line corresponding to the position of the runway and the horizontal reference line to the proper landing path. The pointers of the runway-course indicator and the landing-path indicator are arranged so that they cross each other, the former moving to the right or left of the vertical reference line and the latter above or below the horizontal reference line. The position of the point of intersection of the two pointers thus gives, through a single reading, the position of the airplane with respect to the runway and proper landing path.

The instrument indications for several arbitrary positions of the airplane are given in Figure 5. At (1), the airplane is to the left of the runway course and too high; at (2), the airplane is on the runway course and on the proper landing path; at (3), the airplane is to the right of the runway course and too low.

THE runway localizing beacon is essentially a 200-watt, double-modulation beacon. The two loop antennas, crossed at 90 degrees, carry currents of the same carrier frequency but modulated at different low frequencies—65 and 86.7 cycles. These antennas are so oriented that the vertical plane containing the axis of the landing-field runway bisects the angle between the two antennas. An airplane flying in this plane, therefore, receives equal signals from the antennas. On either side of this plane the signal received from one antenna is greater than from the other. On the airplane a visual indicating instrument is employed which indicates to the pilot the relative magnitudes of the signals received from the two antennas and, consequently, the relative position of the airplane with respect to the runway.

The boundary marker beacon operates on the same carrier frequency as the runway localizing beacon, and employs a transmitting loop antenna.

The receiving system on the airplane is as shown in Figure 6. The filter

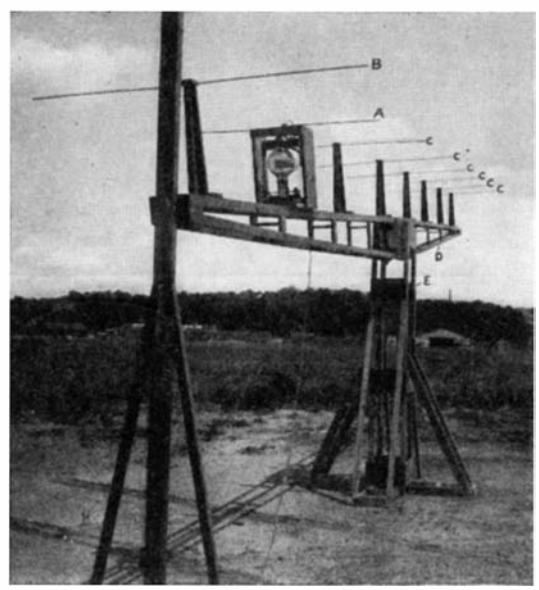


Figure 7: **Landing-beam directive antennas**

unit serves to direct the reed frequencies to the reed indicator or reed converter, and the 1000-cycle marker-beacon signals to the head telephones. The automatic volume control is connected across the course-indicator terminals and, consequently, is actuated only by the localizing-beacon signals.

The landing beam consists essentially of a horizontal polarized beam directed at a small angle above the horizontal, this angle and the degree of directivity being so adjusted that a predetermined line of constant field intensity will mark out just the proper gliding path, clearing all obstructions and convenient for landing. In the set-up at College Park, Maryland, the beam is transmitted on a frequency of 93,700 kilocycles (3.2 meters) and is oriented in the same horizontal direction as the course of the runway localizing beacon.

AN ultra high-frequency was chosen for the landing-beam transmitting system in order to secure the attendant reduction in size and simplicity of equipment. A photograph of the directive antenna array, as set up at College Park, is shown in Figure 7. This is housed in a shed for protection against weather. The ultra high-frequency source (93,700 kilocycles) is coupled to the horizontal doublet, A, (made of ⅛-inch copper tubing), which serves as the radiating antenna and is accurately tuned to the frequency of the source. About 0.8 of a meter behind the radiating antenna is placed a reflecting antenna, B, also a horizontal doublet, tuned to a frequency somewhat lower than the frequency of the source. At approximately every meter in front of the radiating antenna, horizontal-doublet directing antennas, C, are placed. These are tuned to a frequency somewhat higher than that of the source. This array of antennas is supported on

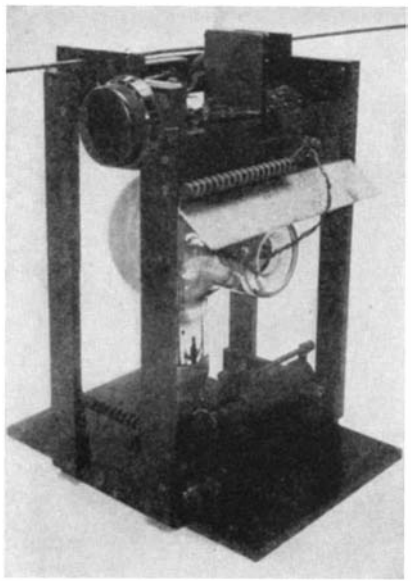


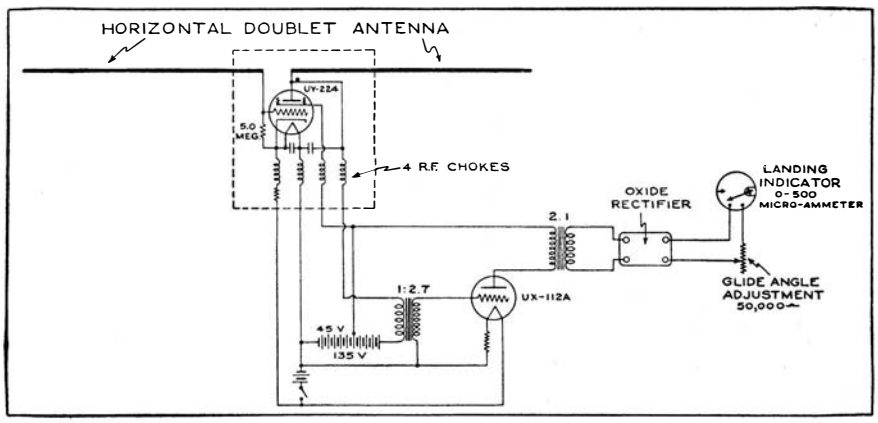
Figure 8: **The electron tube oscillator and doublet sending antenna for 93,700 kilocycle landing beam**

a horizontal wooden structure, D, approximately 2.75 meters above the ground, and pivoted on the vertical support E. To obtain the proper vertical directive characteristic, the wooden structure, D, is tilted approximately eight degrees above the horizontal.

The necessary power output on the high frequency used is secured through the use of a 500-watt three-element electron tube. Figure 8 shows the 500-watt tube and associated apparatus, including the horizontal doublet radiating antenna.

The receiving circuit arrangement (see Figure 9) uses only two tubes without regeneration. This receiving circuit requires no adjustments on the part of the pilot. Even the volume control is dispensed with, since the path followed during the use of the receiving set constitutes a line of constant field-intensity of the directed beam. A 224 heater-type screen-grid tube is employed for the detector, to afford the necessary high amplification without undue microphonic noises. To obtain good efficiency it is necessary to connect the detector tube directly in the center of the horizontal doublet antenna. The radio-frequency detecting portion of the circuit is confined to the section above the four radio-frequency chokes. (See Figure 9.) The four leads running from the lower side of these chokes carry either direct current or the received audio modulation.

The detecting portion of the receiving circuit (within the dotted lines) is



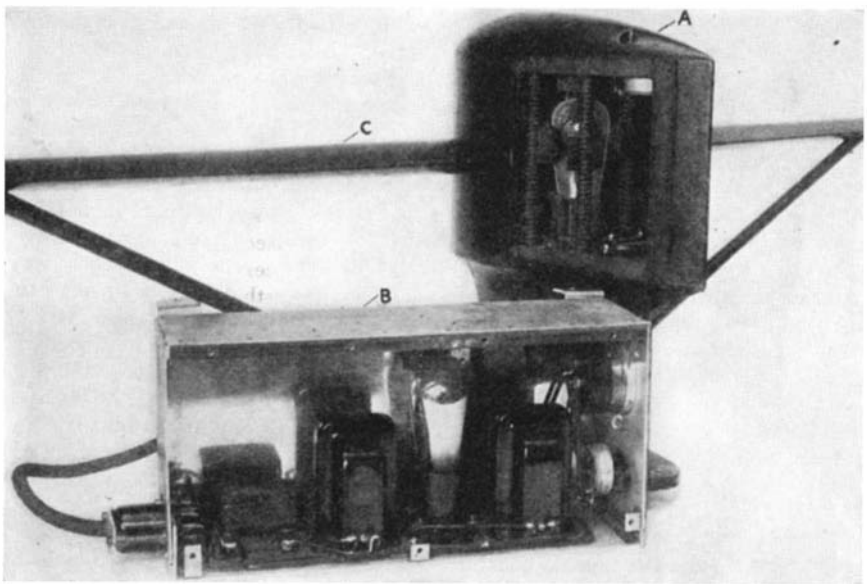


Figure 9, upper: **Landing-beam receiving circuit.** *Figure 10, lower, A:* **Streamlined detector box.** *B:* **Amplifier-rectifier.** *C:* **Doublet antenna. See Figure 6**

external to the airplane, being mounted in a streamline weatherproof box about 14 inches above the top wing. (See Figure 6.) The doublet antenna is in the form of two copper rods housed in wooden streamlined supports projecting from the streamlined detector box. The rest of the apparatus, which includes the audio amplifying tube and transformer, oxide rectifier, A and B batteries, and indicating instrument, are located within the airplane.

Figure 10 shows an inside view of the streamlined detector box. The amplifier-rectifier unit is also shown. The oxide rectifier eliminates one tube, and has been found perfectly stable in its operation at the low frequency employed. The streamlined detector box and antenna system is arranged to plug in electrically to the supporting upright on the wing, a five-terminal plug making the necessary connections.

A SPLINTERED PLANET?

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

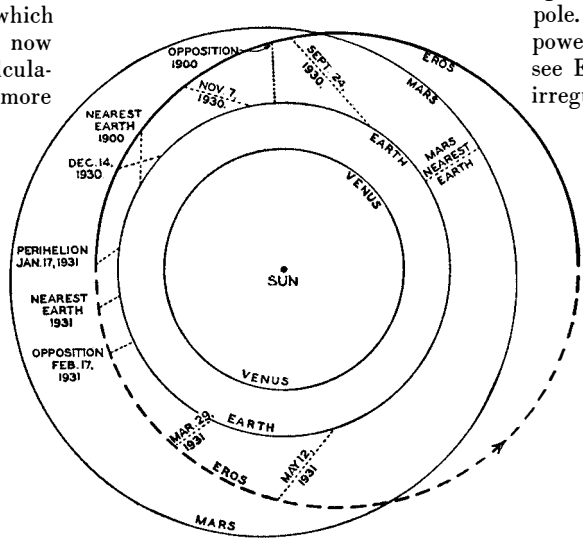
OUR nearest neighbor among the planets, the little asteroid Eros, has come and gone. Last January it was hardly more than 16,000,000 miles from the earth—nearer than any other body which has ever been observed, except the moon and two or three stray comets. By this time it is more than three times as far off and receding rapidly, and it will not come as near us again for more than half a century.

The hundreds of photographs which were taken at many observatories now await the measurements and calculations from which should result a more accurate determination of the planet's distance, and hence of the sun's, than has ever been made before. But this is a huge labor which will occupy years to come. Meanwhile, astronomy has been enriched by direct observations of a simpler but no less interesting sort.

THIRTY years ago, in February 1901, when Eros was also near the earth though not so near as this time, the German astronomer von Oppolzer noticed that its brightness appeared to change from night to night, and even from hour to hour. His discovery set many observers to work and it was quickly found that the variations were large and rapid. In an hour and a quarter the asteroid dropped from full brightness to less than 20 percent, to recover in about the same interval. Further study showed that alternate minima were not equally spaced nor equally deep and that the full cycle was $5^h\ 16^m$, during which the brightness rose and fell twice over, to repeat its changes accurately. Within a few weeks the amplitude of variation decreased greatly and in May the changes were hardly perceptible.

In 1903 and 1905 the variation was again observed, with the same period but smaller range—from $0^m.5$ to $0^m.8$, but in 1907 long and careful observations showed no variability at all. In 1914 the variation was small, $0^m.3$, and in 1916 about the same. In 1919 a large variation of $1^m.5$ reappeared, the planet being four times as bright at maximum as at minimum, but in 1921 the changes again vanished. At the recent opposition they have once more been large, exceeding a magnitude in range.

This seems at first glance a very extraordinary sort of behavior, quite out of keeping with the orderly and reliable progress of astronomical phenomena. But one thing at least has remained uniform: the period of variation has remained constant. The latest determination by Campbell of Harvard is $5^h\ 16^m\ 12^s.94$ and must be correct to a very small fraction of a second.



Courtesy Astronomical Society of the Pacific

Eros has come and gone, now being somewhere near the position of the arrow head in the circle

This indicates that there is really some uniformly recurring process behind the variation. The obvious suggestion that we have to do with a rotation of the planet was made by the earliest of observers and has since been widely accepted. During each rotation there are two maxima and two minima of brightness. This might occur in either of two ways. First, the planet might be spotted in such a way that, as it turned, two light and two dark regions successively occupied the principal part of the visible side. Secondly, it might be irregular in shape. If it were elongated like a cake of soap or a brick, and rotating about one of its shorter diameters, it would alternately appear side on and end on and so change in apparent brightness, even though so remote that no telescope could show it as a perceptible disk, and there would obviously be two maxima and two minima of light in each revolution. The two hypotheses are not inconsistent; the planet may well be spotted as well as elongated, in which case the variation in brightness during a rotation might be complicated with the unequal maxima and minima.

The remarkable changes in the range of variation now find a simple explanation. If the planet's equator is highly inclined to the plane of its orbit—as is known to be the case of Uranus—we, looking from the earth, will sometimes find ourselves above the equator and, again, may be almost in line with the pole. In the latter case, even if we have powerful enough telescopes, we would see Eros as a spotted disk, perhaps of irregular shape, turning round and round its own center but always keeping the same side toward us. There would obviously be no changes in the total amount of light which our telescopes received and if they were not large enough to define the outline of the disk it would look as though nothing were happening.

WHEN the earth lies in the plane of the planet's equator we will see all sides of the latter in succession as it rotates, and get the full benefit of any changes in brightness arising either from irregularity of shape or variations in the diameter of the surface. For intermediate angles of view we will find a gradual change in the range of variation. The effect will always be zero for the observer above the poles but need not necessarily be a maximum for one in the equatorial plane, and of course the brightness of the planet seen from the same distance above its north and south poles may be quite different.

The high eccentricity and inclination of Eros' orbit make its apparent motions in the heavens more varied than those of any other planet. During the last few months, for example, instead of moving east and west like the more conventional planets, it has swept far to the north into Ursa Major and plunged rapidly southward into Hydra. These great changes in the direction of the planet from the earth, or of the earth from the planet, afford exceptional play for the effects which have just been discussed and it is therefore no longer surprising that its variations seems so erratic.

From observations at a sufficiently large number of oppositions with Eros in various parts of the heavens it should be possible to work out the position of the planet's poles and equator. This done, it remains to study the shape of the planet and the spots upon its surface. Here an exact solution cannot be hoped for, since it is often impossible to disentangle the effects of shape and spottedness. It may be proved, indeed, that if we were given any convex body of whatever shape, spotted and, for that matter, colored in any arbitrary pattern, it is possible to take a smooth sphere and paint its surface with a pattern of such brightness and color that, if the two bodies were set up side by side, illuminated equally by the sun, and viewed from a great distance, they would reflect equal amounts of light of the same color, no matter from what direction they were viewed or from what direction the sun's rays struck them. Photometrically they would be indistinguishable, and this is true not only when the spherical body appears like a full moon but when it appears as a half moon or even a narrow crescent. It might seem, then, that there is no hope at all of determining the shape, but if this is so irregular that one part of the surface may eclipse another, as seen from the earth, or shade another from the sun's rays, the resulting light variation may be such that no possible painting of the surface of the sphere could reproduce it.

TO determine from measures of brightness alone whether this was the case, and deduce as much as one could about the planet's shape, would be a difficult problem. Fortunately the recent close approach of Eros provided a solution by the simple process of looking at it directly with a large telescope.

Van den Bos and Finsen, with the 26½-inch refractor at the Union Observatory of the South African Government at Johannesburg, noticed early in February that the disk of Eros was not circular but definitely elongated, so that the planet looked like a very close double star not fully separated. An hour's observation indicated that the position angle of this elongation was rapidly changing, and further watching showed it progressing till a complete revolution was made in a little more than five hours. A fortnight's observation showed the elongation and the rapid rotation continuing whenever the state of the sky and seeing permitted accurate observation, and sufficed to fix a rotation period as 0.2195 days or $5^h\ 16^m$, agreeing exactly with that of the light variations. This proves beyond a doubt that Eros is not spherical like the larger planets but of elongated shape, and that a part at least of the observed variation in light arises from this fact. The longer diameter of the disk, according to the South African observers, was about 0″18. Since Eros was 16,300,000 miles from the earth, this corresponds to 14 miles.

This quantity probably represents the difference between the longer and shorter diameters. The average diameter may be estimated roughly from the light reflected by the planet, and comes out about 20 miles if we assume a low reflecting power like the moon's, or ten miles if Eros has a high albedo like its sister asteroid Vesta. The great range of brightness which has sometimes been observed, corresponding to a ratio of more than 4 to 1, indicates that the actual elongation is probably of this order. The assumption that Eros is about 20 miles long and 5 miles wide and thick would reconcile the data, provided that the reflecting power of the surface is high. This is of course only a provisional estimate. When the observations of the past opposition are fully worked up and supplemented by a study of those of earlier years we may learn a great deal more.

The investigators who deal with the problem may have plenty to do, for the rotation of a body of irregular shape is not a simple matter. The axis of rotation may shift, both within the body and in space, and the angular velocity of rotation is not uniform. If these complications are present the interpretation of the light curves and their changes will demand keen mathematical skill and be just the thing to tempt the enthusiast.

MEANWHILE we may wonder how a planet, even a small one, could have so extraordinary a form. Large bodies such as the earth must necessarily be almost spherical or, at worst regularly flattened toward the poles by their rotation. In such masses the gravitational forces in the interior are so great that they would crush the hardest rock and make the stiffest metal yield. A body of irregular shape thousands of miles in diameter would slump under its own weight like a mass of tar on a hot day, until its surface had become almost uniform. But in the case of a small asteroid the gravitational forces are less than a hundredth part as great, while the strength of the materials is the same, and an irregular form, once in existence, should endure.

But how did Eros get its shape? If the planets were formed by cooling and condensation from incandescent matter ejected from the sun one would suppose that each one had finally solidified from a liquid state in which it must have been nearly spherical.

Seeliger, shortly after the discovery of the variation of Eros 30 years ago, suggested that the planet was but a fragment of an older and larger asteroid, split off by a collision with another asteroid at some incalculable date. The asteroids are so small that collisions between them must be very rare, but it is certainly possible that such an event may have occurred. The unusual orbit of Eros, so much smaller than that of any other asteroid, fits in with this hypothesis, suggesting that this particular fragment flew off from the collision in such a way that its motion around the sun was slower than before, making its orbit smaller and bringing its perihelion in close to our orbit.

Similar though less striking variations in brightness have been detected in several other asteroids and a full study may help toward an understanding, not only of the nature of these small bodies, but of the origin of the solar system.—*Princeton University Observatory.*

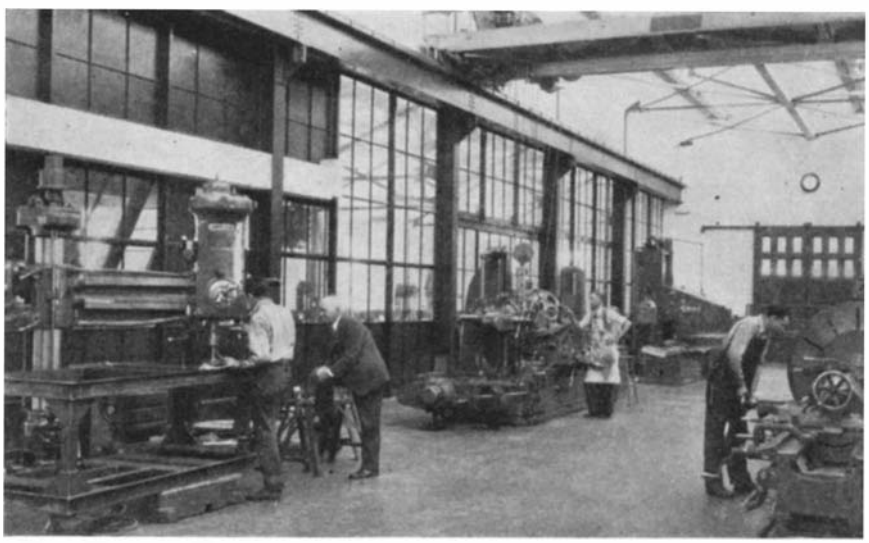


Photo by Oscar S. Marshall

One corner of the recently erected machine shop of the new Astrophysics Department at the California Institute of Technology. In the foreground is Russell W. Porter, who had much to do with its design. The optical shop in which the 200-inch disk will be ground is not yet erected and for other reasons readers may discount stories of the telescope's completion "within two or three years"

THE NATIONAL AIRCRAFT SHOW

By PROF. ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

THE aircraft industry, bent on retrenchment like so many other industries, decided to have but one show this year, the one which has just terminated at the Detroit Municipal Airport. The decision was fully justified. Instead of a number of scattered and uneven efforts, there was one concentrated drive to show the American public what the aviation industry is doing—besides breaking records. The attendance was enormous: 81,000 people paid for admission during the nine days of the show. The public was keen, well informed, and critical but interested. Eighteen percent of the visitors were children under 14 years of age, mostly boys, who collected vast quantities of catalogs and leaflets, asked more intelligent questions than their elders, got in everybody's way, opened and shut all the cabin doors, pulled all the handles and switches they could, generally had a glorious time, and determined to become famous aviators.

In spite of the pessimism from which aviation people are suffering, flying does grow. A total of 505 pilots registered in the "arrival" column of the airport register. On one day 256 landings and take-offs were chalked up.

An aircraft show is not as clearly directed to the public as is an automobile show. From a business point of view, the attendance of dealers, flying school operators, and others professionally engaged in aviation is even more important, and from this point of view, also, the National Aircraft Show was a pronounced success. There were real sales! Seventeen of the 41 airplane manufacturers who exhibited, reported orders for 636 airplanes, valued approximately at 1,652,751 dollars—a figure probably never equaled on any similar occasion.

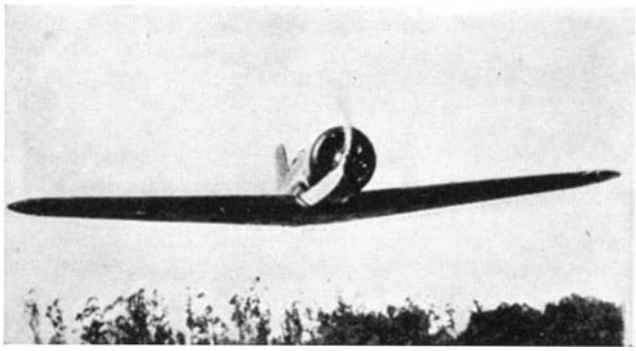
The industry is chastened, deflated, but on the whole sound and confident. The reasons are not far to seek. There are more and better airports, many rapidly growing transport lines for mail, freight, and passengers. Competition has largely eliminated the smaller manufacturers of planes, and the survivors have a higher standard of excellence in their products. Finally, the American public can now buy better planes, cheaper planes, and a greater variety of planes.

One of the great automobile manufacturing corporations proudly states in its advertising that it has an automobile for every purse, and lists a number of types, sizes, and prices. The automobile, however, is strictly limited in size and general characteristics—four wheels, a wheel base with certain limitations, roads which do not permit extension of weight beyond a certain figure. In the airplane the number of different types is far greater, because no such limitations exist.

A YOUNG man who has secured his private pilot's license, and feels that he really must have a plane at the local flying field can purchase a small single seater, equipped with a modified motorcycle engine, at an expenditure of less than 1000 dollars, and have a reasonable sport plane at his command. If he wishes to spend 300 to 400 dollars more he can buy a single seater powered with a 45 horsepower engine which will do close to a hundred miles an hour. If he wishes to retain sociability when flying, he can at an expenditure of 1500 dollars purchase an excellent two-seater in which he can offer original and thrilling hospitality to his friends, at a cruising speed of 80 miles per hour. In all three purchases, his maintenance costs will be reasonable, particularly if he is willing to do a little mechanical and inspection work himself.

For 2500 dollars or so, it is possible to get a snappy sport trainer, with an engine of between 75 and 90 horsepower, in which well over 100 miles an hour is obtainable, and with a fuel capacity more than sufficient for cross-country work.

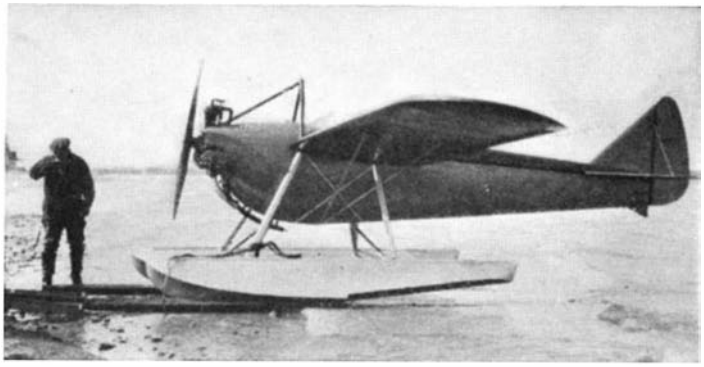
Flying—on the ground! A novel training device that climbs, dives, stalls, and banks, but "keeps one foot on the ground"



The Lockheed Orion, with landing gear retracted. With full load, this plane can fly at 219 miles per hour

The low-wing Northrop Alpha, with accommodations for six passengers. The pilot's open cockpit is in center

The tiny Heath Parasol plane, one of the smallest in use in America today. It carries only the pilot



The Bull Pup, equipped with pontoons, is an ideal light sport plane for use where water landing places are readily available

Bringing in a Heath Center Wing with "hands off"

Just another few hundred dollars and the flying enthusiast can be the proud possessor of a completely equipped two or three seater, with enclosed cabin, every comfort and accessory, including all instruments, heating, lighting, brakes, and so on.

For a little under 6000 dollars, a well-to-do individual or an enterprising business house can purchase a four-seater sedan, with 200 horsepower to drive it through the air at say 120 miles per hour, which will be the last word in comfort, equipment, and strength. Two- and three-seater amphibions which make the owner free in the air or on land or water, can be purchased within the same price range.

Luxurious air yachts, giant transport planes, sport planes which approach the 200 mile an hour mark, freighters, not of such interest to the general public, but of supreme importance to the air-line operators, give the American airplane a scope and utility which would have been unbelievable four or five years ago.

HERE is what the Heath Parasol, a small plane equipped with a modified motorcycle engine and selling at a price within the reach of a moderate purse, can do: Landing speed 28 miles per hour, high speed 85 miles per hour, with only 27 horsepower at 2700 revolutions per minute. The over-all span is 25 feet, the length 17 feet. A single seater such as this is really handy. The builders of the Heath Parasol have now brought out another small plane with cantilever wings. The pilot is bringing it in, hands off, and having lots of fun if our photograph tells the story.

The Buhl Bull Pup, another small single seater, with 45 horsepower in its Szekely three-cylinder engine, is a three-in-one plane. It can be purchased with beginner, intermediate, and advanced wings, of progressively decreasing area. The beginner can practice with the largest wings which allow him to land very comfortably and slowly. As he becomes more expert he can pass to the intermediate wings, and when practice has made him perfect he can use a set of clipped wings and race at over 100 miles an hour with his tiny craft.

The air flivvers have even put on sea legs. One of our pictures shows the Bull Pup with a pair of small floats. Only a rudimentary beaching rig is required for such a light seaplane, well under a thousand pounds in gross weight, and nothing could be a better medium for thrilling yet safe sport. That the public is interested in the small plane was demonstrated by the many sales of this type.

One of the hindrances to private flying is the comparatively high cost of flight instruction. The Department of Commerce now insists on a ground course and on 10 hours solo flying (solo generally comes after six to eight hours' dual instruction) before granting a private pilot's license. This may mean an expenditure of as much as 500 dollars. Therefore a number of ingenious schools and instructors are reverting to the old days, when part of the instruction was given on "penguins," machines with clipped wings, in which a student could taxi rapidly over the field, learn to control his engine, to make turns, and so on, without actually getting off the ground. A number of different devices for ground training have appeared lately; "trainer," "orientator," "coordinator" are the various terms employed for such apparatus.

Visitors to the show, just before entering the tent outside the main hall, were tempted to get a quarter's worth of entertainment and instruction in the ground trainer shown in one of our photographs. The ground trainer is a fairly accurate reproduction of an actual airplane, complete with ailerons, rudder, and elevators, centrally mounted on a ball-and-socket joint, and provided with a propeller driven by a 10-horsepower electric motor. It is much harder to keep one of these devices on an even keel than at first appears, and the craft *will* persist in diving, stalling, or banking sharply. Our readers are advised to try their skill on such a trainer at the very first opportunity!

THE Lockheed Orion in flight, with its landing gear retracted, makes a wonderful impression. Wings, without a single external brace, blend gracefully into the streamline fuselage. The two-place open cockpit scarcely breaks the upper surface of the fuselage. Around the engine is a Venturi cowl reducing the engine's head resistance to a minimum. The Orion can carry 50 cubic feet of mail or express at a top speed of 219 miles per hour; fully loaded it can cruise for 840 miles at 185 miles an hour. The engine is a supercharged Pratt & Whitney, delivering 450 horsepower at 2100 revolutions per minute.

While this is being written, crack pilots of the British Royal Air Force are grooming their Schneider Cup racers over the waters of the south of England to do 400 miles an hour next September. The racers lead, but commercial designers try to bridge the gap as quickly as they can. An overnight service from New York to Los Angeles is not many years away.

Even in luxuriously appointed cabin planes, phenomenal speeds are being

Harold F. Pitcairn, shaking hands with President Hoover, on the occasion of the landing of an Autogiro on the White House lawn. Collier Trophy on center stand

obtained. The Northrop Alpha is a beautiful ship, streamlined to the last degree, which can carry six passengers in the utmost comfort, at a speed of 185 miles per hour. The Alpha also points the way in sound, heat, and cold insulation, and in the smooth metal covering of its entirely metallic wings and fuselage. American designers are now finding it possible to displace wood, to have a perfect metal surface instead of rough fabric on their planes, and also to make the thin metal skin, some 15 thousandths of an inch in thickness, give its share of structural strength.

ANYONE who has seen a Ford tri-motor (such as the craft permanently exhibited in the waiting room of the Pennsylvania Station in New York City) will have remarked that the metal covering of wings and body is corrugated. Such semi-circular corrugations are intended to give local strength, but naturally they also mean a little more air resistance. The Ford Freighter, like several other modern craft, has a covering of flat sheet dural. Designers give stiffness and strength to the cover by internal stringers or braces, and thereby make their planes both faster and neater in appearance. The pilot's cockpit, with sharply pointed windshield, is at the front just behind the engine.

The Ford Freighter has a span of 70 feet, and with a 600 horsepower, water-cooled Hispano-Suiza engine, it can cruise at 110 miles per hour, although the freight capacity is about 2000 cubic feet.

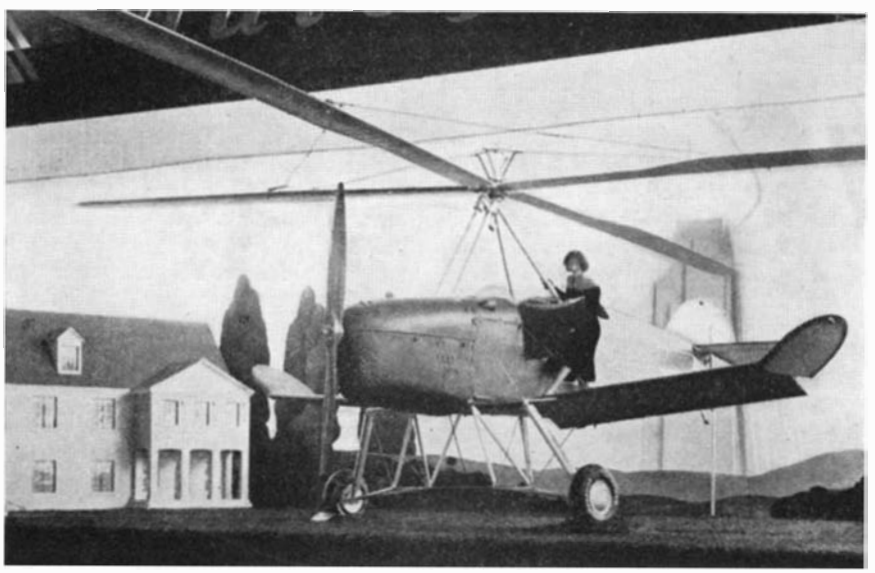
Three days after the end of the Detroit Show, an Autogiro piloted by James G. Ray landed on the south lawn at the White House, just before President Hoover presented the 1930 Collier Trophy to Harold F. Pitcairn for the greatest achievement of the year in American aviation, namely the engineering development of the Autogiro. The space on which the landing was made is only 300 feet in length by 100 feet in width. Ray circled the White House twice and then landed without the slightest difficulty, stopping after a run of 50 feet or so. It is achievements such as this that have convinced the public of the possibilities of the Autogiro for private flying. At the show, visitors exhibited intense interest in the two beautiful exhibits of the Autogiro Company of America. Our photograph shows the smaller of the two models exhibited, the PAA-I, a two-place, tandem cockpit machine, driven by a 125 horsepower air-cooled engine. We have had occasion to describe the Autogiro rather fully in a previous issue, but this photograph gives an exceptionally clear idea of the general appearance of the craft.

IT would carry us too far afield to describe all the splendid engines exhibited by some 18 manufacturers. Aircraft engines are constantly increasing in power for a given weight, and in reliability and endurance, but no radical innovations or changes were in evidence at the show. It was rather surprising to see but one water-cooled engine in the whole vast hangar, the one installed on the Ford Freighter; all others were air-cooled.

A great many of the medium powered engines were of the inverted in-line type. As shown in our photograph of the Autogiro, the in-line inverted type gives the front end of the fuselage a very clean appearance with maximum vision for the pilot.

While much experimentation is going on quietly on the aircraft Diesel, only two engines of this type were exhibited—the Packard and the Guiberson. The advantages of the aircraft Diesel in its ability to use economical, heavy fuel oil have often been dealt with. These advantages assure a bright future for the type. The Packard Diesel is giving a good account of itself in various long flights. A recent improvement in the Packard, of rather too technical a nature to be dealt with briefly, allows the Diesel to be throttled down just like the gasoline engine. This is of inestimable advantage to the pilot in landing.

The dictates of the Editor have made us keep this story short. We have glossed over many examples of the aircraft builder's art, many wonderful devices. Perhaps the reader will be moved to visit the next aircraft show for himself! Such a visit will be well worth while.



A moderate power Autogiro in an exhibition booth at the National Show

THE BIBICAL DELUGE A FACT*

By DR. STEPHEN LANGDON
Director of the Oxford Field Museum Expedition at Kish
Professor of Assyriology at Oxford University

THE remarkable results of the Oxford-Field Museum Expedition to Kish in 1929 have already been communicated to the public. In this article I am able, after having studied the detailed reports of the various members of the staff, to place at the disposal of scholars an accurate survey of the only series of stratifications of a city whose history was continuous from the beginning of history right down to the Parthian period.

In the center of the illustration at the right, accumulated water is shown. The excavators sank a shaft eight feet square at this point nine feet to virgin soil. Now it is only from the top of this shaft—in other words, 25 feet below the pre-Sargonic period of the red stratum (*circa* 2900 B.C.)—that painted ware is found. It is absolutely impossible to date this period after 3000 B.C. Below the flood level to water level, through 15 feet of débris, there is a continuous civilization, marked by different types of pottery. It is impossible to date the age of any of the painted ware later than 4000 B.C., and the beginning of this city later than 5000 B.C., and perhaps much earlier.

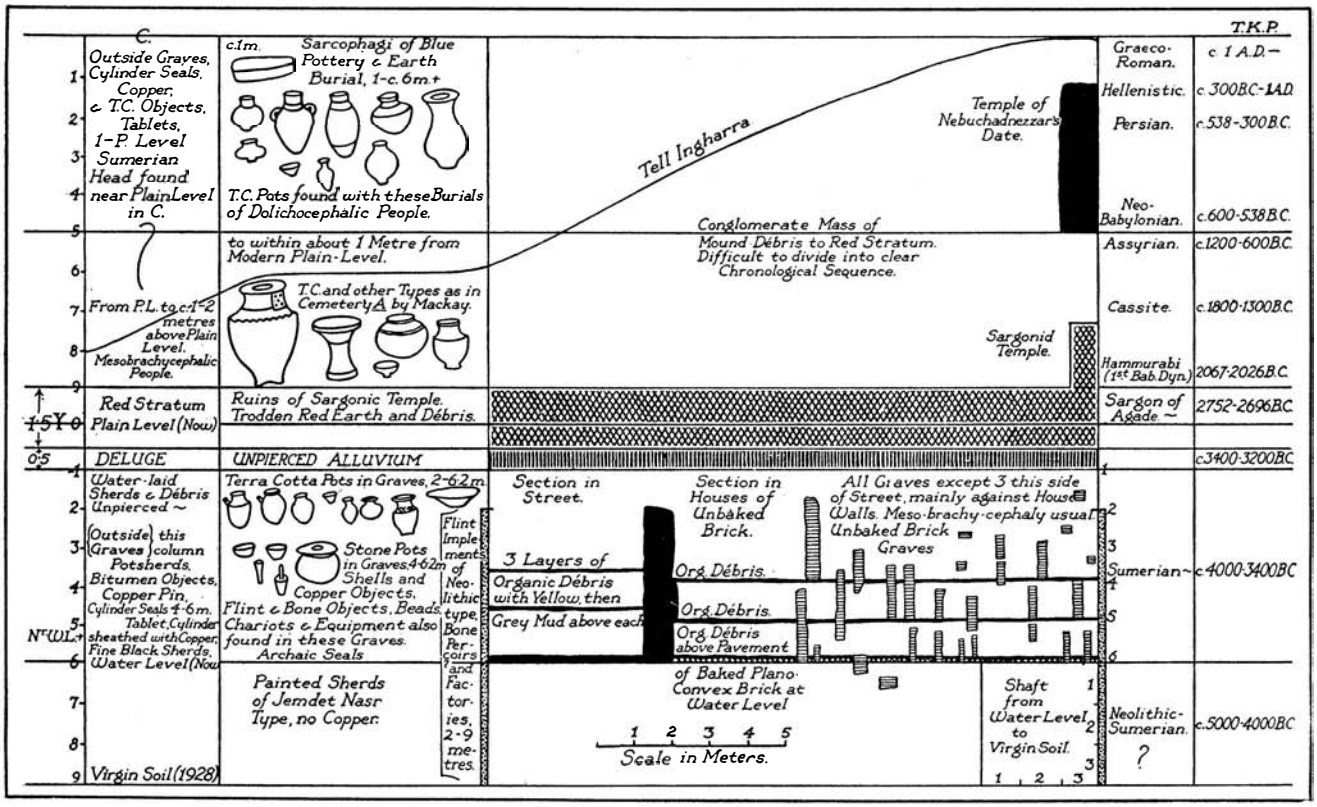
Geological survey may prove that this Flood, on which were founded Sumerian, Babylonian, Assyrian, Aramaean, and Hebrew stories, extended over a greater area of the valley below Kish—for example, at Shuruppak, where Xisuthros built his ark and saved his family from the Deluge. However this may be, the Flood destroyed Kish, and certainly all the great cities of Sumer, which were all on the Euphrates. It was a local riverine disaster, but the civilization above the flood stratum is continuous with that below. There are differences, but these are due partly to the disaster itself, partly to the increasing domination of the Semitic race.

●

The erroneous conclusions on this subject that have been drawn elsewhere, and the length of time before any detailed report will be available, render Prof. Langdon's article welcome.—The Editor.

Excavations at Kish corroborate Flood traditions. Alluvial stratum tells of inundation of city not later than 3200 B.C.

*Abridged from *The Illustrated London News*.



The Deluge stratum in a vertical section of the Kish excavations, with approximate dates. Plan of the stratification drawn by Mr. C. L. Watelin, head of the excavation staff and Mr. T. K. Penniman, anthropologist. Scale at bottom is in meters

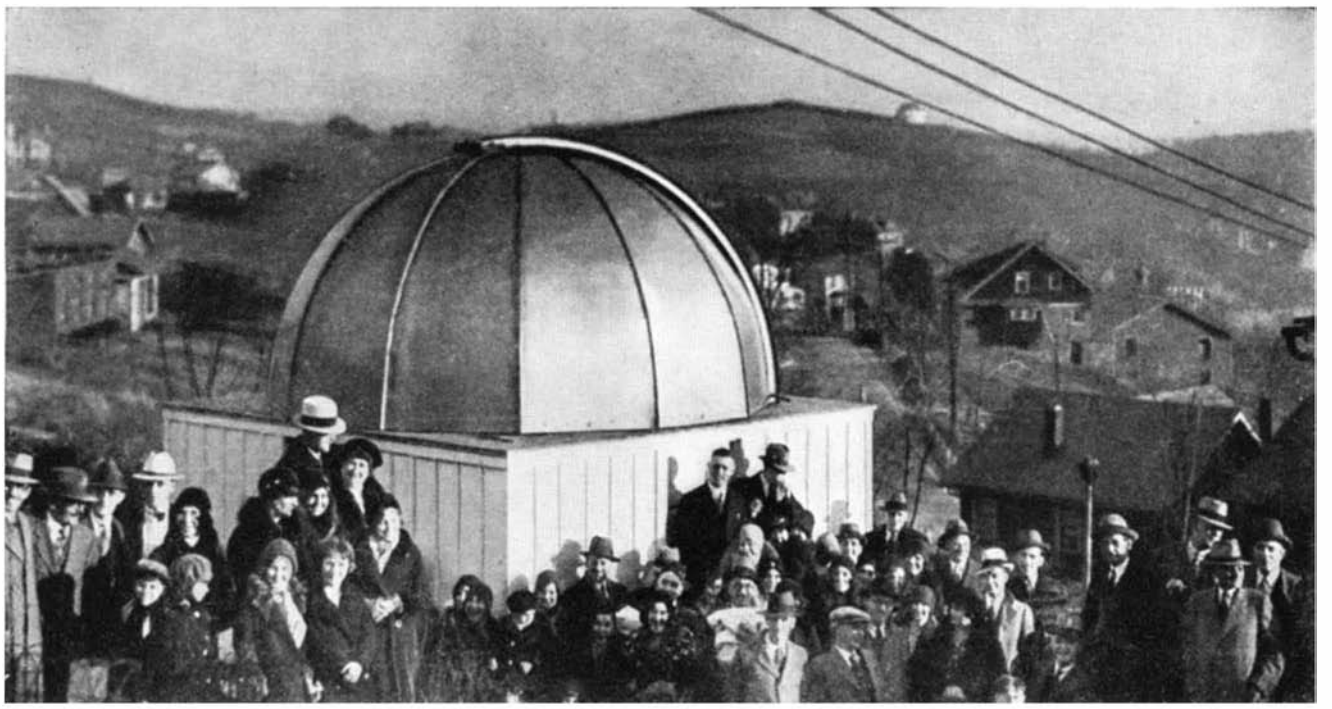


Figure 1: When the observatory was completed the neighbors all wanted to inspect it, so a formal dedication was held

AMATEUR ASTRONOMY IN PITTSBURGH

HOW an enthusiastic group of Pittsburgh amateur astronomers, after making their own astronomical telescopes, set out to construct an observatory for their common use, is narrated by Leo J. Scanlon, secretary-treasurer of the Astronomical Section of the Academy of Science and Art of Pittsburgh in an informal communication to the editor.

Some time ago Mr. Scanlon completed a ten-inch reflecting telescope, and mounted it near his home, with the expectation of finding amateur star-gazing an unalloyed pleasure. It soon turned out, however, that the dazzling street lamps of the city interfered with the comfort of this form of outdoor sport, for the eye of the astronomer, before it can function efficiently, must become adapted to the dark and the effect of strong outside illumination is to close the pupil and render the seeing unsatisfactory. "We found," says Mr. Scanlon, "that painting the nearby street lamps black where it did the most good, was no more effectual than their complete annihilation with an air gun, as the lighting company displayed remarkable zeal in changing the doctored globes the following morning.

"A screen of building board was next erected around the telescope and this helped, but it did not eliminate the glare of more distant lamps. The upshot was the proposal to build an observatory which would keep out the extraneous light and also serve as headquarters for our group of amateur astronomers. All we needed, anyway, was a fair excuse to do this, just for the fun of it.

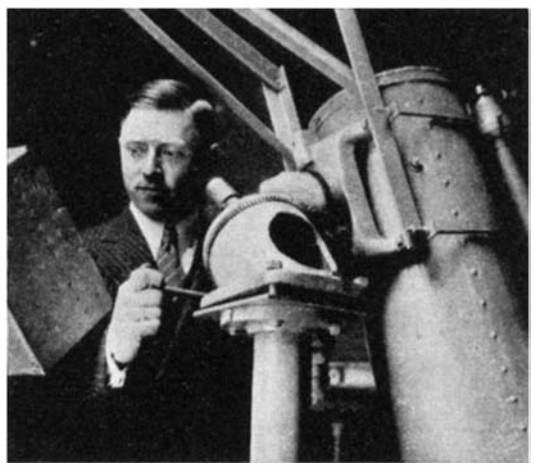


Figure 2: Amateur astronomer Scanlon near the eyepiece studying a variable star chart at left

"We speedily completed the plans, made lists of materials, inveigled a local lumber dealer into giving a five percent discount (in the name of the advancement of science) and the makings were on the spot the following Monday morning.

"That evening we laid out the floor joists and bolted them to the concrete foundation slab, upon which a ten-inch reflector had been mounted several months previously. The next evening the studding rose rapidly under the saws and hammers of a dozen willing workers (Figure 3), and just about the time the neighbors began to complain of the din far into the night, all the wooden parts of the observatory were completed.

"A piece of one by one and a quarter inch angle-iron of suitable length was curved to the predetermined radius, and this circle (Figure 4) was attached (Figure

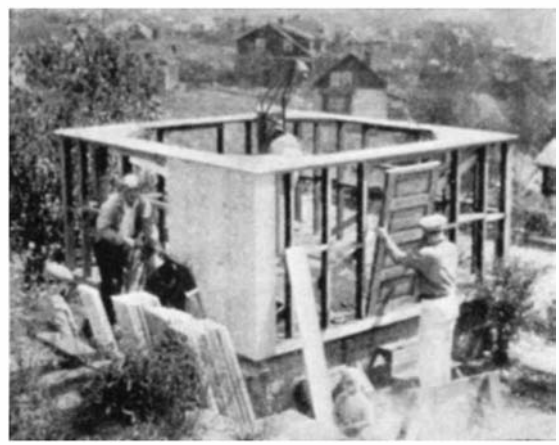


Figure 3: "The studding rose rapidly under the saws and hammers of a dozen willing workers"

5) to the woodwork of the square observatory building, the corners of the roof being of course filled in. This served as a fixed track on which the dome was to revolve on rollers.

"We borrowed an electric drill and drilled all the holes in the two-inch angle iron base for the dome proper, and this then had to be bent quite accurately to the shape of a 12-sided polygon, or dodecagon (Figure 6). The web of the angle iron was notched at predetermined intervals, and bent by hand to an angle of 30° at each cut. A welder closed the joints of the angle iron at these notches, after which 12 two-inch rollers, having deep flanges on both sides, were attached to the dodecagon, and as the same photograph shows, it was then hoisted aboard the observatory. It was checked for fit with the track, and found to be true, so it was given a coating of aluminum paint as a protection from dampness.

Figure 5: **The circular track was permanently attached to the top of the wooden structure**

"When dry, we began attaching to it the tapered aluminum sheets, (Figure 7) previously cut to size, which were to constitute the dome itself.

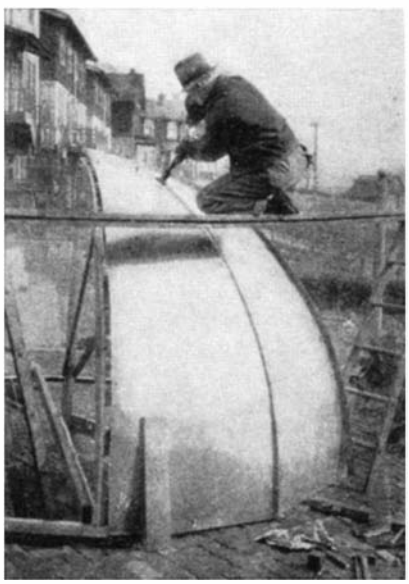


Figure 7: **The iron polygon shown in Figure 6 was dismounted and the gores were attached one by one**

Aluminum bolts and nuts were used in this process to prevent electrolysis. To assist in curving the sheets to the proper radius, a rigid wooden form was built to fit inside the dodecagon and was placed under each sheet as it was added to the dome.

"Dealers in aluminum sheets were skeptical concerning our hoped-for rigidity of the metal dome, as we planned to omit all forms of internal bracing and let the curved sheets stand for themselves. The dealers predicted that the dome would wiggle like a hula-dancer. As we shall see later, it didn't.

"When we laid out the gores we first calculated the width of the finished gore at each five degrees up along the sector; that is, we figured out 17 separate widths from butt to tip. Thus we knew to a whisker the finished width of each sheet. The sheets as received from the dealer were 40 inches wide and ten feet long before cutting, and we allowed additional material along either edge of the finished width for the seam.

"A simple seam with capping strip riveted on was originally planned, but experts in this field from the Aluminum Company of America advised that the expansion and contraction of the metal would eventually enlarge the rivet holes. We thereupon decided to use a double-turned seam such as is used on tin roofs. The turn-ups were made with a special tool which I made from a pair of blacksmith's tongs and two pieces of scrap angle iron. Later when the sheets were being assembled, these standing parts were double-turned, giving an interlocking joint which added materially to the strength of the dome, having almost equal strength with that of an angle brace of similar dimensions, at the same time giving a perfectly smooth dome inside, without obstructions.

"After the first gore had been bolted to the base and bent over the wooden form, the latter was moved to the next position and the second sheet bent over the form. The seam between the two was held by "C" clamps until the turning operation was completed. It took three of us four hours to fasten and seam the first two sheets, and then we gained speed after a routine had been developed, finishing the dome at the rate of an hour a section. We worked several evenings at this.

"The wooden arcs for the shutter

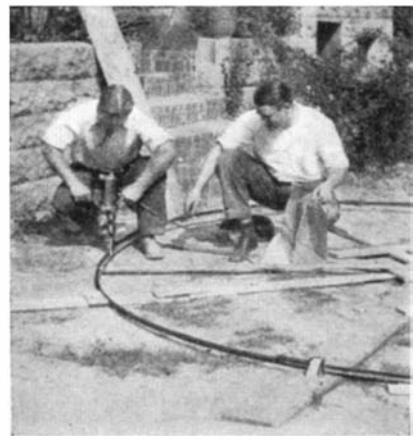


Figure 4: **The fixed track of angle iron, after being bent, was drilled**

framing and sides of the slot covers were cut to size, and the sheets of aluminum for the covers were bent around them and fastened with copper nails.

"After all of the aluminum sheets were joined together, we had a complete hemisphere. The writer clambered up on top (Figure 8) in order to see how much 'hula-dancing' the dome would do, as per prediction. The dome did not live up to the prophecy. We believe a dome of much larger size could safely be constructed in a similar manner without sacrifice of rigidity.

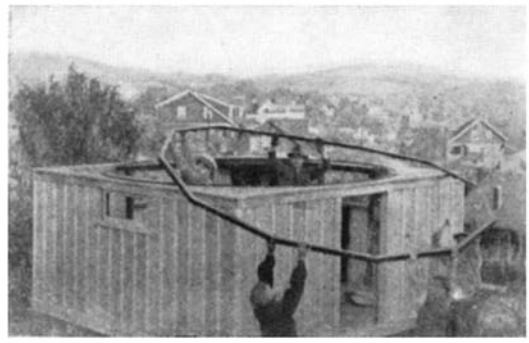


Figure 6: **A 12-sided iron figure, with rollers attached, was built for the bottom of the dome**

"Cutting out the opening for the shutter (Figure 9) was as easy as clipping coupons from an eight percent bond. The coaming was added and that part was then complete. The next Saturday afternoon we had a neighborhood 'barn raising.' Eight of us picked up the dome bodily, walked it up three flights of garden steps and on up by way of two planks until it was spotted over the observatory building, (Figure 10) when it was lowered on the track. It was now in position, and it actually revolved. We knew it would, but nevertheless we had to let out a cheer when we saw that all was well and that everything worked as planned.

"With some sash cord and awning pully blocks, we rigged the means to open and close the shutter, both sides simultaneously. There is a two and one-

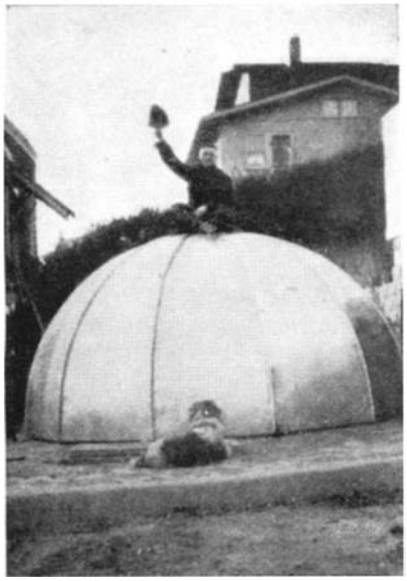


Figure 8: **"Climbed on top to see how much hula dancing it would do"**

half inch lap on the shutter joint, which makes it weather-tight and seaworthy.

"The movable dome does not exceed 250 pounds in weight, and it can be rotated easily with half a hand. The inside of the dome was given two coats of blackboard black, to eliminate reflections. Each of the 12 gores is scaled off with fine white lines representing the network of the heavens, each gore being divided into two hours of right ascension. Parallel circles of declination represent each 10° from pole to S. 20°. About 300 stars, down to the fourth magnitude, have been painted on the inside of the dome in correct relative position and magnitude, with aluminum paint. They are placed with regard to the month labels on the gores so that the stars on the meridian at 9 P. M. in the middle of the month are seen in the correct gore. This was done for the convenience of visitors. The Pole Star is at the zenith of the dome, and the Big Dipper, the Pleiades, Northern Cross, Lyra, Orion, the Sickle, and so on, are easily discernible.

"Around the walls of the observatory are large transparencies, some of them from Yerkes Observatory, some the result of our own efforts, representing conspicuous show objects of the heavens. Each plate is mounted separately in an aluminum box made of scrap material, and lighted from within the box.

"In one corner of the dome there is a desk with dim red lamp, while a still more dim neon lamp is for use at the telescope. A special lamp for use with the variable star charts, adjustable so that the chart can be rotated to correspond with the field in the eyepiece, was also devised from scrap material, and is mounted on a pedestal at convenient eye height, (Figure 2). Charts are placed on the glass face of the box and illuminated by a red globe from within.

"The floor of the observatory is eleven feet six inches clear, with plenty of room for visitors in the corners, where seats are provided. The radius of the dome itself is 70 inches clear.

"THE telescope, (Figure 2) is a ten-inch reflector with circles and slow motions, which was made last winter according to information contained in 'Amateur Telescope Making.'

"Other pieces of equipment available are a sun telescope of 20 feet focal length, which throws large images of the sun upon a white screen, permitting the direct observation of sun spots, or if desired, their photography; also a pair of spectroscopes, a radio set for obtaining time signals, and a pendulum clock.

"You have asked for details of the work and cost. Making the drawings and blue prints consumed about 61 hours, this part being contributed by Mr. E. P. White and two assistants. The total working hours on the wooden parts of the observatory, including all painting, contributed by several of us, was 100 hours. The metal work required 168 hours, nearly all of which was done by Mr. White, the writer, and my brother Larry. The electrical work for general lighting, transparencies, and chart lamp required 14 hours, all of this work being done by a brother, P. A. Scanlon. Other participants in the undertaking were C. B. Roe, president of the Astronomical Section, Warren A. Donaldson, and a brother, N. W. Scanlon.

Figure 9: **Cutting out the opening for the shutter was the next thing**

"The cost of the woodwork material was 87 dollars; that of the metal 152 dollars; the electrical material 10 dollars—a total of about 250 dollars. This small cost is not a true measure of the fun we have had and still are having. That cannot be measured in dollars and cents."

●

As announced in last month's number (page 425) a general "get-together" of amateur astronomers, to which all are welcome, will be held at the observatory described above, on August 8 and 9. Inquiries will be forwarded to Mr. Scanlon if sent in care of The Editor.

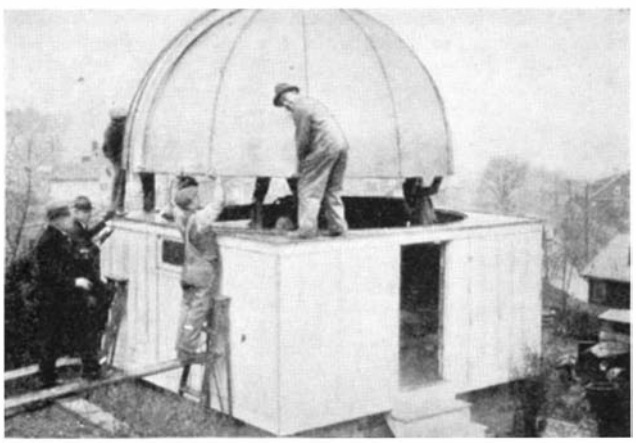


Figure 10: **All hands picked up the dome, walked it aboard the building, and tenderly lowered it to position**

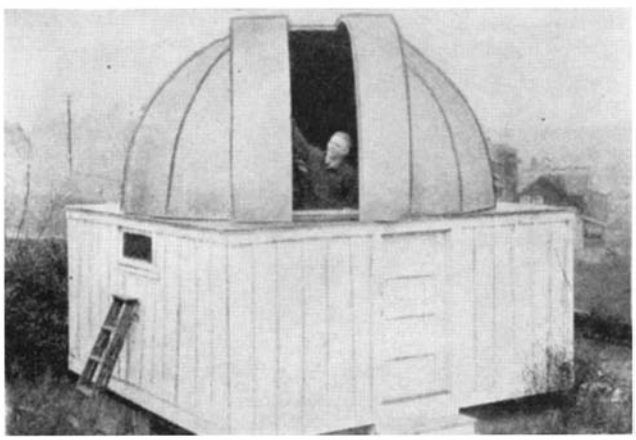


Figure 11: **The job was complete and we all went inside to look it over. Everything worked as planned. We cheered**

TELEVISION NOW ON SCHEDULE

By D. E. REPLOGLE

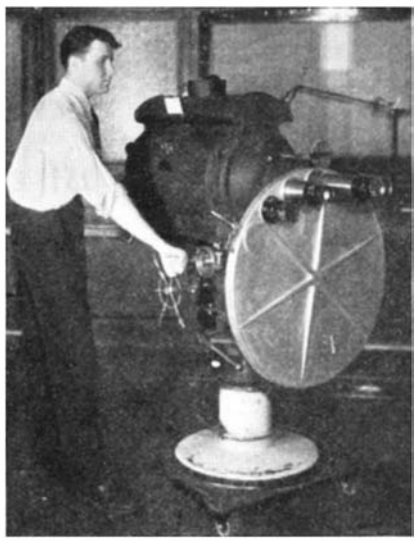
Vice-president, Jenkins Television Corporation

AFTER many years in the laboratory and out in the hands of radio experimenters, radio television today makes a bold bid for public acceptance. During the past three months, the erstwhile experimental television stations have in most instances turned to showmanship in greater or less degree, realizing that the general public is interested primarily in entertainment, once the novelty of snatching pictures out of the air wears off. As a companion move, simple and relatively inexpensive television home equipment has been developed and placed in production, ranging from kits of matched components that may be readily assembled into television receiver and televisor by the average handy man or boy, to complete, ready-to-use receivers and cabinet type televisors for living room use by the veriest layman. The mechanics of television are ready: it is now a question of converting the experiment into an entertainment medium. Can this be done? Upon the answer rests the entire future of the nascent television industry, and in large measure the future welfare of the parent radio industry which sadly needs fresh stimulus today.

BY far the most ambitious showmanship in television is presented by the inauguration of New York's first public television studios. These studios are arranged to pick up living subjects and motion picture films alike, so that programs may never want for available material, together with the sound accompaniment which may be the voice, living music, or musical records.

Two organizations have closely collaborated in bringing "radio talkies" or synchronized sight and sound programs to the homes of metropolitan New York and a considerable section of the outlying country. The Jenkins Television Corporation has supplied the television or sight channel, in the form of the television pick-up equipment and the powerful 5000-watt television transmitter, W2XCR, installed in the same building as the studios. The General Broadcasting System has set aside certain hours during its daily broadcasting schedule for the handling of the synchronized sound component of the television studios, over station WGBS at Astoria, Long Island.

The television studios include the direct pick-up studio and the film pick-up studio. The first is not unlike the usual sound broadcast studio, with the customary acoustic treatment of heavy drapery, and the ever-present microphones. In addition, however, there is the direct pick-up equipment which the performer must face during a television performance. This equipment comprises the scanner, which casts a sweeping



The "flying spot" scanner, using lenses of different focal lengths

beam of light on the subject, and the photo-electric cell banks. The scanner comprises a powerful arc contained in a lamp house carrying an enclosed whirling disk, the holes of which direct the powerful beam on to the subject. Three lenses of different focal lengths are provided, so that the beam may be focused for a close-up, half length, or long shot. Thus it is possible to pick up more or less of the subject without changing the relative positions of subject or scanner, thereby providing a pleasing variety in television presentations. The reflected light from the subject as it is swept by the beam is caught by the photo-electric cells and translated into electrical terms which, amplified millions of times, are sent by wire to the television transmitter for broadcasting purposes.

Meanwhile, the nearby microphone, either in or out of the range of the televisor pick-up, takes in the sound accompaniment which, in greatly amplified electrical terms, is transmitted by direct wire to the remote WGBS broadcast transmitter.

At the home end, two separate and distinct receivers are necessary. The usual broadcast receiver is simply tuned to 1180 kilocycles or 254 meters, bringing in the sound signals. A television short-wave receiver is tuned to 2035 kilocycles, bringing in the pictorial signals which are translated by the televisor into animated pictures. Since picture and sound started in step, they are certain to remain in step when received at the home end.

Radio television, heretofore judged purely as an experiment in flashing little pictures through space, looms big in entertainment possibilities now that sound broadcasters are supplying the essential sound channel. Whatever may be the deficiencies of television today—and they are frankly admitted by sincere workers—the inclusion of the synchronized sound accompaniment makes television showmanship a wonderful possibility from the very start.

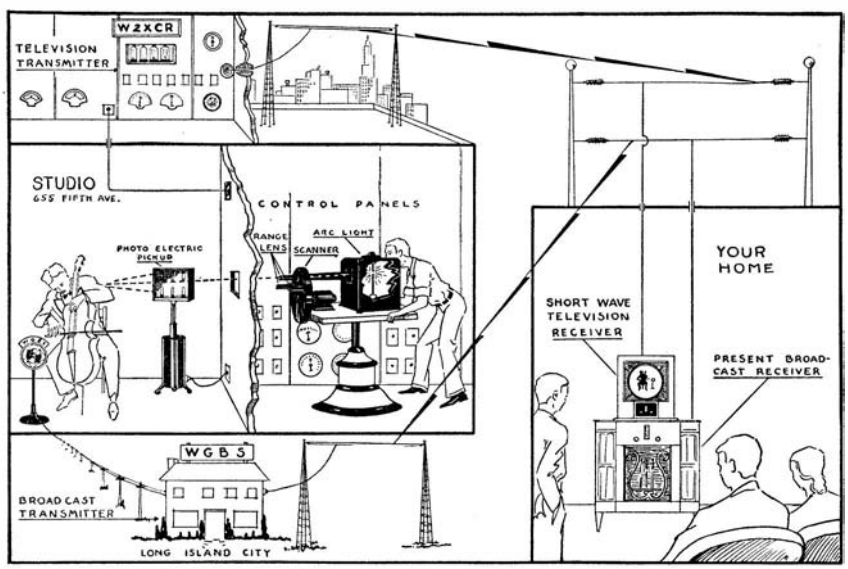
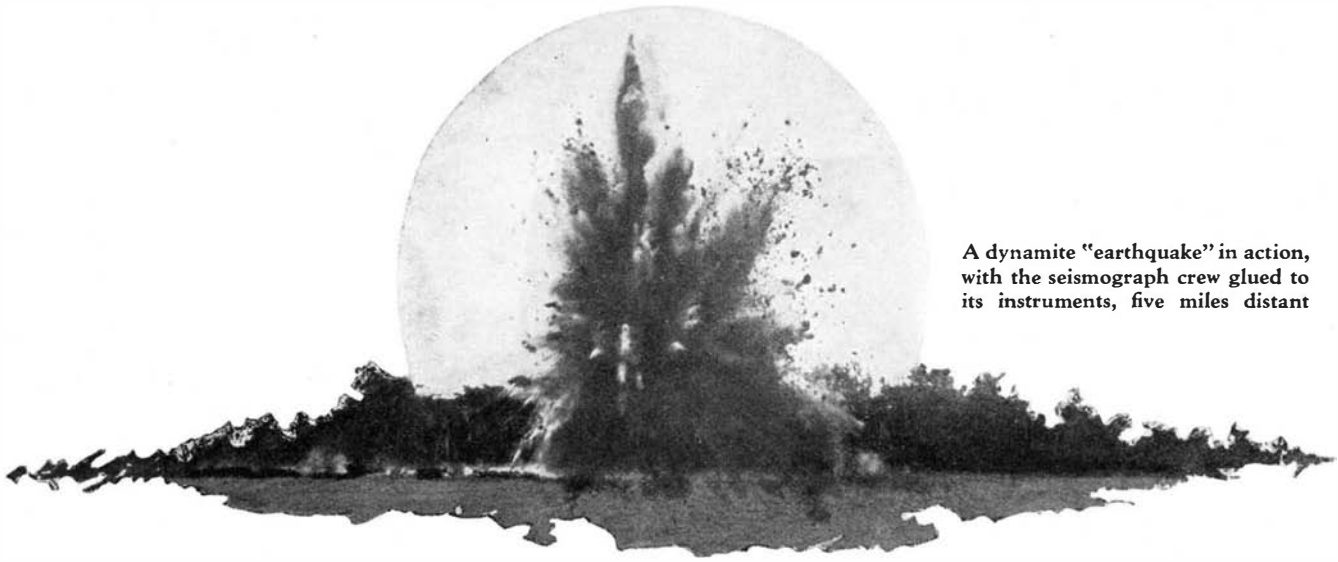


Diagram depicting television transmission and reception, showing how sight and sound are linked. Two complete transmitters and two receivers are necessary



A dynamite "earthquake" in action, with the seismograph crew glued to its instruments, five miles distant

SCIENCE IN SEARCH OF OIL*

IF there is one phase of the business of hunting for oil which has made tremendous strides during the past few years, it is geophysical prospecting. It is characteristic of an age which accepts the greatest miracles of science with the same calmness that it does the workings of the solar system, to fall into an exaggerated concept of the geophysicist's powers.

Undeniable as have been the practical results of geophysical exploration, there is no instrument known to science which can point to the ground and say definitely, "Here is oil."

The geophysicist covers very much the same ground as his fellow scientist, the geologist, in that his job is to "dope out the structure" underground and lay it out on the map. The difference is that while the geologist works up his data from observations he can make with his eyes, the geophysicist relies on his instruments. There are many of them, of course. But the three most important, from the standpoint of practical achievements, are the seismograph, torsion balance, and magnetometer.

TEXAS is the favorite stamping ground of the geophysicist, although he has had some remarkable results in California and Mid-Continent fields. But geophysical instruments are at their best, perhaps, in locating salt domes, and Texas is full of them.

Start out early from Houston some morning and a hundred mile drive will bring you to where the seismic crew is "shooting." You'll find them one of the finest crowds one ever meets in the field—young chaps, most of them, not long out of technical college. Dressed in khaki riding breeches, leather boots, and slouch hats, tanned a deep bronze by weeks in the hot sun, laughing, joking, poring over maps at the hotel, tinkering with a car that had gotten out of its usual habit of running "regardless."

As a general rule, the territory to be "shot" has been previously covered by geologists, and also by the engineers.

The principle of the seismograph is simple enough. Just as you can hear better through a paper partition than through heavy felt, so it is with the various strata of the earth. When an explosion is set off, the sound waves travel down through the ground much as is shown in the sketch on "profile shooting." When they strike a certain stratum, two things happen. Part of the waves are reflected backward, in the same way that light is reflected from a mirror. And part of them pass through the stratum—but at an angle. In other words, they are "refracted," much as light is refracted through a prism.

The dynamite crew making a 20-foot hole into which, after enlargement, 300 pounds of dynamite will be put

Now the geophysicist may do one of two things. He may measure the reflected waves, which come to the surface at or near the point of the explosion, or he may catch the refracted ones, which ordinarily reach the top some distance away, as shown in the diagram. Probably 90 percent of seismograph reconnaissance is done on the refraction principle.

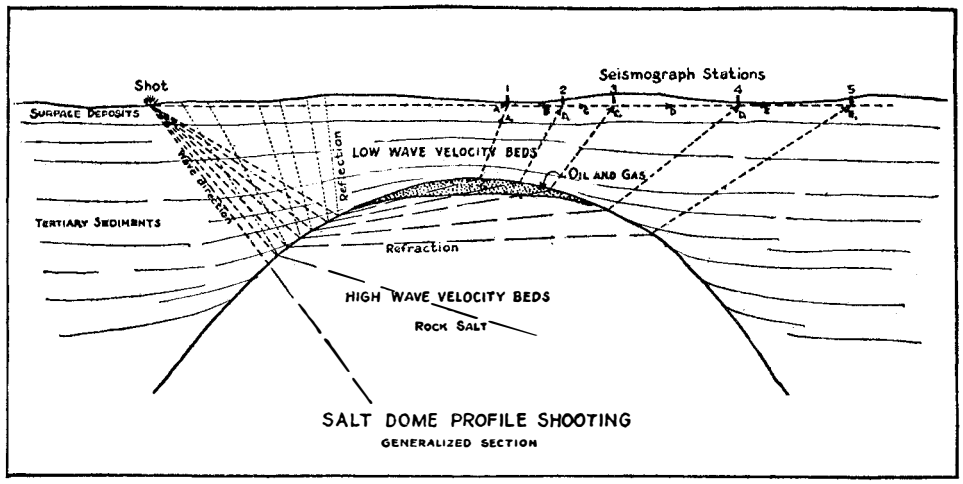
KNOWING the different velocities with which various strata transmit sound waves, the geophysicist can judge from his readings what sort of material lies beneath him, and at what depth. Since the instruments can be placed as far as five miles or more from the shot, considerable territory can be covered in a comparatively short time.

A happier crowd at work it would be hard to imagine. Bright and early the little cavalcade of dust covered cars starts out, trailing behind the chief operator and his assistant, each vehicle with its compact radio and seismic reception sets, its portable aerial mast. Finally they come to the first fork in the road and the party begins to sep-

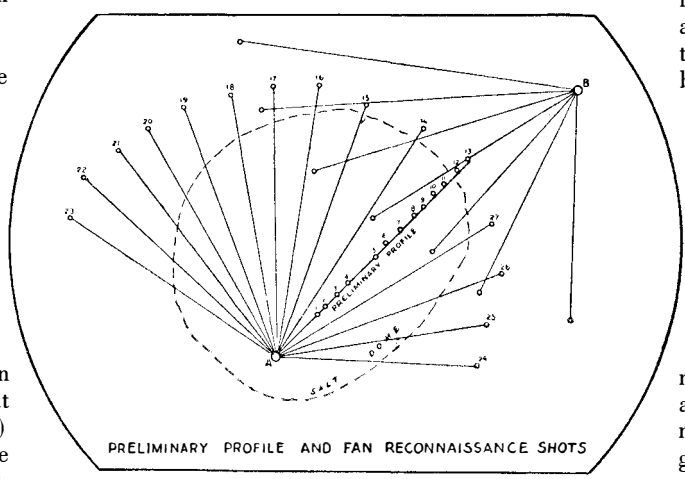
*Courtesy of *The Lamp*. This is the final article of a series of three on salt domes and other sources of salt, sulfur, and petroleum. The previous two appeared in our May and June numbers.—*The Editor.*

arate. The shooter, followed by the explosives car, goes off in one direction, while the operators head in another.

Seismic shooting may be fan-shaped or progressive. In the former, the various operators set up their instruments fan-wise, with the point of the explosion as the handle, as shown in the second of the sketches. Naturally enough, more territory can be covered in this way. Profile shooting, which is used more when the structure has been partially defined and a closer check is desired, consists in setting the instruments one after the other in a straight line from the shot.



Above: **How the principle of differential sound velocity reveals hidden rock structures.** *Below:* **"Fan shooting"**



WHILE the operators are getting set up, the dynamite crew is preparing for business. A hole is put down about 20 feet or so with ordinary post-hole augers, and a small charge set off to give a little room at the bottom, so that the force of the explosion will not be expended upward. Then the dynamite itself is tamped down (with a swift nonchalance that makes the layman shudder) and all is ready. Men are posted to keep any stray persons in the field at a safe distance.

Meanwhile, the shooter himself is checking up. All the operators must be ready to take the reading, and there must be no foreign disturbance anywhere that would interfere with the ground waves set in motion. Let's listen in on the radio set.

Number one is reporting. "Say," he calls, "there's a train here that's going around in circles, or something. Wait'll she clears out."

Number two. "All O.K."

Number three. "All O.—hold it! Here comes that old Model T again. Asked him to clear out before. He's rattling like a load of tin."

Four was ready, but number five had the prize "disturbance."

"Give me," he pleaded over the five miles of ether, "three minutes. There's a darkey plowing over in the next field and I'll have to stop him."

When all the operators are ready, down goes the plunger beside the shooter's car, and 300 pounds or so of dynamite explodes with a dull roar. Two readings are taken—one, the speed and direction of the wave through the ground and the other, the air wave, although the latter is not always necessary. It gives the operators the distance of their instruments from the point where the shot went off. The waves are recorded on a negative roll inside the seismic instrument and are developed immediately afterward in a dark compartment—"Turkish Bath," the crowd calls it in hot weather—in the rear of the car.

After the usual check-up following each shot, the cavalcade forms again at the cross-roads, the sweating operators tearing up in clouds of dust to compare notes and check the location of the next shot. Good records are a matter of considerable pride to a seismograph crew, and heaven isn't too good for the chap who consistently turns in clean-cut impressions on his little rolls of developed prints—at least, in the opinion of the unlucky fellow back at the hotel who has to plot the readings, with tables, slide rule, and graph paper, into practical data for the home office.

Field work like this gets into the blood. Big Swede, head operator of this particular outfit, has been at it for years and wouldn't swap jobs with the chief geologist. He knows his crowd, and they get along. Take Shorty, for example.

Shorty is the comedian of the outfit and is particularly distinguished by the number of things he contrives to have happen to his car. Not purposely, you understand. Coming back into town after a hot, dusty day, a tire is just as likely as not to go scooting off his front wheel for no reason at all. This particular time, the tire was obviously past its best days. Shorty had no spare, so with characteristic cheerfulness he hobbled along home on three wheels, the naked rim skidding back and forth across the dirt road until from the distance his car looked like a lopsided crab.

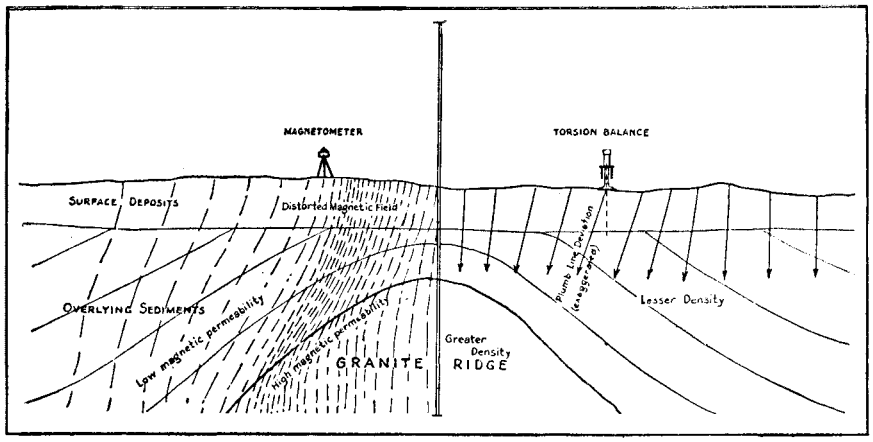
Shorty had the last laugh, at that. For his ingeniousness he got a brand new tire, and a new spare to boot. All he needed now, he explained gravely to the crowd, was a new car and three more tires.

Torsion balance and magnetometer operations are radically different from the chasing about the country which the seismic crew must do. In fact, if you ask a seismograph man, he will tell you in all seriousness that the torsion balance boys are just youngsters whom the company wants experienced and who therefore are allowed to follow him around and go over his readings with their new-fangled toys. If, unconvinced, you seek a torsion balance operator, he will tell you just as solemnly that you cannot locate any salt domes by tearing around the landscape in little cars and shooting off firecrackers. And so forth.

FROM all of which you will correctly gather that each method is equally useful in its own field.[1]

Seismograph work, naturally enough, is better for reconnaissance, since it covers more surface territory at a faster

[1] "Of the total of 158 salt domes [located since 1925], 68 are reported to have been located without the aid of geophysics, 20 by the torsion balance, and 70 by the seismic method. Of a total of 80 domes tabulated by the Department of Conservation of the State of Louisiana for the coastal region of that State, 62 were discovered by geophysical methods (55 by the seismic method; 4 by the torsion balance, 2 by the seismograph and torsion balance, and 1 by the geophone and torsion balance) and only 18 by drilling."—From abstract of an article in *Oil Field Engineering*, which appeared in *Geophysical Abstracts*. All of the methods mentioned in this article are described in detail in Eye and Keys' book entitled "Applied Geophysics."—*The Editor.*



At left is an interpretation of the principle on which the magnetometer works, and at right an interpretation of the torsion balance applied to the same case

clip. The torsion balance, on the other hand, reaches farther beneath the surface and is likewise sensitive to masses some distance from where it is set up.

The torsion balance works on the principle of gravity. Hold a golf ball in your hand and drop it, and you will find it falls in a vertical line, at right angles to the surface. That is because the gravitational pull from the center of the earth normally works that way. The vertical plumb line is an even better example. But suppose the various strata underlying the surface were inclined at an angle, as in a dome or anticline, making a number of dense masses. The lines of gravitational pull would then be warped, and if your plumb were a sensitive instrument, it would tend to hang at an angle, leaning in the direction of the dense mass.

That, of course, is theoretical. Like all other geophysical instruments, the readings of the torsion balance have to be taken, not blindly, but in correlation with other known geological factors. That is why the successful geologist has gray hair on his brain, if not on his head. There is no substitute for experience in the field.

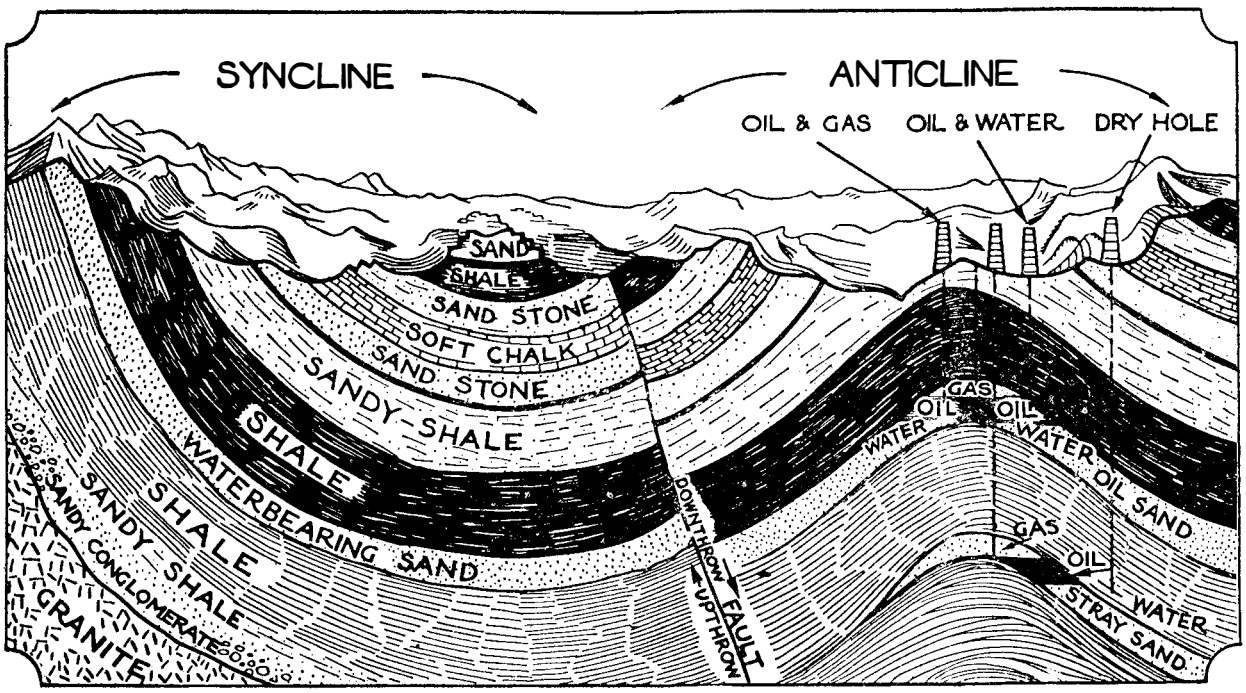
The purpose of the magnetometer is much the same as that of the torsion balance. The entire earth is an enormous magnet. Theories vary, of course, but just for purposes of discussion we can picture the lines of magnetic force radiating outward from the poles of our magnet. Now, with the exception of certain materials like magnetite which have what is called dynamic attraction, every material which goes to make up the crust acts as a sort of screen or blanket, tending to prevent passage of the magnetic lines of force.

Suppose we consider the various strata as huge screens, laid one above the other. As our lines of magnetic force flow toward the surface, they will pass right through the strata with "coarse mesh," but where they hit a "fine mesh" one they have to "struggle" to get through. Where the bed is extremely impervious to the lines of force (as, for example, limestones, shales, or sandstones), the magnetic lines have to "detour" until they strike a more permeable loophole, such as granite or volcanic rock, through which they crowd. The various types of rock all have their own peculiar ways of "warping" the lines out of their normal course. It is this crowding and distortion of the lines which the magnetometer measures.

The instrument has been used with considerable success in Kansas, Oklahoma, and the Texas Panhandle district, where the structure consists mostly of huge ridges or buried mountains. It is economical under such circumstances, quick and easy to read, but difficult to interpret. The torsion balance, while it must remain on the spot for a longer time—four hours, or so—and must be carefully isolated from interference, is not quite so difficult to interpret.

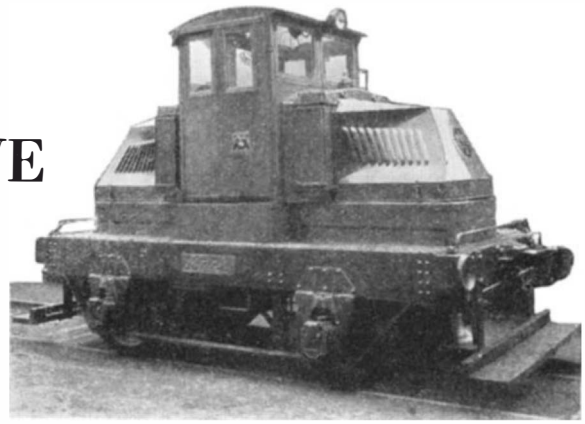
THE oil man, like everyone else, is not in business for his health. While both he and the geologist himself realize that the latter is far from infallible, he has found from experience that, given time, the geologist can and does produce results. Every producing subsidiary of the Standard Oil Company (N. J.) has its own geological department and each has its record of achievement.

Some day, perhaps, science may evolve a real "doodlebug" capable of definitely locating oil deposits. Greater miracles than that have happened. But in the meantime geology, geophysics, paleontology, and their allied sciences are doing much to reduce the chances of failure in drilling for oil.



Oil and gas, being lighter than water, often work their way to the crest of a long anticline or ridge in the rocks

A FAMILIAR TRUCK BECOMES A LOCOMOTIVE

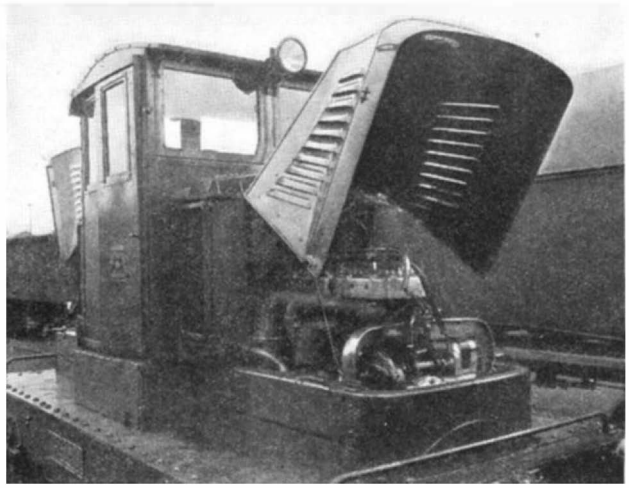


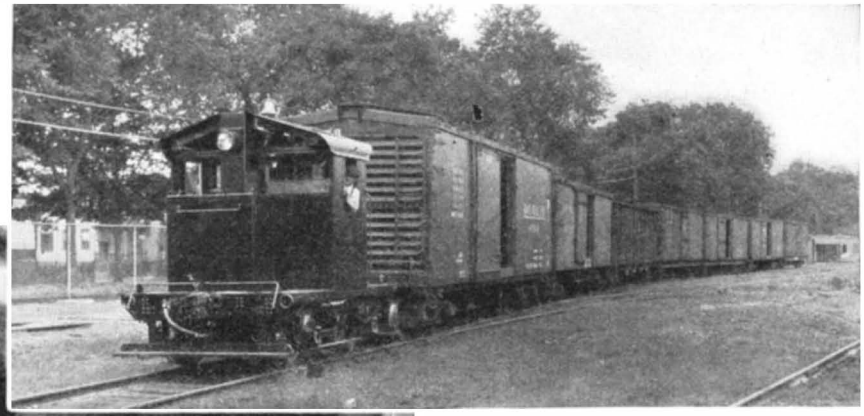
One of the two types of 12-ton locomotives; and *below*: Standard Mack engine beneath the hood

THE locomotives illustrated have been developed by the manufacturers of Mack trucks to perform the work of light steam locomotives now generally used by many large industrial plants to do their switching of freight cars on their own railroad tracks or by other industries such as logging camps, quarries, or steel mills which must move heavy or bulky materials in their manufacturing processes. They are known as gas-electric locomotives and are essentially electric locomotives which carry their own power house around with them instead of collecting electrical current from a third rail or overhead trolley. Electric motors are geared to the axles and turn the wheels when power is delivered to them from electric generators which are driven by gasoline engines.

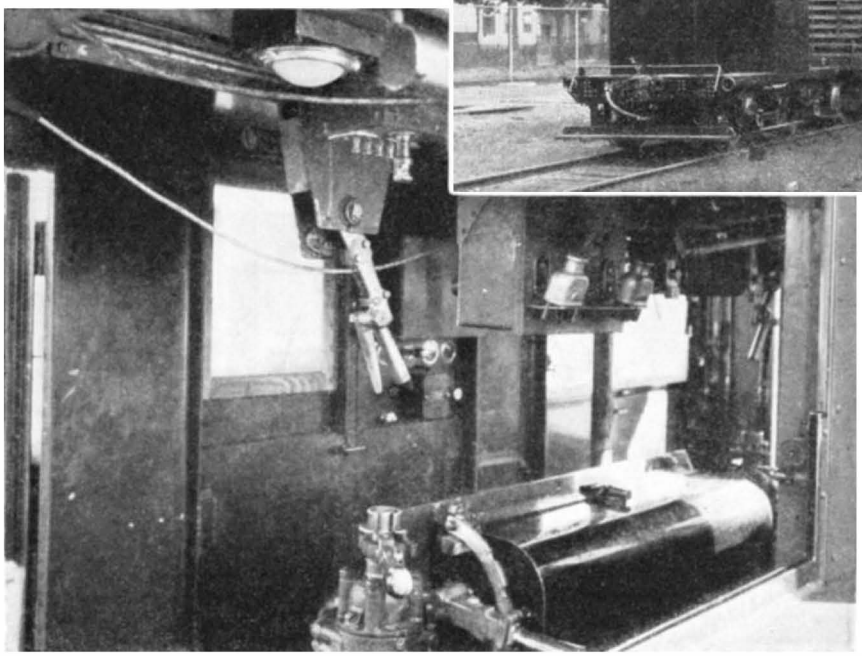
It is claimed that all the advantages of electric operation such as the absence of smoke and noise of steam locomotives, greater flexibility, improved performance, economy of operation, and increased reliability can be obtained without the expense of putting in a trolley or third rail system.

The Mack company equip their locomotives with gasoline engines that are duplicates of those used in their larger motor trucks. When a locomotive is equipped with more than one engine it may be operated on only one engine when it is doing light work. The remaining engine or engines are started whenever additional power is required, just as in a power house additional turbines and generators are put into operation when the load becomes greater than the capacity of one unit. In switching service this feature is of particular advantage because of the great differences in the number and weights of the cars to be hauled at one time during the day's work. When few cars are to be moved, only one engine is used, resulting in a low fuel cost and in prolonging the life of the engines not required to be in operation.





A 12-ton locomotive at work in the yards of a large industrial plant



In the cab of gas-electric locomotives, all controls are grouped within easy reach of the operator. Flexibility of operation is one of their strong points

By selecting their standard motor-truck engines, the manufacturers have greatly simplified the servicing of their locomotives, as replacement parts and mechanics trained to repair these engines are available at more than 100 service stations located in the principal cities of the country.

Two convenient control stations provide fast operation of these gas-electric locomotives with maximum safety. They require no coaling or round-housing. Starting is instantaneous, and power plants are shut down completely during stand-by periods.

PROFESSIONAL METHODS IN AMATEUR ARCHEOLOGY[1]

IN 1920 the National Research Council organized the Committee on State Archeological Surveys to encourage systematic study of the fast-vanishing Indian remains. In the ten years of its existence the committee has assisted in the formation of research organizations in various states, has sought to systematize and unify methods of investigation, and through publications, conferences, and visits of its Chairman, has endeavored to keep all workers in the field informed of the progress of archeological research throughout the United States.

The activities of the committee have been purely advisory. It has not sought to control the actions of any group or state, but has freely offered its help and advice in the advancement of scientific work. It now seeks to extend its services to amateur archeologists and to all who are interested in the early history of our country. In presenting this article, the committee hopes to enlist the active co-operation of all intelligent laymen in the preservation of archeological sites. It seeks to give information which will enable the local investigator to carry on work according to the most approved methods, so that he may assist in unravelling the story of human development on the American continent.

IT is evident to everyone that the great majority of our Indian remains have already been destroyed. This has been due in part to the fact that many prehistoric sites have been occupied by white settlers who have found it necessary to level Indian mounds and earthworks in order to utilize the land for farm purposes, for city development, or to make way for roads. However, the greatest destruction has been wrought by curio hunters who have dug into the mounds in search of relics, without realizing that they were destroying valuable historical material. To open an archeological site without knowing how to preserve the record is equal to tearing pages out of a valuable book, a book which can never be re-written.

In each state there are some people who are interested only in securing specimens which they can sell for personal gain. They care nothing for history or science, and are not disturbed by the fact that their ruthless methods destroy materials of great interest to their fellow citizens. This article is not addressed to them. Their activities will only cease when public opinion is strong enough to make their work unprofitable. Today no scientific institution and no well-informed person will purchase archeological material which is not accompanied by a full record. When intelligent local collectors take the same attitude, the work of these commercial "pot hunters" will cease. An Indian relic without data is as worthless as an unidentified postage stamp or bird's egg. The pages which follow seek to show how amateur archeologists may assist in recovering the pre-history of our country, and at the same time help to preserve the existing Indian sites for future generations.

It is well known that some of our Indian tribes were nomadic. They were wanderers who made their camps near favorable hunting grounds and who moved to new sites whenever whim or necessity dictated. Other Indian groups were chiefly dependent on agriculture, and these made permanent settlements which were occupied for long periods. But exhaustion of soil, hostile raids, epidemics, and other causes led to their abandonment and the establishment of new camps. Thus it sometimes happened that a single camp site was occupied several times, and the record of these periods of occupation can now be read by careful excavation. In some places it is possible to carry back the record through successive stages of development from historic to ancient times. Examples of such stratification are rare and should be noted with the utmost care. Through them we can trace the movements of peoples, the growth of culture, and the effects of environment on man in America.

BUT such a story can not be obtained by the careless digger, or by those who are interested only in beautiful specimens. It can only be revealed by those who preserve every evidence of this early life. Every potsherd, every implement of bone or stone, no matter how crude or fragmentary, every animal bone or vegetable product, becomes an important part of the record. Nothing should be discarded until it has been made the subject of careful study. Even the scattered surface finds have great value if their location is recorded, for when their distribution is plotted on a map they tell of migrations, of trade routes, and of local development.

In some places the Indians built great earthworks, fortresses and pyramids. In others they constructed mounds of earth in the form of birds and animals—the so-called effigy mounds. In some localities they buried their dead in graves dug in the earth or surrounded them with stone slabs. In other places they placed the corpses on the surface and raised over them mounds of earth, some of considerable size; still others constructed mounds in which they placed the dead. Many different methods of preparing the body were employed. Sometimes it was laid out full length on its back. Again it was placed on its side with hands and feet drawn close up to the body. In some instances cremation was practiced, while still other groups placed the dead on platforms until the flesh had vanished, then tied the bones

Co-operation With Science

IN April the National Research Council called a conference between scientific men and engineers and others engaged in construction work, for the purpose, as stated in a communication from Professor Fay-Cooper Cole of the Department of Anthropology at the University of Chicago, "of impressing upon commercial excavators the need of careful observation and the prompt reporting of materials uncovered during excavation. There have been many reports of human bones or utensils made by man found associated with extinct animals or in ancient strata. Usually the bones are disturbed before competent scientists can visit the sites, and thus data possibly of great value is lost. Today we have many hints that man may have reached America before the end of the glacial period, but no positive proof. It is hoped that the proposed co-operation will make it possible to solve this question."

The conference was attended by H. G. Clark, chief engineer of the Rock Island Railroad; C. N. Conner, engineer of the American Road Builder's Association; A. J. Moorshead, president of the Madison Coal Company; W. B. Storey, president of the Santa Fé Railroad; A. W. Newton, chief engineer of the C. B. and Q. Railroad, and others.

This is a step in the right direction. The accompanying article outlines further steps toward real co-operation between laymen and scientists in dealing with finds in an efficient manner.——*The Editor.*

[1]Prepared under the auspices of the Committee on State Archeological Surveys of the Division of Anthropology and Psychology, National Research Council: Fay-Cooper Cole, Chairman of the Division (1929-30), and Carl E. Guthe, Chairman of the Committee. Reprinted by permission, with minor authorized changes.

into bundles and placed them in the mounds. All these methods are of extreme interest to the student, and the record of their presence may go far toward identifying the Indian groups in question.

It not infrequently happened that a mound was originally built by a people practicing one method of burial, but was later used by incoming tribes. Such intrusive burials are most instructive in deciphering the sequence of cultures.

In the southern, eastern, and far western states, Indians living near to the sea lived largely on shell fish, and during long periods of occupancy built up great refuse piles in which are found animal bones, broken bits of pottery, and other objects which help to reveal the life and habits of the builders.

Courtesy Department of Anthropology, University of Chicago

Students of the University of Chicago excavating in central Illinois. Note brush and bellows for clearing sand from skull

Cave dwellings are for the most part restricted to the southwestern part of the United States, yet important sites have been discovered in the Mississippi Valley and elsewhere.

WITHIN recent years reports of finds of early man have been current. These range from the finding of utensils associated with the bones of animals now extinct, to the discovery of arrowheads and similar objects lying in undisturbed gravels at points where river erosion or excavation has exposed successive strata. Still other important sites are ancient mines and quarries from which Indians obtained their flint and in some cases copper.

No single collector can hope to obtain a representative exhibit from the whole country, nor would such a collection be desirable, for upon the death of the owner it is almost certain to be scattered and its scientific value lost. However, each local archeologist can become a specialist in his own locality. He can gather the most accurately recorded collection from that area. He can obtain information which when added to that of his fellow workers will ultimately reveal the pre-history of America, and he can have the satisfaction of knowing that he has assisted in preserving prehistoric monuments for future generations.

In many sections of the country it is possible to obtain plat books which give locations of farms, roads, lakes, and other features which may serve as guides in the field. If these are not obtainable, township or section maps may be used, but here it is necessary to transfer from county maps, streams, roads, and other information by which it is possible definitely to locate a site. On such a map first place all existing Indian sites, then those whose former existence can be definitely determined, and finally the approximate location of doubtful sites. In order that all work may be uniform, the symbols shown in Figure 1 are suggested.

Indian trails which can be located from old land surveys, maps, or county histories should be drawn in with blue pencil, but only so far as they can be definitely and accurately identified.

Should there be several mounds so close together as to make it impossible to place them on the map, this can be indicated by placing a number at the lower right-hand side, as, for eight circular mounds: O_8. If further identification becomes necessary in describing, letters can be placed above the figures, as O^A_8.

For describing particular sites, squared paper should be used, and the exact location and size of each mound should be noted. Thus each square might be considered as five feet, and the group of mounds O^A_8 might be shown as in Figure 2.

In such a case the use of a tape and compass is necessary to place the mounds in their exact relationship to one another.

When mapping the Indian remains in a township, it is desirable to make surface collections, and to locate the material with relation to the nearest mound, village site, and so on. Such surface material should be carefully numbered and entered in the catalog. Never depend on your memory alone for locating specimens.

Village and camp sites are often located by the profusion of broken pieces of pottery on the surface. Black earth containing charcoal and burned animal bones is also a good indication of former occupation. In places, low circular mounds reveal the foundations of wigwams, while low mounds with central depressions may be the remains of earth lodges.

IN nearly every section of the country private collectors will be found. These may be farmers who have preserved only the specimens found on their property, or they may be those who have collected materials from several townships. In all cases where the owners have any knowledge of the locality from which their collections came, it is desirable to make a record of their specimens. For this purpose it is not necessary to draw in or photograph every piece. First of all, separate the arrowheads into *classes*. Then with a lead pencil trace in the outline of one of each class, and state the number of such pieces in the collection. Or place one of each type on a suitable background, photograph them, and indicate the number of each. Thus, if three classes of arrowheads are found they might be indicated as in Figure 3.

A similar method should be followed for stone axes, hammer stones, and so on. It is desirable to photograph pottery, but if this is impossible, make

	NOW EXISTING	FORMERLY EXISTING, DEFINITELY LOCATED	REPORTED
ROUND OR CONICAL MOUND	○	⊗	?
ELONGATED OR ELLIPTICAL MOUND	⬭	⊗	?
EFFIGY MOUND			
VILLAGE SITE	△	△	?
EARTHWORK OR FORTIFICATION	▭	⊠	?
QUARRY			
BURIAL GROUND (NOT A MOUND)	† †		
ROCK SHELTER OR CAVE SHOWING HUMAN OCCUPANCY	⊏		

Figure 1: **Map symbols**

drawings, and always indicate the style of decoration if any is present. Also state whether the pottery is sand or shell tempered. Pictures and descriptions of potsherds are also desired. With such information it will ultimately be possible to learn the distribution of type utensils. Local archeologists can render service of great value if they will obtain the data indicated and make them available to the Committee on State Archeological Surveys, or to one of the members whose names appear at the end of this article.

Every amateur who desires to carry on excavation should first of all receive instruction from a trained archeologist. The ability to see the record in the ground frequently depends on training and experience. A beginner, with the best of intentions and with every attempt at care, will often miss stratification lines, or fail to recognize the difference between disturbed and undisturbed deposits.

Your state university or museum, any member of the Committee on State Archeological Surveys of the National Research Council, and particularly the institution furnishing these instructions will gladly assist you. *You are urged not to excavate without this instruction unless it becomes necessary to save the record of a site which is about to be destroyed.* In such a case, the following methods should be followed (the letters refer to the points and lines so designated on Figure 4):

RUN a line across the north and south axis of the mound, as line O—O. Five feet to the east run another line parallel to O—O, and continue these five-foot lines until you are well outside the mound. Now, do the same on the west side of O—O. Then, beginning on the south, well outside the mound, run an east and west line C—D. Five feet to the north run another such line, E—F, and continue this procedure until you have gone beyond the northern limits of the mound. Now place stakes at each point of intersection of the lines, and your whole site will be divided into five-foot squares. Before starting work you should make a map of the squares, such as Figure 4. Along the line C—D sink a trench to a depth of about two feet below the surface or disturbed soil. Now carry this trench forward much as you would cut a loaf of bread. Always keep a straight face to the cut, throwing the dirt behind you so as to leave an open space.

As you enter the mound, you may find evidence of a prepared or hard-beaten floor, or of the undisturbed ground upon which the mound was erected. You should be constantly on the watch for fire lines or evidences that the mound was built in two or more different periods. If the primary mound stood for years, and grass and other materials accumulated on the surface, and then at a later time more earth was heaped upon it, this will probably be indicated by a dark or humus line. All evidences of this character should be carefully noted, and your record should indicate the situation for each square. Likewise, every find of a stone implement, pottery, or skeleton should be accurately placed in your plan, and should receive further notice in your field notebook. By following the plan indicated in Figure 4, it is an easy matter to place every object found in its exact place on the map.

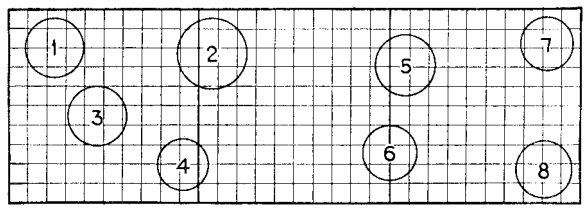


Figure 2: **Marking locations**

Thus such a square as the one marked "I," which begins on the five-foot line E—F and lies east of the zero line O—O, can be written: I-5EO (i.e., it begins on the five-foot line, east of the zero line), while square II-10E5 (i.e., it begins on the 10-foot line, five feet east of the zero line). If an object is found at 1x, it can be written in your notebook as 12.5-W-7, which indicates that it lies 12 feet and 6 inches north of the line C—D, and seven feet west of the line O—O. You should also note in your book how far below the present surface and how high above the floor of the mound the object lies. Each time an east and west line is encountered, as E—F, you should measure the height of the mound from the floor at each stake. By following such a method, you will have a complete record of the mound, its composition, and its contents. In all excavations test pits should be sunk from time to time below the level of your work, to be sure that you are not overlooking some more ancient site. Village sites and cave deposits should be staked for excavation in like manner.

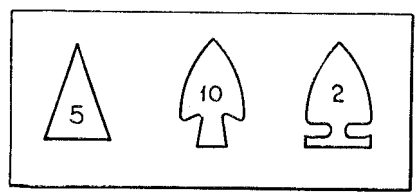


Figure 3: **Types of arrowheads**

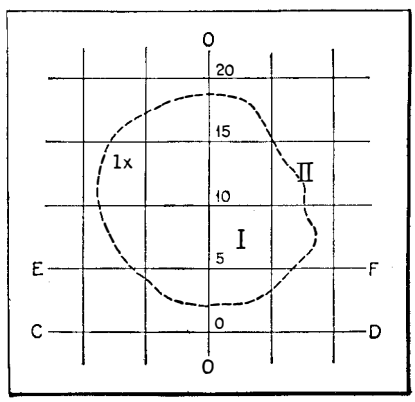


Figure 4: **A typical plot record**

A pick and shovel can be used for the preliminary trench, but when entering the mound it is necessary to use other tools. A mattock with a short handle can be employed for shaving down the face of the cut *from top to bottom*, until objects of interest are encountered, when smaller tools—trowels, dull knives, orangewood sticks, whisk-brooms, and smaller brushes—become necessary.

Never remove a specimen by pulling it out. Always expose the object fully by cutting away material above and on all sides of it, and if it appears to be associated with other objects or with a skeleton, allow it to lie in place until all are uncovered and photographed. Pottery, human and animal bones are sometimes so soft when encountered that they can not be removed without injury, but exposure to the air for a few hours often hardens them considerably. Very fragile bones can be strengthened by spraying them with a very thin solution of shellac. Often it is desirable to cut below a fragile object, and slip in a thin piece of wood or tin, on which it can be removed. When working around bones and similar materials, remove the soil by means of thin knives, orangewood sticks, or by brushes. Any object which is worth uncovering is worth preserving. *Unless you are willing to give this time and care to preserving the record, you should not attempt excavation.*

PRESERVE all fragments of pottery and bone; they may be capable of restoration later. Each specimen should be numbered and entered in a notebook. Since tags are easily lost, it is wise to mark each specimen with a 6-H (hard) pencil. Then wrap separately in paper and attach tag to this. When many potsherds are found together, they may all be placed in a box and properly labeled. Never place pottery, arrowheads, and heavy stone specimens in the same box. Copy all your notebooks, drawings, and pictures in duplicate, and send one copy to your local institution or to the State Archeological Surveys Committee for interpretation and safekeeping. Your interests will be protected and you will be given full credit for any information used.

Mention has been made of the possibility of finding evidences of early man

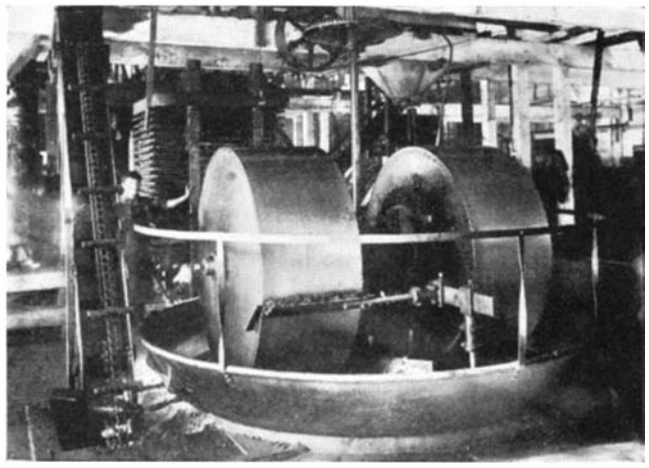
(*Please turn to page* 66)

AMERICAN OLIVES BY THE TON

Photographs courtesy *Standard Oil Bulletin*, California

Paraffin-lined vats of fruit, while being processed, are agitated with compressed air. *At left*: Mature olive trees. Olives are hand-picked

A half dozen primitive animal-powered olive crushers are still used by a few minor oil makers in California



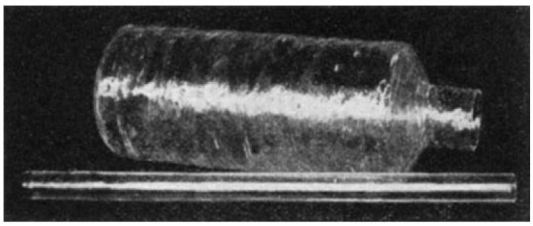
All of the large olive oil plants in the state are equipped with geared, mechanically-driven crushers similar to this

IN the mind of the average person, olives are generally thought of in association with the Levant. There has been so much written about them in connection with the shores of the Mediterranean and with Biblical lands, that they just seem to belong there—and there only. In California, however, olive cultivation dates back to 1769 when Padre Junípero Serra brought olive trees from Mexico and planted them at Mission San Diego de Alcala. As other missions were built, each planted its grove and the industry grew finally to commercial proportions. Today there are in California approximately 28,000 acres of commercial orchards with an annual production of 865,000 cases of packed ripe olives, 300,000 gallons of olive oil, 1000 tons of fresh olives that are shipped to the eastern part of the United States for pickling, and from 1500 to 2500 tons of the so-called Greek-cured and Sicilian-cured fruit for American residents who are of Mediterranean extraction.

After the olives are crushed, a hydraulic press expresses the oil from the pulped meat which is spread thinly between heavy press cloths

PRESERVED FOR 10,000 YEARS TO COME!

FOLLOWING the great Japanese earthquake of 1923, there was a popular demand that the names of those who lost their lives should be listed and saved for all time in some imperishable form. Newspapers in recent years gave renewed expression to this desire and fixed 10,000 years as the time through which such a memorial should be capable of preservation.



One of the quartz bottles made to keep for ages the record of Tokyo earthquake victims

Ten thousand years! The challenge of that demand impressed itself deeply upon the imagination of a citizen of Tokyo, Mr. M. Yamaki, an engineer of the Tokyo Electric Company, and he began to discuss the possibility with other people. Opinion was general that it could not be done. It was pointed out that in the long history of Japan, the Jimmu Era dating from the accession of Emperor Jimmu was only about one quarter as long and that, practically speaking, 10,000 years is another expression for eternity.

BUT the mayor of Tokyo at the time of the catastrophe. Mr. H. Nagata, was an ardent promoter of the plan and lent his enthusiastic support. In due course, it fell to the Tokyo Electric Company to undertake the project, and to Mr. Yamaki, himself, was assigned the task of producing such a preservative container as would keep the record intact against the ravages of time.

Mr. Yamaki was advised that for permanence a certain quality of dark blue Japanese paper with the inscriptions in gold paint, such as used in ancient Buddhist scriptures, would be the best. But neither of these materials is available at this time, equal in quality to the old, and Mr. Masaki, President of the Tokyo Art School, recommended white Japanese paper with the names written in Chinese ink. This recommendation was adopted and the paper was specially made of the very best quality by the Government Printing Bureau. A total of 548 sheets, measuring 10.5 inches in width and 27 inches long, were required and their total weight was 22 pounds. Upon these the names of the victims of the earthquake were carefully inscribed. Other sheets bore an explanatory statement by Mr. Nagata, Mayor of Tokyo, a chapter from Buddhist scriptures copied by Mr. Masaki, above mentioned, and the names of those who were associated in producing the memorial.

The problem of protection was twofold: First, to prevent deterioration of the scrolls and, second, to safeguard them from mechanical injury. The Society of Resources studied the subject and recommended, as a general plan, that the list be put in a glass bottle, the air exhausted and nitrogen gas introduced, after which the bottle would be hermetically sealed and covered by a lead sheath with a view to burying it in the ground. Mr. Yamaki, while adopting this method in principle, saw the wisdom of certain changes in detail.

In assembling the earthquake record the scrolls were carefully inserted in four bottles

He substituted for glass a container made of fused quartz crystal which, although far more difficult to make, had the advantage of less fragility and the ability to withstand sudden and extreme changes of temperature. The choicest Brazilian crystals were chosen and melted in an electric furnace into the form of thin rods like lead pencils. Placed side by side, these rods were fused together one by one in an oxy-hydrogen flame and a bottle was thus constructed 5 inches in diameter and 12 inches long. At the top, the bottle was drawn into a neck so that the heat of the final sealing process would be far enough from the contents to prevent injury. Owing to the difficulty of making one container of sufficient size and strength to carry all the scrolls, four crystal bottles were produced.

The method of inserting the scrolls was to roll them as tightly as possible and push them in through the two-inch opening of the neck. Once inside, the unrolling tendency made them open up to the inside diameter of the bottle, leaving space at the center for additional rolls. The inner surface of a bottle made in this way lacked uniformity of diameter and it was desirable that the scrolls in their released position should be uniformly cylindrical in order to get in the maximum number of sheets. Provision was made for this by placing in the bottle three circular bands of thin monel metal at top, bottom, and center, against which the scrolls unrolled themselves to a uniform size. Monel metal, an

The asbestos covering of a bottle

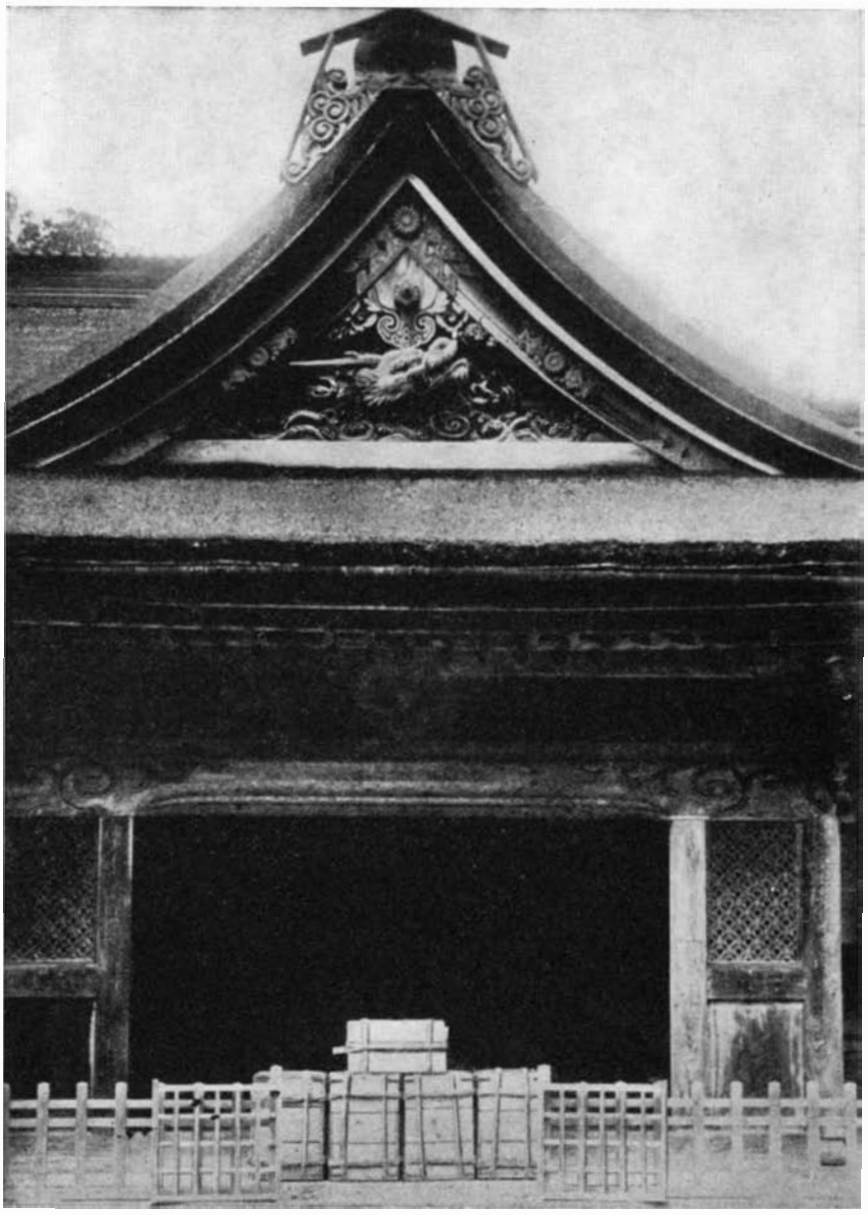
Text and photographs courtesy *The Digest*, International General Electric Company.

alloy of nickel, copper, and iron, was chosen in part because of its resistance to corrosion. Both the top and bottom bands were covered with braided asbestos as a cushion against the bottle, and the middle band was decorated with a black and white silk braid in token of mourning. Both the silk and the braid were very carefully made by the Kuno Shoten in Ginza, using silk sterilized and dyed by Mr. Sampei, engineer of the Silk Examination Station.

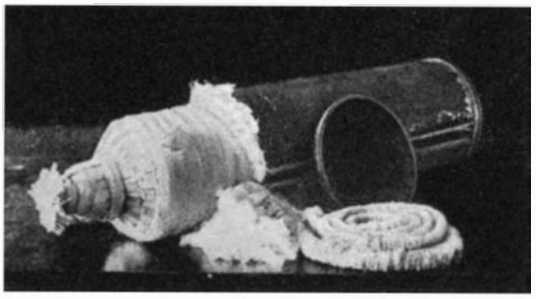
After each bottle had been filled, a crystal cover was fused over the top of the neck, the space immediately below being first filled with asbestos. It was then exhausted of air and filled with argon gas, the temperature of the bottle being kept at 80 degrees Centigrade by immersion in hot water. When this process was completed, the gas pressure inside the bottle was approximately equal to atmospheric pressure.

THE next process was to cover the bottle by braiding over its entire surface strips of asbestos over which in turn was a wrapping of asbestos tape. For external protection, the bottle was sealed into a lead container, and this again was put into a fireproof cylinder of Carborundum made especially for the purpose by the Nippon High Grade Furnace Material Manufactory. Because of the extreme hardness of Carborundum, it was difficult to give the outside jacket a polished surface; nevertheless this was undertaken for the sake of appearance and the many points of its crystalline structure were made to shine like mirrors.

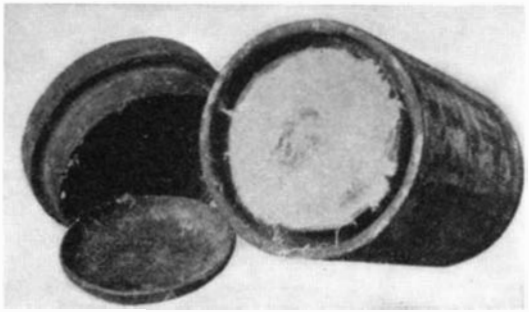
The repository chosen for the records toward the preservation of which so much ingenuity, skill, and labor were expended, is an ancient Buddhist temple at the summit of Mount Koya. At this temple, which has a history of a thousand years, the names of the earthquake victims are to remain in a specially constructed hall. The locality is 400 miles distant from Tokyo, and transportation for a considerable distance is by primitive methods. To meet all emergencies of rough handling each container was supported by steel springs within a wooden packing case stuffed also with excelsior.



At the entrance of the ancient temple on the summit of Mount Koya



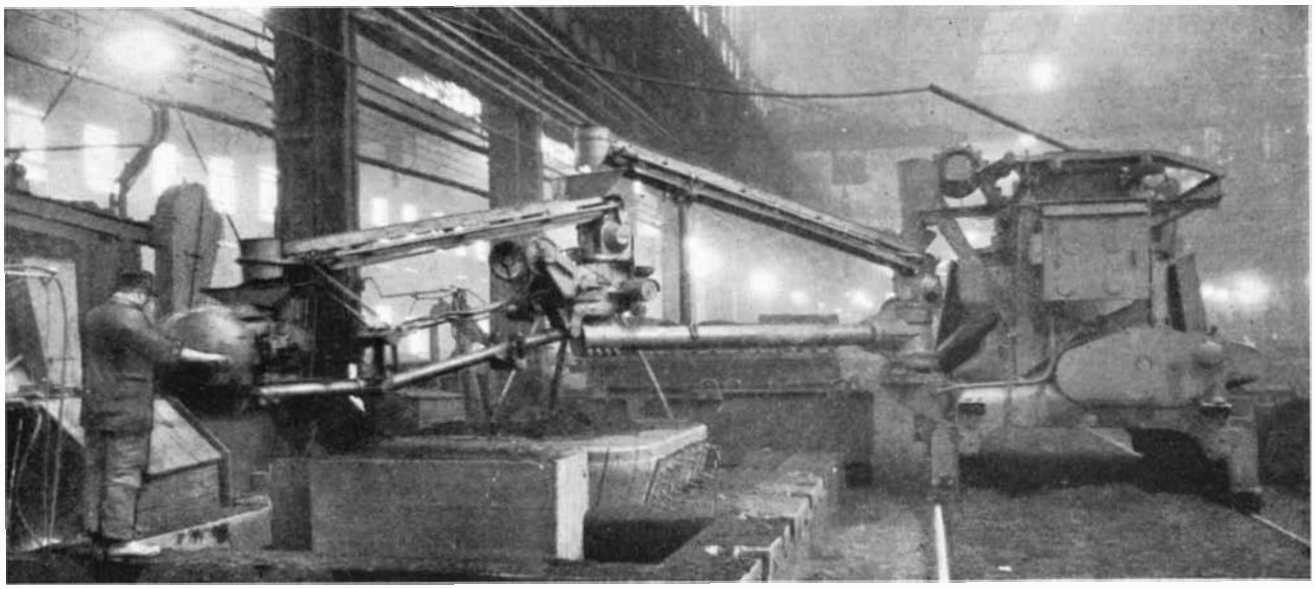
Inserting a bottle in its lead sheath



The outside container of Carborundum

It would seem that human ingenuity could scarce go further toward insuring the preservation of documents for 10,000 years plus or minus. Considering the single item of silk for the mourning bands, Mr. Yamaki reflects that there are silk wares today in Shosoin, at Nara, that were made 1200 years ago in the Tempei Era and which have retained their original forms in spite of all unfavorable conditions. He thinks that eight times their life may be reasonably expected of the silken mourning bands which with the other contents have been so sedulously protected. "In my opinion, however," he says, "the possibility of 10,000 years' preservation depends less on the technical features described than on the behaviour of future peoples." And he points to the avidity with which archeologists have delved into the intimate personal surroundings of the Pharaohs of 3000 years ago.

Perhaps the pathetic victims of Japan's catastrophe will rest as quietly whether their record comes to light a thousand years hence or four thousand or ten thousand, for humanity instinctively associates its future existence with Him of whom the psalmist wrote: "A thousand years in thy sight are but as yesterday, when it is past, and as a watch in the night."



The world's largest locomotive type sandslinger ramming up a pit mold

MECHANIZING A GIANT FOUNDRY

By J. B. NEALEY

BRINGING the variables under closer and closer control is an ever-present problem in foundry technique. New ideas and equipment with this purpose in view are being constantly devised and put into use. This modernization of foundry practice has been carried on at the two foundries of the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, to a remarkable degree.

This company manufactures gas engines, steam engines, turbines, condensers, and air and gas compressors, tractors, mining machinery, and many other large unit machines, as well as a large variety of specialty work. The heavy castings are made in No. 1 foundry, which is one of the world's largest. For example, the building of gas engines of 6000 horsepower or more includes castings requiring as high as 125 tons of molten metal at a single pouring.

METAL for the foundry is produced in six cupolas. One of these is for chilled or hard iron which is cast in iron molds, shaped for crusher heads ranging from 5 to 20 tons in weight each. More than eight million pounds of metal can be poured monthly in this foundry, while No. 2 foundry has capacity for five million pounds. All pouring is direct from cupola to flask with the crane service, and ladles running from 1½ to 30 tons are used.

Hand, machine, pit, and loam molding are all employed. Centrally located is a continuous molding unit for tractor parts. The various operations are centered in and about a continuous traveling conveyor, laid in the form of a loop 130 feet long and 40 feet wide. Inside are located a sand conditioner, shakeout stationary sandslinger, and turntable for making up the flasks, in the order named. One of the noticeable things about this unit is the absence of smoke and dirt in the air.

Flasks from the shakeout are put onto a roller conveyor which takes them, by gravity, to the turntable onto which they are transferred as needed. This turntable is equipped with patterns for two copes and two drags. One half the flask is rammed up with the sandslinger, transferred onto the loop conveyor, the core placed with a swing post crane and the other half rammed up and placed on top. The conveyor carries it along to the pouring station opposite the cupolas where the metal is poured.

The flasks travel around the loop to the shakeout station very nearly opposite to the pouring station. The flasks are set on a vibrating shakeout over a grid covered pipe through which all sand and smoke are sucked into a separator, outside the building, where all the dust, smoke, and foul air are removed and the sand dropped onto a traveling belt conveyor. This conveyor runs under the floor back to the molding unit where it meets an elevator conveyor which takes the sand up into the riddle and then into a sand muller. On

Photographs courtesy American Gas Association

The belt in foreground elevates sand to sandarator and hopper over sandslinger. The one in background carries sand from shakeout and separator to sand muller

the way up the sand passes under a magnet which removes any tramp iron and nails used in the molds. The sand is dropped into a muller from measuring hoppers, where new sand or binder is added; from the muller, the sand drops on to an inclined belt, which drops sand on to a sandarator mounted on top of a 40-ton storage tank. The aerator fills the tank level and aerates the sand. The 40-ton storage tank serves as a feeder for the sandslinger.

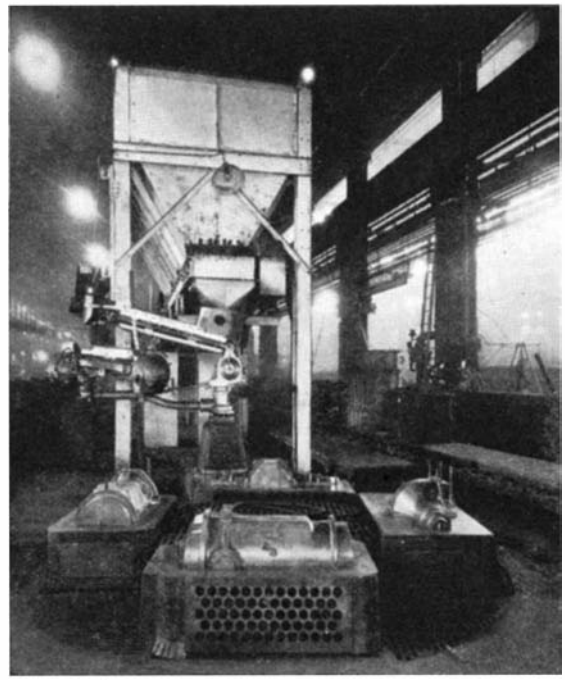
As the table revolves under the sandslinger head the molds are rammed. This molding unit will produce 120 castings per day with the labor of but nine men.

IN the center bay is located a 450-foot track on which operates a locomotive type sandslinger with a 27-foot arm for the propeller head. This is the largeest sandslinger of its type and was specially constructed for the Allis-Chalmers Company. On both sides of the tracks are rows of pits for pit molding, some as large as 42 by 14 by 10 feet. This sandslinger is also used in ramming up large molds as it goes up and down the track. After the molds are shaken out, the sand is placed between the sandslinger tracks by means of a grab bucket, and the sandslinger prepares the sand for re-use by wetting and riddling. It is then elevated and dropped into the sandslinger hopper feeding the propeller head.

Another track, parallel and located in the east bay, carries two locomotive type sandslingers smaller in size, one of which has a 12-foot ramming arm. The ramming is done on flask molds and the flasks are shaken out between the tracks, the sand to be removed by the sandslinger.

The loam molding section is in the south end of the center bay, and is served with two sand conditioners located in a gallery in the adjacent west bay and over the sand molding department. Giant molds and cores are built up to pattern with sweep boards on immense cast iron bases, the wooden pattern being first set up and a brick wall built to conform to the job. The face of the mold or core is then surfaced with loam or made of molding sand to give it smooth surface.

A "bug" or cast-iron ring is now lowered and placed in position around the cast-iron base and another brick shell is built up on this, and outside the first shell, to conform to the outer part of the pattern. When finished, the outer bug and shell are raised and placed on the floor close by to be loam surfaced on the inside. The two parts of the mold are then blackened and placed in giant core ovens, fired with gas, to be baked like cores. After they are baked they are put together ready for pouring.

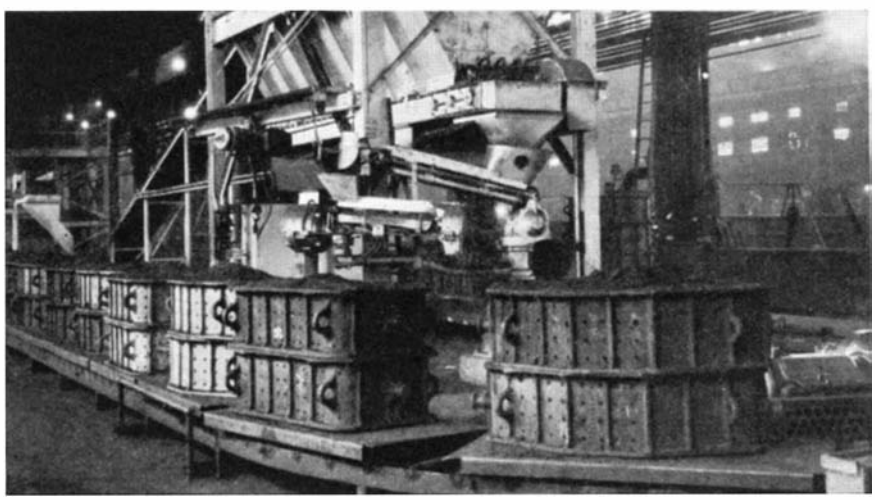


Continuous molding unit with turntable and patterns in foreground and sandslinger behind

The method of firing is by means of a two-pipe system, using air at approximately one pound pressure; the side burners are supplied with two rows of burner tips while the center burner has but one row of these tips. Stacks, two in number, are located in the top of the oven and are equipped with dampers, while fresh air is brought into the oven and to the burners by air ducts extending laterally and under each burner. This oven consumes about 1320 cubic feet of gas per ton of dried cores, the work consisting of a large variety of sizes.

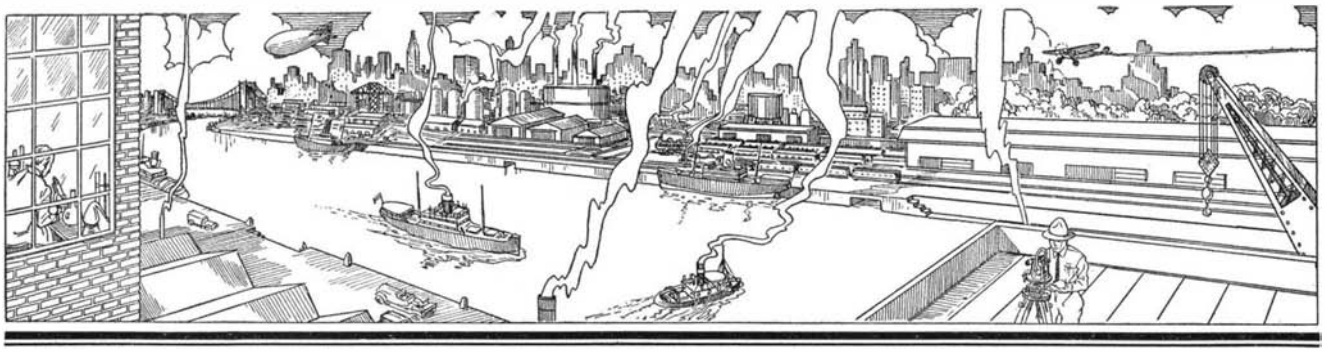
While there are several core making units, set up at different places in this foundry, mention will be made only of that for tractor cores. Here is located a core sand conditioning machine with overhead bins and automatic scales, the sand being ground with water, oil, and so forth, between steel wheels rotating against a steel bottom plate and revolving about a vertical shaft. The correct amount of oil for each batch is obtained through the use of an air operated valve on the oil supply line which automatically shuts off when the right volume has passed through.

This prepared sand is elevated by bucket conveyor to hoppers which drop it onto belt conveyors which take it to points just over the core makers where it drops by gravity and through chutes directly into the core boxes on molding machines. The sand feed is started and an automatic device shuts off the flow when the correct amount, for the core being made, has dropped into the machine.



Continuous flask conveyor with molding unit and completed flasks. Turntable and patterns visible at extreme right, and sand conditioner in left background

ONE of the unique pieces of equipment in this foundry is a specially designed washer where the cores and sand are forced out of the casting hydraulically and at the same time the castings are cleaned. This machine is housed in a concrete chamber 48 feet long, 20 feet high, and 42 feet wide. The steel top doors and front doors are automatically, electrically operated and the castings are lowered into it with cranes and set on a cast-iron table that revolves. Three stages of nozzles are located one stage above the other and the water from these is played on the castings with the aid of an arm that extends outside the structure. These nozzles are manipulated by men who stand in front of windows where they can observe the play of water as they work. The water and sand flow into settling tanks from which the sand is removed by a grab bucket.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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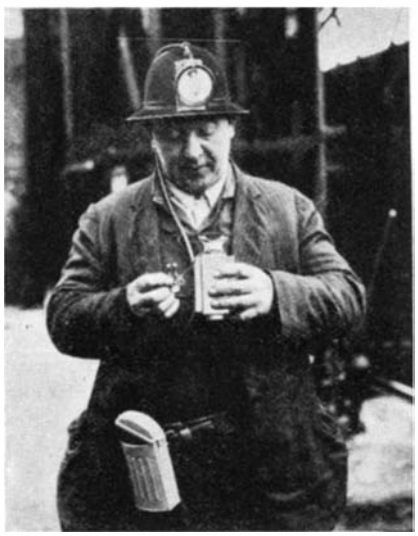
Self-Rescuer for Mines

IT very often happens that when an explosion occurs in a mine, shafts or passageways are blocked so that a number of miners are entombed alive. When this happens and afterdamp is present, the feverish efforts of rescuers are often of no avail



Demonstrating the self-rescuer. Note nose clips and mouth grip

because the entombed miners may die of gas poisoning in a short time.

The improved self-rescuer which has been developed by the Mines Safety Appliance Company, gives the miner an extra lease on life despite any poisonous gases that may be present. This small device is a miniature gas mask consisting of a small canister with a mouthpiece directly attached and provided with filters for keeping out smoke and a chemical for transforming deadly carbon monoxide, the poisonous constituent of afterdamp, into harmless carbon dioxide. The mouthpiece is gripped tightly under the lips by pressure of the teeth on lugs, while a small clamp fastens over the nostrils to force mouth breathing only.

The self-rescuer weighs only 14½ ounces and is conveniently carried on the belt—for which a holder is provided—or in the pocket. In the event of a fire or an explosion, a miner wearing a self-rescuer can travel for about 30 to 70 minutes in any concentration of carbon monoxide likely to be encountered.

The United States Bureau of Mines says that "although the self-rescuer does not supply oxygen, it does remove the hazards of carbon monoxide for half an hour or more and thus greatly increases the miner's chances of getting out alive. Thus the self-rescuer is a life saver for the miner and is as essential in mines as life preservers on ships."

Blood Donors

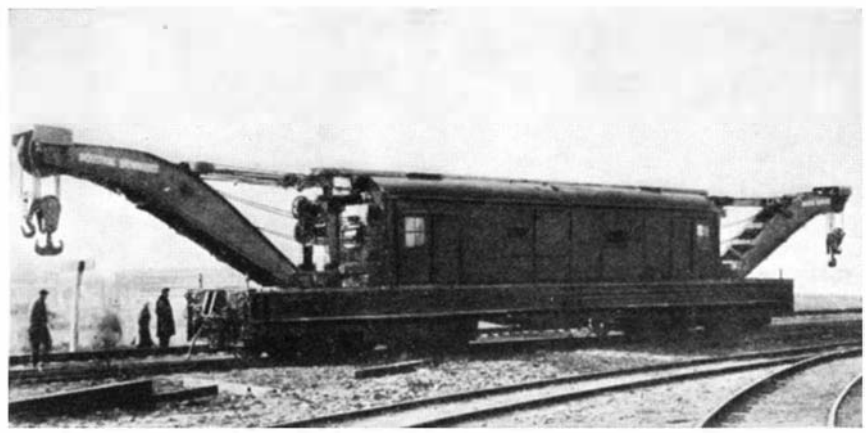
NEWSPAPERS recently reported the death of a blood donor who had provided blood for more than 200 transfusions. In general, the donation of blood is safe, provided too much is not given at any one time or that quantities too large are not taken too frequently. In a recent report of the subject, Drs. H. W. Jones, Herbert Widing, and Lyle Nelson have made a study of reactions to loss of blood in 500 donors who have provided fluid for more than 4000 transfusions. The majority felt improved by the bleeding, the skin seemed clearer, and several with acne reported the disappearance of the lesions. Some who were chronically constipated had normal intestinal function after bleeding.

After a person has contributed blood, he takes a diet rich in meat and green vegetables for the following week. If as much as 400 cubic centimeters or almost a pint of blood is taken, the number of red cells drops about 300,000 red cells per cubic centimeter, and the red coloring matter drops about 4 percent. The average immediate loss of weight is from one half pound to one pound. It was found that women cannot give blood as freely as can men, and that tall, wiry, robust donors between the ages of 30 and 40 stand the loss of blood better than do those who are short, and better than those who are tall but fat. The usual price paid for one gill to one pint of blood is from 25 to 50 dollars.—*M. F.*

First Gasoline Powered Wrecking Crane

A SPECIAL 105-ton capacity, gasoline-powered, Industrial Brownhoist, double-ended wrecking crane was recently demonstrated before a number of prominent railroad officials at Bay City, Michigan. This machine is designed to work in underground tunnels where clearances are close and is the first wrecking crane to be powered by gasoline engines. It will be placed in operation at the Cleveland Union Terminal and a duplicate crane is now being built for the Grand Central Terminal in New York.

These cranes have a capacity of 105 tons at either end and are equipped with three independent power units, any one of which will run the machine. These units consist of two 225-horsepower gasoline engines directly connected to 350-ampere, 400-volt direct current generators and one 208-cell



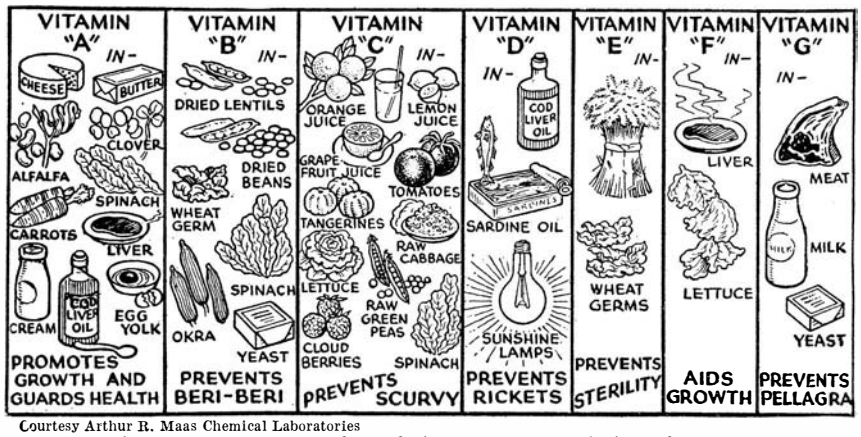
The first gasoline-powered wrecking crane has a capacity of 105 tons

storage battery. All crane movements are electrically operated and the machines travel approximately 33 miles per hour under their own power.

Seven Vitamins—Each Has a Function

THERE is still a great deal to be learned about vitamins and, as James H. Collins points out in a recent issue of *Chemistry and You*, there are still opportunities for commercial development of new ways of utilizing these valuable food adjuncts. Thus, for example, some way might be found to utilize the vitamins now thrown away with the large percentage of trimmings taken from lettuce before shipment. Spinach, carrots, okra, green peas, tomatoes, and other vegetables contain various vitamins. Alfalfa and clover are excellent sources of vitamin A, and while not likely to be popular with people, are important for the health of farm animals, which are important for people.

We are indebted to Mr. Collins for epitomizing the occurrence and functions of seven known vitamins by means of the accompanying illustration.—*A. E. B.*



Courtesy Arthur R. Maas Chemical Laboratories

The seven vitamins, a few of their sources, and their functions

Evade Sugar Duty by Shipping in Solution

A FLAW in the new tariff act has been capitalized by importers of sugar to dodge the duty of two cents a pound levied on raw Cuban sugar. Under the new law, Cuban raw sugar pays a duty of two cents per pound. Mixtures of sugar and water testing from 50 to 75 percent sucrose are dutiable at a rate of 1.7125 cents a pound plus 0.375 cents for each additional percent. But no provision was made for mixtures testing 50 percent and under. So wily importers had their consignments of sugar shipped in solution, claiming that such a product falls under the "sugar syrup" classification with a duty of only one-quarter cent per gallon. The sugar is, of course, crystallized from solution after it arrives in this country.

Raw sugar imports contribute 100,000,000 dollars annually to the duties collected on United States imports. Therefore, this defect in the tariff law may permit the evasion of a very considerable sum unless Congress or the courts take remedial action.

Natural chemistry may also block the practice, for sugar solution inverts rapidly into dextrose and levulose, and cannot be converted back to sucrose; it ferments quickly, particularly in the warm temperatures of the subtropics. One tanker put into Philadelphia with the sugar foaming from the hatches as a result of fermentation. Useless as sugar, the cargo was sent to a distillery where the process of converting the solution into alcohol was completed.—*A. E. B.*

Vacuum-Oiling Eggs to Preserve Them

CHEMISTS in the United States Department of Agriculture have gone a long way toward improving the reputation of storage eggs. A method just developed seals into the egg all of its original moisture and carbon dioxide, so that it will come from storage nine months later with all the freshness of youth.

What usually happens when eggs are put in cold storage is that they lose a considerable amount of moisture and carbon dioxide. The more of these constituents lost, the more the quality of the egg is lowered.

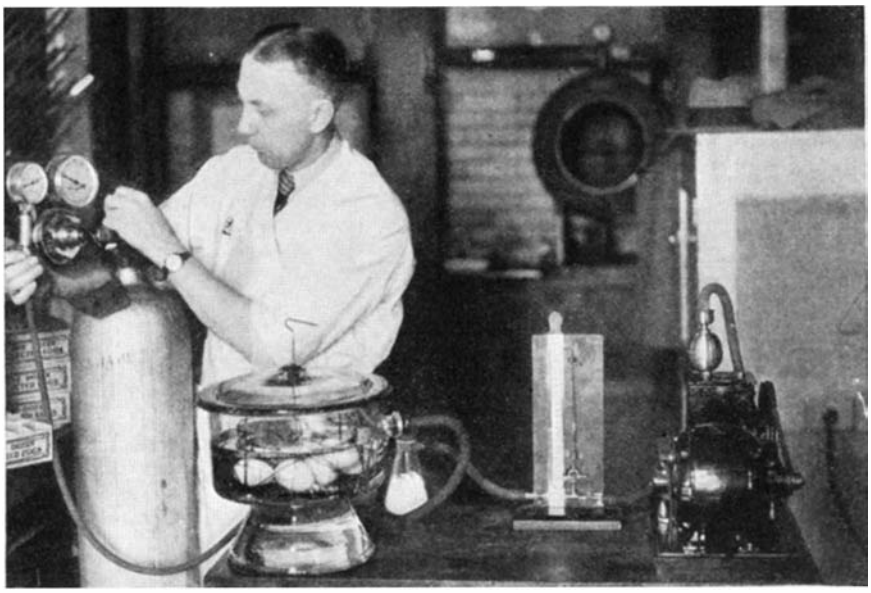
Egg shells are porous, but when dipped in oil the pores are sealed. Shippers in the west discovered some time ago that they could dip their eggs in open vessels before putting them in storage and prevent some of the loss of moisture and carbon dioxide. What the Federal scientists have done is to go a step farther and do the oiling in an air-tight chamber, from which some of the air has been pumped.

Surrounded by a partial vacuum, the egg not only drinks up the oil but also gives up a small part of the air it contained. The next step is to turn carbon dioxide into the vessel. With the outside air pressure again normal, the egg draws some of the carbon dioxide inside the shell. As the carbon dioxide penetrates the shell it carries a film of oil with it and forms a seal in the inner membrane.

The vacuum makes it possible to draw nearly four and one half times as much oil into the shell as is possible when the dipping is done in open vessels. After 10 months of storage, vacuum-dipped eggs have lost only 1/10 of 1 percent of their weight, while eggs oiled in open vessels lost 16 times as much, and untreated eggs nearly 27 times as much.

A high grade of mineral oil is used for oiling the eggs, and tests have shown that it does not hurt the quality of the eggs in any way. When broken after 10 months of storage, vacuum-dipped eggs compare favorably with those only one or two days old, and the table quality is said to be just as good.

The process for vacuum-dipping and carbonating eggs was developed by T. L. Swenson and associates in the Bureau of Chemistry and Soils. Mr. Swenson has obtained a public service patent on the process, and already plans are being made to put the plan into operation on a commercial scale.



Preserving eggs by first placing them in a partially evacuated vessel and then giving them a "dose" of carbon dioxide and oil. They are preserved for months

Longest Natural Gas Pipe Line

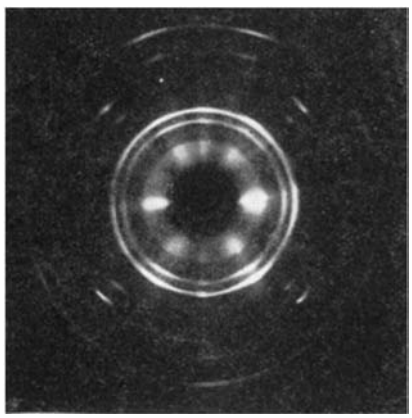
THE last link in the world's longest natural gas pipe line, which will bring gas from Texas to Chicago and surrounding territory, will be completed about July 1, according to the terms of a contract awarded by the Continental Construction Company to Ford, Bacon & Davis, Inc., engineers. Compressor (pumping) stations, and other adjuncts of the line, will not be ready for transporting the gas itself until some time in the fall.

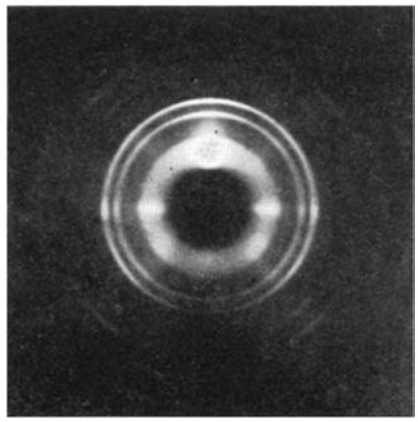
This last, or seventh, section of the pipe line will extend from Rock Island to Joliet, a distance of 155 miles. Like the rest of the line—950 miles long from Texas to Joliet—it will be 24 inches in diameter. At Joliet it will connect with the pipe line system for distributing the gas to the Chicago district.

Because of the time provisions of the

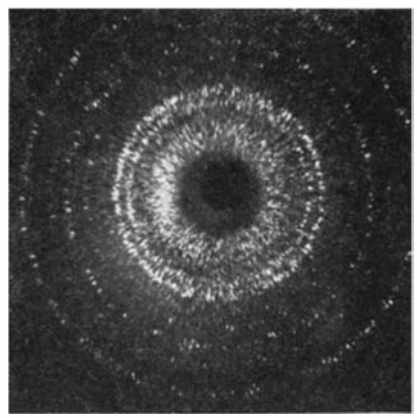
contract, which put a premium on speed, a large amount of equipment is being used on the job. About 100 tractors, trucks and ditching machines are in service. About 50,000 tons of steel pipe and fittings are being transported and placed in service.

In operation, the pipe line will carry natural gas from the Texas Panhandle to northern Illinois at pressures up to 600 pounds per square inch. To maintain this pressure, 10 compressor stations will be placed along the line. Together, they will have engines of 65,000 horsepower. The largest of these stations—and the largest compressor station in the world—is under construction at Borger, Texas. It will have 12 compressors of 1250 horsepower each.





Above: **Diffraction pattern which, by the sharp concentric circles, shows that the crystals are arranged in one direction, giving the steel "directional" properties so that it tends to split with the grain.** *At left:* **Another sample of rolled steel showing objectionable directional properties.** *At right:* **After the steel had been properly heat-treated, the X ray revealed a re-distribution of the crystals into a heterogeneous arrangement which eliminates any directional property. This steel is equally strong in all directions**



Novel Motorboat Engine

A NEW type of marine engine for small power boats was recently designed by a shop in Maryland.

About six such motors were fabricated by the shop which obtained old four-cylinder motors taken out of scrapped or used cars and cut them in half, as small boats of this type usually employ two-cylinder engines. It was necessary for the shop to make up the extra parts and weld up the half sections. The open end of the water jacket, caused by cutting in two, had to be welded up as well as the cylinder head. The crankcase was also shortened and welded up. These cast-iron parts were preheated by means of a charcoal fire and the necessary welds were made using a cast-iron welding rod. After the preheating, welding, and annealing, the castings were in first-class condition, as a result of observing the correct procedure.

Another interesting feature of this redesigned motorboat engine was that the crank shaft had to be cut in two places in order to re-arrange the throws and then the pieces had to be welded together again. Steel welding rod was used to weld the shaft.—*Oxy-Acetylene Tips.*

X Rays Reveal Minute World to the Chemist

EVERYONE appreciates the value of the X ray in photographing broken bones and recording other internal conditions of the human body necessary for modern medical diagnosis. Only the chemist appreciates the value of the X ray in photographing the "bones" or internal structural arrangements of inanimate substances, for by means of the X ray he has discovered a fascinating new world in the molecules of matter where distances are measured in billionths of an inch and where the wonders of nature are hidden from even the most powerful microscope.

By passing a beam of X rays through a tiny piece of matter, the expert can obtain a photograph from which he can calculate the size and shape of the unit cells which compose the matter, the structural arrangement of molecules in a compound, the number and distribution of atoms in the molecule, and a dozen secrets formerly hidden from the eye of man, although deduced, in part, by his brain. Thus it is possible to identify an unknown substance, and to study the mechanism of the changes it undergoes as it ages or the existence of internal stresses which affect its physical properties.

While such studies involve a highly complicated and theoretical science, they have a very practical significance. Thus, for example, the quality of steel used in automobiles has been studied by H. V. Anderson, of Lehigh University, who recently presented some interesting results of his work before the American Chemical Society. His studies reveal the reason why steel must be heat-treated after rolling, and give the steel manufacturer a positive check on the efficacy of the heat-treating process. Another interesting investigation by Professor Anderson reveals the internal structure of asbestos and makes clear why one grade of asbestos is superior to another for service as brake linings, for example. The accompanying illustrations show some of Professor Anderson's typical X-ray diffraction patterns.—*A. E. B.*

Milk-Sensitive Babies

THERE was a time when severe skin eruptions of any kind, particularly on a baby, were called eczema. In the last 15 years much more has been learned about the subject so that now eczema has been divided into a number of conditions, including a general pustular infection of the skin, scabies, or itch, and similar disorders. One type of eruption on the skin in infants seems to be due to various sensitivities to food or to similar substances. In one instance a child was found to be sensitive to orris root in its mother's face powder, which developed in the child not only skin eruption but also asthma.

Among the most difficult types are those due to sensitivity to milk. In these cases it is possible to provide for the infant a food combination that does not contain milk, based largely on a combination of soy-bean flour with other substances. Soy-bean flour is taken as the source of the protein, because it is rich in protein and contains the correct amino acids for growth. The formula also contains, in addition to 67.5 percent soy-bean flour, 9.5 percent barley flour, 19 percent of olive oil, 1.3 percent sodium chloride, and 2.7 percent calcium carbonate. Soy-bean flour is defective in calcium, sodium, and chlorine, but contains adequate amounts of magnesium, potassium, and phosphorus. Since this combination is not especially rich in vitamins, orange juice and cod-liver oil are always given as they are given with other types of infant feeding. —*M.F.*

Circuit Breakers to Protect House Circuits

FOR the protection of electrical circuits in the home and for providing at the same time convenient means for restoring service after a circuit has been overloaded and subsequently opened, a small circuit breaker has been developed by the Westinghouse Electric and Manufacturing Company. The use of this device eliminates all dependence upon fuses for circuit protection and avoids the inconveniences of replacement attending their use. This device can also be operated as an ordinary "off" and "on" switch to control the circuits as desired.

The tripping action is not instantaneous, however, but the time of operation of the tripping mechanism is in inverse ratio to the amount of current passing through the device. Thus a small overload, say 10 percent, takes about half an hour to trip the breaker. As the current increases, the time of operation of the trip decreases—always protecting the wire with an adequate margin of safety. A short-circuit causes the device to open the circuit almost instantaneously.

Because of the inconvenience of replacing blown fuses, people are tempted to use fuses

rated at more than the permissable rating of the circuit or to bridge the fuse with a coin or other piece of metal. This situation has led to the demand for a small circuit breaker to protect branch circuits.

The switch is of the toggle type with the fixed center mounted on a swinging arm. This arm is ordinarily latched under a catch on the bimetallic thermal over-current unit or thermostat. As long as this arm remains latched under, the switch operates as any other toggle switch. As the current passing through the thermal unit increases, the bimetallic unit, being composed of two metals of unequal coefficients of expansion, bends more and more until, when the current exceeds a certain limit, it releases the latch; the end of the toggle moves out of line; and the toggle promptly collapses and opens the switch.

Making the time of operation of the tripping mechanism inversely proportional to the amount of current passing permits a slight overload of short duration which would do no harm to the wiring. Therefore, if several electrical appliances happen to be connected on one circuit for a short period of time, the service will not be needlessly interrupted.

Even if the breaker is closed while the circuit is overloaded, it only opens again, tripping free of the handle. Because of this "trip-free" arrangement of the handle, it is impossible to hold the breaker handle closed when the circuit is dangerously overloaded.

A group of these small circuit breakers, mounted on a single panel and located at a central point in a house, provides a convenient method of controlling the branch circuits.

How Physicians Die

DURING 1930, a total of 2943 physicians died in the United States. The average age at time of death was 63.7 years, a decrease of about a year from the average age of 1929, which was 64.9. The oldest was 97 and the youngest 23. Sixty-six doctors died in automobile accidents, 24 from falls, 8 from gunshot wounds, 5 from overdoses of medicine, and 3 from airplane accidents. One was kicked by a cow and one swallowed a dental plate.

Sixty-six physicians committed suicide in 1930, which was 19 more than 1929. The method most frequently employed was shooting, which accounted for 33 deaths. Seven cut their arteries, and seven took poison; six inhaled gas; four hung themselves; two died through overdoses of drugs, and two by drowning; and one jumped from a high place. These facts, alone, should indicate the temporary mental aberration of suicides, since certainly physicians are informed of relatively painless and certain methods of causing death which they might have used instead of the shooting and hanging routes to oblivion.

Physicians, as do the rest of the public, die in the large majority of cases from heart disease, high blood pressure, brain hemorrhage, pneumonia, diseases of the kidneys, and cancer. Physicians are often asked why their mortality rates are higher than those of the rest of the public and why, in general, they seem to die at an earlier age. The answer should be obvious. They are constantly exposed to all types of weather, they work long hours, and they are in intimate contact with infection.—*M. F.*

American Scientist Gets Unusual German Honor

A MOST unusual procedure in granting academic honors was followed in the presentation at the German embassy in Washington, on April 27, of an honorary Ph.D. from the University of Berlin to an American scientist, Prof. R. W. Wood of the Johns Hopkins University. Professor Wood is on the SCIENTIFIC AMERICAN staff of contributing editors.

It is a very exceptional thing for the degree of Ph.D. to be granted as an honor; it usually follows the establishment of a stated residence and the performance of definite research at the granting university. The University of Berlin, moreover, is very sparing about the granting of any honorary degrees at all, and to confer one on a foreigner at the distance of a whole week's travel from its campus is almost unheard-of. By going to the German Embassy, however, Professor Wood entered what is legally German territory.

The diploma of the degree, which was handed to Prof. Wood, was brought from Germany by Prof. F. Henning, director of the division of heat and pressure of the German Reichsanstalt in Berlin, who is now working with Dr. H. C. Dickinson at the United States Bureau of Standards.

Professor Wood, who has built an international reputation as an experimental physicist, was a graduate student at the University of Berlin from 1894 to 1896. He has been professor of experimental physics at the Johns Hopkins University since 1901. He is recognized as one of the most versatile men in American science, although his chief interest lies in the field of optical physics.

Like Charles L. Dodgson, who achieved fame under the pen-name of Lewis Carroll as writer of the delightful "Alice in Wonderland," Professor Wood has found time to produce some excellent nonsense literature aside from his more serious output. His "How to Tell the Birds from the Flowers" and "Animal Analogues" have a wide and delighted reading public among people who know and care little about optical physics.—*Science Service.*

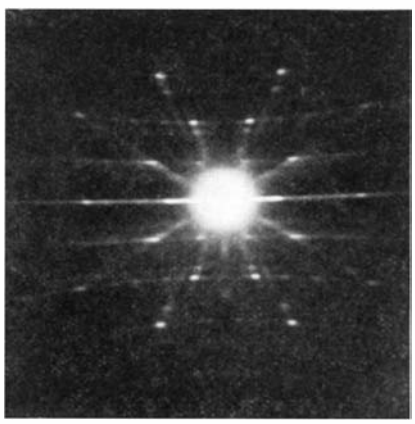
New Process Used in Making Soft Drinks

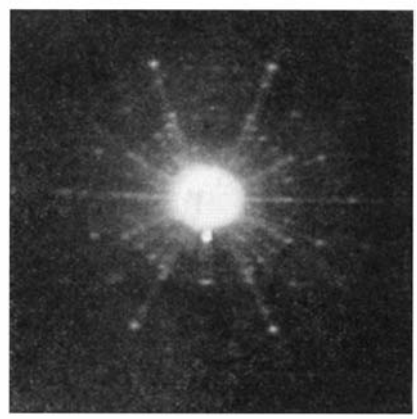
FREEZING, to concentrate or to preserve fruit juices for beverage purposes, is developing rapidly, according to an editorial writer in a recent issue of *Food Industries.* The trend closely parallels the trend away from the old style, imitation-flavored carbonated drinks toward genuine fruit flavors for this class of beverages.

A development that is slowly emerging from the research stage into commercial tests is the Heyman process, by which sterile carbonated beverages are produced by pasteurizing before carbonating. Concentrated syrups are heated to pasteurizing temperatures, then measured into sterile bottles, and next filled with sterile boiling hot water under pressure. Still under pressure, the neck space is now filled with compressed carbon dioxide gas and the bottle is capped. After cooling, the carbon dioxide is absorbed by the liquid.

A variation of the process, for chocolate milk, is the addition to sterile bottles, of a hot liquid concentrate made from a mixture of powdered milk and cocoa powder with sugar, followed by filling with water at 260 degrees Fahrenheit under pressure, capping, and cooling at an appropriate rate. Here the temperature is high enough to sterilize the entire contents of the bottle.

The "Electropure" system of electrical





At left: **A sample of good quality asbestos as it comes from the mines shows a definite cellular arrangement which is responsible for the fibrous structure.** ***At right:*** **When this asbestos is heated for 24 hours at 900 degrees Centigrade, it loses its fibrous structure and becomes soft and crumbly.** ***Below:*** **The same fiber, treated with hydrochloric acid, loses its fibrous structure and produces a pattern like an amorphous substance. This is due to the removal of the hydrated silicate minerals of the native asbestos**

pasteurization, which has been used with success in the dairy industry, is being tested experimentally in the beverage field for the production of sterile fruit juices without impairing the flavor.

Fruit juices are preserved in another way by evaporation in a vacuum at a very low temperature to a thick liquid, which is then mixed with granulated sugar and dried. This gives a crystallized product for shipment to bottlers.—*A. E. B.*

Liver Extract in the Veins

IT has long been recognized that direct injection of remedies into the veins secures more prompt, and in many instances more potent, action than the use of the same remedies taken by mouth, injected into the intestines, or even under the skin. This is particularly true of extracts of the various glands of the body which pour their secretions directly into the blood—the so-called glands of internal secretion.

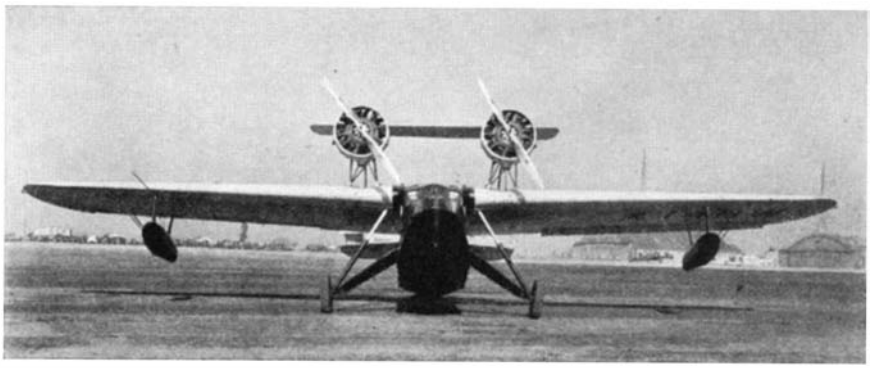
One of the greatest of modern discoveries is the method of prolonging the life of those with pernicious anemia by the feeding of liver. These patients, whose blood is impoverished both as to the number of red blood cells and red coloring matter, promptly improve when large amounts of liver are taken in the diet or when they are given liver extracts of various types. Sometimes, however, they are in such serious condition when they first come to medical attention that every moment of delay may be serious. It is for such cases particularly that Drs. William B. Castle and F. H. Laskey Taylor of the department of medicine in Harvard University Medical School have developed a form of liver that can be injected directly into the veins.

It was found some years ago that the injection of extract of liver promptly lowered the blood pressure; in fact, so promptly that the results were harmful in some cases. It has been found that this lowering effect can be overcome if the material is injected slowly and if the blood pressure is closely watched during the time of the injection. Whereas the feeding of liver by mouth produces a reaction in approximately 10 days, the injection of this new extract directly into the vein produces a maximal response in the form of building of new blood cells within five days. Furthermore, the amount injected is small compared with the total amount that may be fed to the patient.

Investigators in the University of Michigan got a maximal response in 10 days from 3000 grams of liver given at a single dose by a stomach tube. By the new method, maximal response was obtained in five days, giving an extract derived from 100 grams of liver by the vein in one dose. It is significant in medical science that any new discovery is promptly followed by intensive research which brings rapid improvement. Of this type is the continued work on liver extract in pernicious anemia.—*M. F.*

Smoothing Flow Past the Engine

AS we have often pointed out, the radial air-cooled engine, with its projecting cylinders, has a great deal of resistance. Unfortunately, the exposed engine cylinders not only produce drag themselves but also disturb the flow in relation to other parts of the machine.

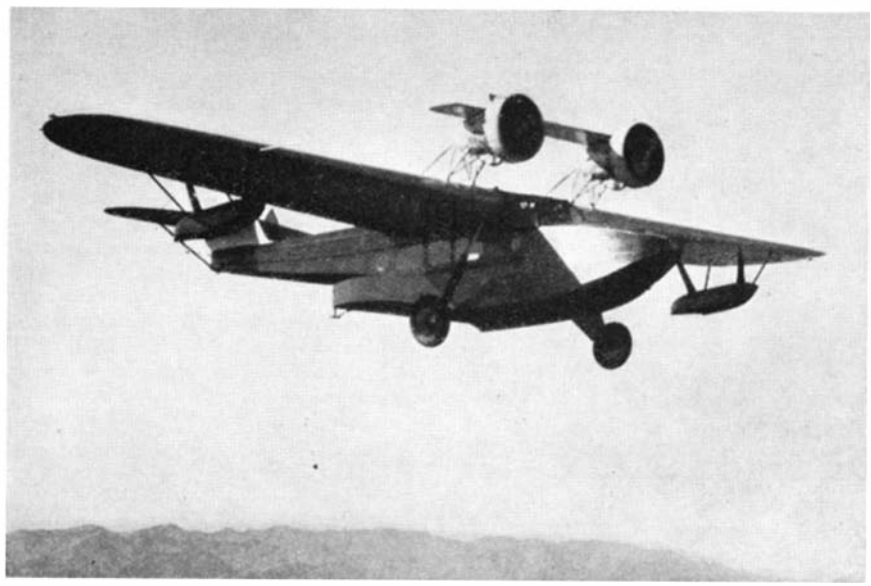


The plane on which the Townend ring or cowl has been used to smooth the flow past the air-cooled engines. Note also the auxiliary wing behind the engines

In the Douglas Commercial Amphibion, the engines, mounted high above the wing, have around them the now familiar Townend ring or cowl for anti-drag effect. In addition to this, a small auxiliary wing is mounted behind the two nacelles and it is claimed that this also helps to smooth out the flow and to diminish the aerodynamic interference between the engine and the wing.

The Commercial Amphibion with its two Wright 300-horsepower engines, carries a crew of one, five passengers and a useful load of 2395 pounds; and has a gross weight of 8000 pounds, a range of 600 miles, and a top speed of 136 miles per hour.

The wheels are mounted at the ends of what amount to small strut airfoils on each side. This is another useful aerodynamic refinement.—*A. K.*



The Douglas Commercial Amphibion in flight

The Latest in Wind Vanes

THE wind cone or "sock" has one big advantage; when the wind drops, the sock droops. The pilot then knows that there is no tail wind to worry him when landing, with excessive speeds relative to the ground and excessive length of landing run. But he does not know what is the direction of the greatest length of the field, the direction which he should follow on landing. The conventional T-type wind vane suffers from a similar defect. When the wind falls, the T may remain at rest pointing in the direction of the last prevailing gust.

The *Aeroplane* describes an ingenious form of wind indicator which overcomes this defect.

The Martin Wind Indicator is in the form of an arrow about 20 feet long, the shaft of which is in the form of a light girder, with "barb" and "feather" formed of yellow-doped surfaces. The surfaces include both vertical and horizontal areas so that the arrow appears as such from above and from the side, and the bright yellow finish makes it very conspicuous.

The feather or tail surfaces are very much larger than the front or "barb" surfaces, and this serves to keep the indicator pointing into the wind, just as with conventional wind vanes.

When the wind drops below five miles an hour, however, the indicator points into a pre-determined direction. This is achieved in a very simple yet ingenious way. The axis about which the indicator rotates runs in ball-races immersed in oil so that the indicator is very sensitive, and this axis is tilted slightly forward, in a pre-determined direction. The indicator has its center of gravity a little ahead of the axis of rotation. Therefore there is a slight turning moment which causes the vane to rotate into such a position that the center of gravity is at the lowest possible point.

When the wind is too weak to overcome this turning moment, the arrow points in the direction of the greater length of the field.

The arrow is wired for night use with red lights, and the current reaches them through a simple slip ring. Each arm of the main girder is hinged, so that it can be unfastened and folded downwards at the axis when bulbs are to be replaced or minor repairs are to be made.

Why did no one think of this gravitational control before?—*A. K.*

Electrical Construction Equipment for Hoover Dam

THE Westinghouse Electric and Manufacturing Company has been awarded contract for electrical construction equipment of Hoover Dam, part of the Boulder Canyon project. It includes motors and control for driving all electrical shovels, hoists, pumps, conveyors, and compressors; locomotives, switching equipment, circuit breakers, switchboards and transformers, lightning arresters, and meters. A large part of the equipment will be built in the Oakland, California, plant.—*Barron's.*

Aeronautical Meteorology

THE second "Aeronautical Edition of Meteorology" by Willis Ray Gregg, is just as sound and scholarly as the first one, with the addition of much pertinent and practical information.

For example, Chapter II—Instruments and Methods of Observation—has been brought completely up to date.

Pilot balloon theodolites are now in common use for measuring the height of ceilings; that is, the height of the underside of the lowest cloud layer at the point of observation. Accurate knowledge of this height, which is included in all airways observations, is of great importance since the pilot, as a rule, prefers to fly beneath the clouds, rather than to fly blind above.

Measurement of the height of ceiling is accomplished in a number of ways: One is by pilot balloon observations. The height is obtained by multiplying the ascensional rate of the balloon by the number of minutes from the time of release, until the balloon disappears or enters the lower cloud layer. The theodolite has to be used, of course, in conjunction with the balloon. At night a special ceiling light projector is used. This is an electric searchlight which throws a spot of light on the underside of the cloud layer. The height of the light spot is found by the use of a so-called Alidade, a ceiling-height indicator.

A great deal has recently been added to our knowledge of atmospheric visibility, both by outdoor and by laboratory experimentation. The layman is apt to speak of fog in very vague terms. The meteorologist has a very definite scale which is highly convenient to the aircraft operator in transmitting reports. Few of us know that the following accurate scale is now in use:

Scale	Descriptive Terms	Limiting Distance
0	Dense fog-prominent objects not visible at	55 yds.
1	Very bad-prominent objects not visible at..	220 "
2	Bad-prominent objects not visible at.....	550 "
3	Very poor-prominent objects not visible at..	1100 "
4	Poor-prominent objects not visible at....	1¼ miles
5	Indifferent-prominent objects not visible at.....	2½ "
6	Fair-prominent objects not visible at.....	6¼ "
7	Good-prominent objects not visible at.....	12½ "
8	Very good-prominent objects not visible at.....	31 "
9	Excellent-prominent objects visible beyond	31 "

The conditions of ice formation are well understood and once understood can be avoided, and Mr. Gregg discusses them fully. Ice increases the air resistance of the wings and exposed parts of the plane, decreases the lift of the wings, and adds to the load.

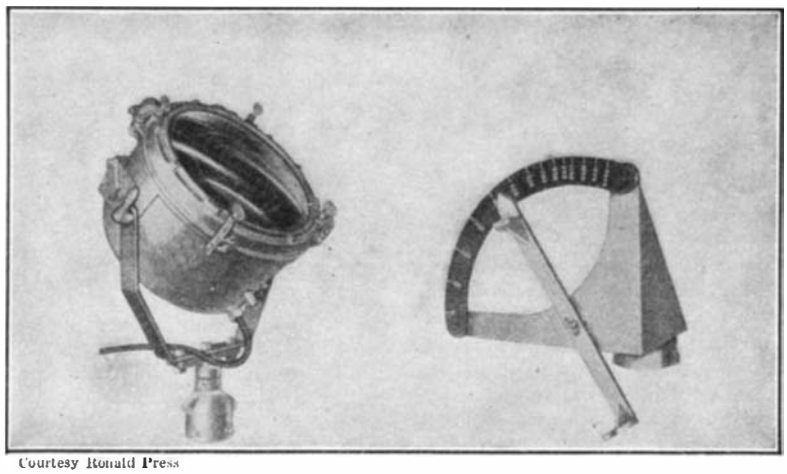
The increase of drag is due to two important causes: 1. The direct enlargement of wings, struts, wires, and so on, thus opposing greater area to the wind. 2. By the rough or rippled surfaces of ice formation which adds materially to surface friction.

The decrease of lift results from altered wing curvature; the shoulder of ice usually forms first on the upper portion of the leading edge, changing the lift of the airfoil materially, the process being rapidly aggravated by further increase in the size of the shoulder.

Dangerous vibration stresses are also set up by ice. When the propeller blade collects ice unequally, vibration will be particularly serious and may break the airscrew.

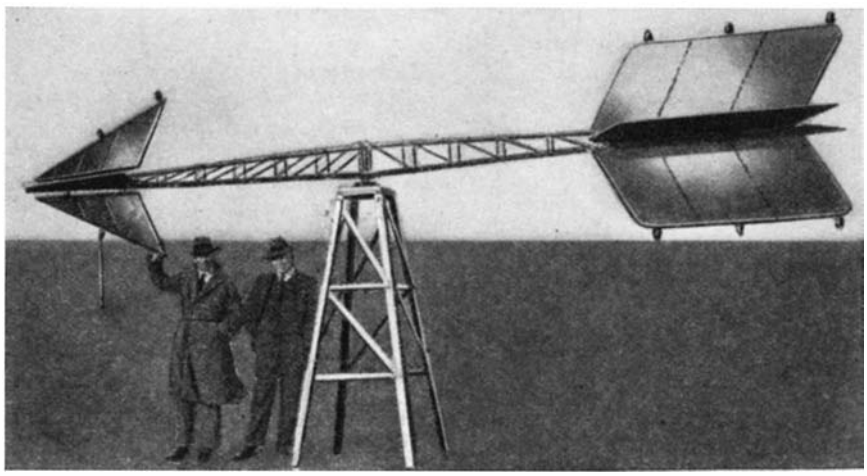
Ice is now being fought by warning the pilots of the conditions likely to lead to ice formation, and by the use of instruments which indicate temperature conditions likely to give rise to ice.

The book ends with a description of the splendid airways weather service now available in the United States.—*A. K.*



Courtesy Ronald Press

Type of searchlight used for spotting the underside of a cloud at night and the Alidade with which is found the height of the light spot



The Martin wind indicator which incorporates several new features

Vapor Lock

RECENTLY in Detroit, Dr. O. C. Bridgeman, Research Associate of the Bureau of Standards, was awarded the much prized "Manley Memorial Medal" given annually by the Society of Automotive Engineers to "the author of the best paper relating to theory or practice in the design or construction of air research on aeronautic power plants or their parts or accessories"—a most formidable definition.

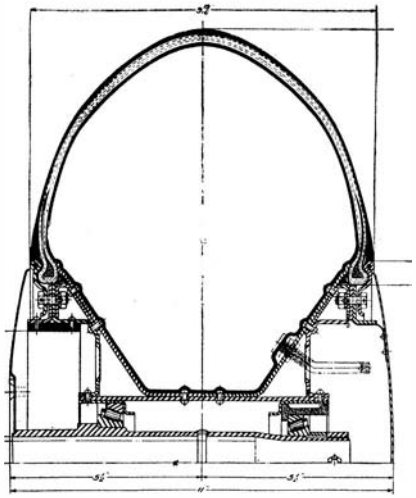
The subject of Dr. Bridgeman's paper was "The Effect of Airplane Fuel Line Design on Vapor Lock."

"Vapor lock" means the interruption in the flow of gasoline from the fuel tank to the carbureter due to the boiling of the liquid fuel at some point in the feed system. (See also page 194, March, 1931 SCIENTIFIC AMERICAN.—*Editor.*)

Vapor lock to the automobilist is merely an annoyance, but to an airplane pilot, it is much more serious. Vapor lock may cause the engine to quit suddenly on a take-off and so induce the dangerous stall and spin. The elimination of vapor lock in the airplane power plant would, therefore, be a real contribution to safety.

Fuel feed systems in the airplane may be divided into two general classes: Gravity feed systems, in which the tank is placed high up in the wing so as to give the fuel a large head above the carbureter; and pressure feed systems, in which a fuel pump is employed.

To eliminate vapor lock in a gravity system, the remedies are simple. The tub-



Manner in which the streamlined tire fastens to the airplane wheel

ing must be large, all unnecessary bends in the system must be eliminated and the piping should have a uniform cross-sectional area throughout its length. Bends in the line trap any fuel which has boiled; that is, any that has been converted into gaseous form. Sudden changes in cross-section of the piping also assist in the retention of bubbles of air or vapor.

The same remedies apply to the pump feed systems in which vapor lock may occur between tank and pump, although not between pump and carbureter.

Dr. Bridgeman's results, while such as common sense alone might have indicated, now put both the causes and remedy of the evil on a scientific basis.—*A. K.*

"Sky Car" Credit

IN connection with the item on William B. Stout's Sky Car, that appeared on page 410 of our June issue, we reproduced a line drawing of the plane under discussion. Due to an oversight in connection with makeup, credit for this illustration to *Aero Digest* was omitted. We take this opportunity to express our regret for this occurrence and to thank our contemporary for their courtesy in the matter.

A Streamlined Tire

THE air resistance of an airplane landing gear may be as much as a third of the whole resistance of the plane, wings not being taken into account. Therefore, designers have made many efforts to reduce landing-gear drag. Some have applied cowlings or "pants" to the wheels. Others have substituted a single cantilever strut for the three conventional landing-gear struts on each side of the fuselage. Others have employed the retractable landing gear in which wheels, struts, and shock absorbers are all made to swing upwards and to disappear inside the wings or fuselage of the airplane. Of course, the most effective method of getting rid of under-carriage resistance *is* to retract it, but this involves a certain mechanical complexity which pilots do not view with favor.

Now the General Tire and Rubber Company have struck out in a fresh direction by streamlining the tire itself. Our photograph shows one of these new tires applied to a low-wing monoplane, and the appended diagram shows a cross-section of the tire. From these two illustrations it can be quite clearly seen that the wheel and tire indeed form a streamline body.

Wind-tunnel tests in the Army Laboratories, at New York University, and at the University of Michigan, show that the resistance of the streamlined tire is unusually low. The streamline form is explained by the fact that the tire has a parabolic shape which blends into the circular portion of the wheel. The new tire is operated at very low pressure, yet owing to its parabolic shape the tire maintains its form very nicely even in rough service.

Another very interesting point about this design is that the bead of the tire is mechanically clamped to the rim of the wheel; hitherto tires have been made tight on the rim by increasing air pressure. The mechanical clamping effectively prevents the tire from sliding around the wheel rim when brakes are applied forcibly and suddenly. This mechanical clamping also prevents the tire coming off when the airplane lands with appreciable side motion.—*A. K.*

Taming Gushers on a Rampage

WILD oil wells—nature uncontrolled—an even ton or more per square inch of pent-up rock pressure abruptly released from its age-old prison and bursting suddenly forth destroying everything in its path! How, asks *The Lamp*, lapsing into the vernacular, do they get that way, and how are they tamed?

Let's watch them bringing in a big well. The rotary bit has bored its way into the earth to the top of the pay sand, according to the geologists' calculations. The long string of drill pipe is withdrawn and next comes the job of setting the final string of casing and cementing off.

With his casing set, the driller now starts his tools down the hole again. First of all—with high pressure wells—he makes sure that there is sufficient mud in his well. The object is that when the well comes in, the weight of the column of mud standing in the hole will be sufficient to overbalance the rock pressure at the bottom so that the well in question may be brought in under control. Sometimes it is necessary to help the mud with a weight loading material. The heavy tools reach the bottom, the driller pulls them out quickly, and the mud is baled out bit by bit until the rock pressure overbalances the weight of the remaining column of mud; and the latter begins to flow out of the hole of its own accord. The monster finally comes in with a roar and the valves are left open for a while until the well cleans itself of mud.

It sounds simple enough. Why, then, the tremendous gushers running wild? Why the rocketing tools, the twisted drill pipe, the mangled valves and fittings?

Carelessness and inexperience are frequent causes of wells getting out of control. More often perhaps it is just a case

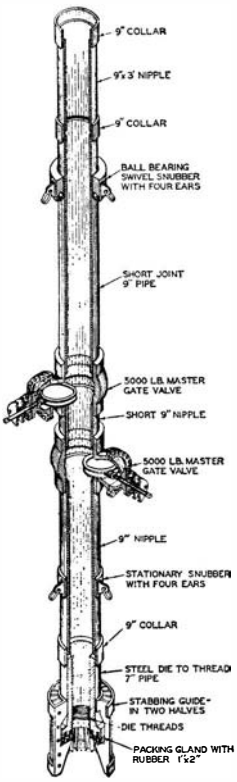
The streamlined tire mounted

of trying to outguess nature and guessing wrong. If geologists figure, for example, that the drill should strike pay sand at 6200 feet, and it drops into a high pressure gas pocket at 6000 feet, the driller is left very much in the position of the fellow who was intently engaged in examining the mouth of a large cannon at the precise moment

C. E. Stout No. 1 well on a rampage, drenching Oklahoma City with oil

some wag chose to pull the firing cord.

In the case of the C. E. Stout No. 1 well, which created such a sensation in the newspapers a few months ago by getting out of control and drenching with oil a large residential section of Oklahoma City, everything went perfectly for a time. The well was brought in under perfect control, but it was then found that the three big 5000-



The "Christmas tree" connection

pound master gate valves did not function properly. Before they could be made to work, the terrific blast of sand and oil under tons of pressure cut right through the partly closed valves like an emery wheel through cardboard. While the well raged, men began working feverishly to replace the broken fittings.

First of all, the sand-cut "Christmas tree" connections (so-called because of the several valves and fittings which protrude from different sides of the affair) were removed. A new Christmas tree arrangement was feverishly assembled and hauled to the derrick floor ready to be placed.

To the onlooker, a Christmas tree looks like an ordinary pipe—a particularly heavy one—with two valve handles protruding near the center. Some of them contain several gate valves and countless nipples, joints, and elbows—as, for example, the complicated "trees" which now crown some of the California wells. Snubbers with rings in them, located near the top and bottom of the piece, afford attachments to which chains may be hooked for hoisting the huge affair.

Inside the bottom of the pipe a steel die collar was fitted, so that the "tree" would cut its own threads as it was screwed over the old casing. A fluted arrangement, as shown in the accompanying illustration, was provided to serve as a guide in fitting the new piece over the casing. When all was ready, the massive affair was hoisted upright by means of a winch and heavy chains and then "stabbed" into the blasting column of oil. Men swathed in oilskins and helmets guided this difficult operation as powerful chains hauled the "tree" into place. The valves were open all this time, of course, so that the gusher continued to shoot through the new connection up into the air, with a goodly amount spraying out the bottom to soak everyone within range. Finally the fitting was screwed down and secured firmly by means of heavy chains and turnbuckles to the legs of the steel derrick. Then the two 5000-pound master gate valves were carefully closed—and the battle was over.

Photographs courtesy *The Lamp*

Here workmen may be seen working in mud and oil hoisting a new "Christmas tree" near the well preparatory to stabbing it into the wildly roaring gusher

Inspection Gage Accurate to 1/100,000 Inch

LIKE a miniature traffic signal a new Sheffield electric gage in the inspection department of the Reo Motor Car Company flashes green, amber, and red lamps to indicate to the operator whether the part checked is undersize, satisfactory, or oversize. It is the first machine of the type used by an automobile manufacturer and it indicates with certainty any variation as much as one one-hundred-thousandth part of an inch below the low limit or above the high limit of size specified on the production blue print. For each part to be inspected two standards are made of hardened alloy steel and lapped to exact size, one to the high and the other to the low limit of size specified by the engineers. These standards are used by the operator for setting the

Green, amber, and red lamps on this gage tell the operator the condition of the part inspected

electric gage for any new part to be inspected and for checking it from time to time during inspection.

To resist wear the lower end of the plunger is tipped with a selected, carefully lapped diamond and the hardened steel anvil on which the work rests carries a lapped insert of tungsten carbide, a substance ranking second only to the diamond in hardness and selling for over 400 dollars per pound.

Because of its high degree of accuracy this gage proves the most satisfactory device for measuring the standards to which it is to be set for measuring production parts. It is used when the master gages are being lapped to check their sizes against tool-room master gage blocks which in turn are accurate to the millionth part of an inch.

Accuracy of the highest order, however, is only one of the advantages claimed for this novel device. Increased speed in inspecting and complete absence of eye strain are also afforded. With ordinary limit or snap gages the sense of "feel" of the operator determines acceptance or rejection and with conventional types of dial gages the operator must watch closely and constantly the movement of a hand across a dial and judge whether it stops or passes just below one or just above the other of two limit marks. With the new electric gages the lamp of a certain color lights or it does not light, eliminating the human equation.

Rubber Bearings Lubricated with Water

A RECENTLY perfected method of bonding rubber to metal has made possible the use of rubber for bearings on certain machinery where it is not practical or convenient to lubricate with oil, such as shafts running in water on ships, hydraulic power turbines, sand and gravel pumps, deep well pumps, agitator bearings in chemical plants, and in many other places where water or other lubricants not injurious to rubber are available for lubrication.

Babbitt, bronze, and other soft metal bearings have held undisputed power as bearing surfaces so long that it is difficult to imagine anything taking their places. It becomes easier, however, when one considers that rubber properly compounded

and vulcanized will stand abrasion much better than bronze, babbitt, or even steel.

Cutless rubber bearings consist of a metal sleeve lined with a tough, resilient compound similar in texture to the rubber tread of a high grade automobile tire.

Rubber, like water, is practically noncompressible and is capable of supporting a shaft of great weight with negligible deflection. Another property of rubber underlying its success is its low coefficient of friction when wet. It is commonly known that rubber heels tend to slip when wet and that automobile tires skid on wet streets. In spite of these familiar examples the Cutless bearing is probably the first application of this property in the engineering field. Years of continual use on all classes of equipment up to 30 inches inside diameter have proved the Cutless rubber bearing beyond question to be better fitted for certain conditions than any other bearing now on the market.—*A. E. B.*

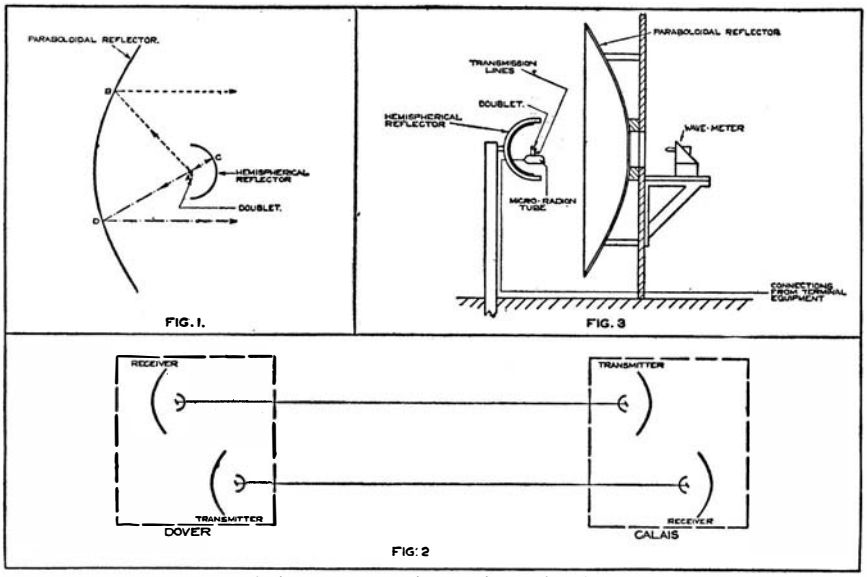


Figure 1: **Function of the micro-ray hemispherical reflector.** ***Figure 2:*** **Layout of transmitters and receivers in test.** ***Figure 3:*** **Cross-section of transmitter**

Micro-Ray Telephony and Telegraphy

ON the cliffs at St. Margaret's Bay, Dover, England, the International Telephone and Telegraph Laboratories, Hendon, England, in co-operation with the Laboratories of Le Matériel Téléphonique, Paris, France, recently gave a successful demonstration of a new ultra-short-wave radio telephone and telegraph equipment and circuit between Dover, England, and Calais, France. The equipment was largely developed by French engineers in the Paris Laboratories. The demonstration at Dover was conducted by engineers of the International Telephone and Telegraph Laboratories and at Calais by engineers of Le Matériel Téléphonique.

In this demonstration, oscillations of wavelengths as low as 10 centimeters, designated as "micro rays," were used for the first time to provide a high quality two-way radio telephone circuit. From distances covered and results obtained, it was quite clear that the equipment employed can readily be adapted to commercial use. The enormous advance in technique shown by the present demonstration definitely indicates that the range of wavelengths as low as 10 centimeters is now available for commercial radio transmission.

In the demonstration a link had been established between a station on the cliffs of St. Margaret's Bay, near Dover, and a similar station across the Channel at Blanc Nez, near Calais. The two-way radio telephone circuit using a wavelength of 18 centimeters was noteworthy for the quality of speech received. Not only was it well up to the standard of a high quality telephone circuit, but it showed no signs of being affected by fading, a disability from which waves in this frequency are apparently immune.

When compared with radiations of the more usual wavelengths, "micro rays" present many striking features. For example, their extremely short wavelength permits the use of electro-optical devices more usually associated with light, such as reflectors or refractors, in addition to diminutive antenna systems. Fog, rain, and such like climatic effects, as well as day and night, do not materially interfere with the propagation of the "micro rays."

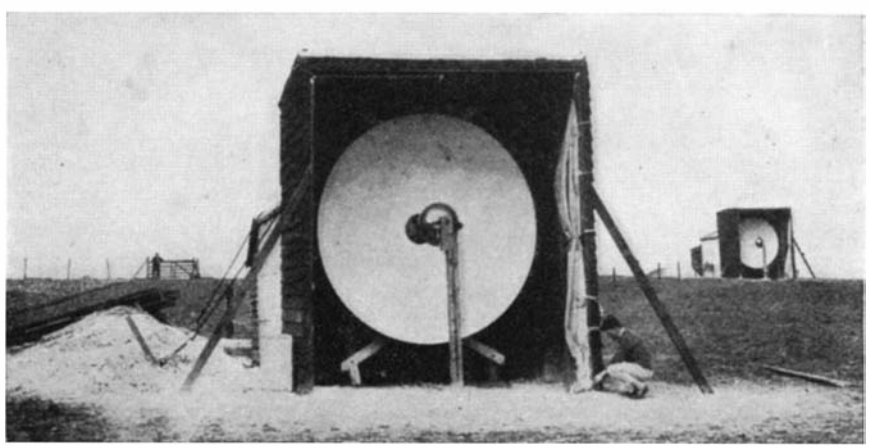
The two stations at Dover and Calais were in all essentials identical. Each comprised a transmitter and receiver with terminal equipment of normal design for connecting them together so as to give facilities for two-way communication. The outgoing signals are applied to a "micro-radion" tube in which the high-frequency oscillations are generated. A short transmission line connects the tube to the radiating system or doublet which is about two centimeters long, in contrast to the enormous system usually employed. The amplitude of this high-frequency current along the doublet at any instant is substantially the same. The doublet is situated at the focus of a paraboloidal reflector some three meters in diameter. After concentration of the rays by the paraboloidal reflector into a fine pencil of rays somewhat similar to light rays sent out by a searchlight, they are projected into space. In order further to increase the efficiency of the system by the prevention of radiation other than in the required direction, a hemispherical reflector is located at the opposite side of the doublet to the paraboloidal reflector and having the doublet at its center. This serves to collect all the radiation propagated in a forward direction and to reflect it back again towards the source. The radius of the hemispherical reflector is so chosen that when the reflected radiations reach the focus again they are in phase with those being radiated at that instant.

The function of this hemispherical reflector is illustrated, the effect of diffraction being neglected in this description, although in practice it must be taken into account. It will be seen that the direct radiations such as AB pass straight to the paraboloidal reflector and so are directed towards the distant receiver, whereas waves such as AC are reflected by the hemispherical reflector back through A onto the paraboloidal mirror at D, and so out in the required direction. It is estimated that the gain due to the paraboloidal reflectors on one channel is of the order of 46 decibels to which the hemispherical reflectors add another 6 decibels.

The receiver is a counterpart of the transmitter except that no high-frequency measuring device is provided. That is to say, it comprises a doublet connected by a transmission line to the micro-radion tube where detection takes place. Paraboloidal and spherical mirrors exactly similar to those of the transmitter are also provided for concentrating the received waves upon this doublet.

To avoid coupling, the receiver is situated about 80 yards from the transmitter at each terminal and is arranged to be in its electro-optical shadow, adequate allowance being made for diffraction. The same wavelength is used both for sending and receiving.

Commercial applications in a world-wide communication network like the Interna-



Micro-ray transmitter and receiver at Dover. The receiver is located in the electro-optical shadow of the transmitter so there will be no interference

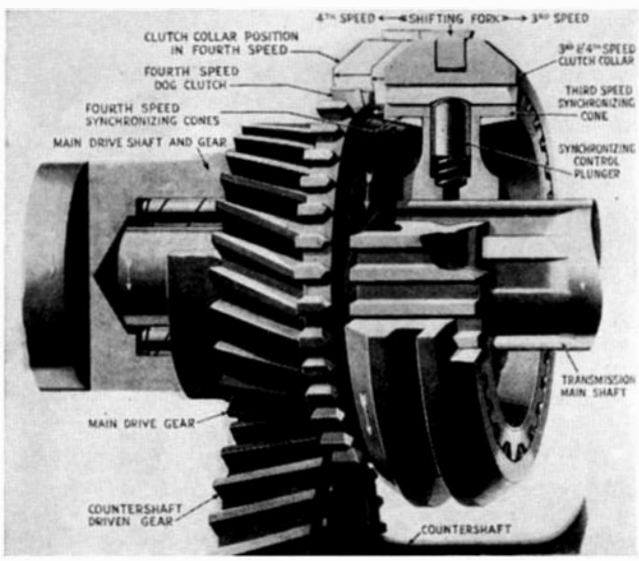
tional System are obvious. The frequency band available will permit the working of a very large number of permanent and continuous channels between the same places without mutual interference.

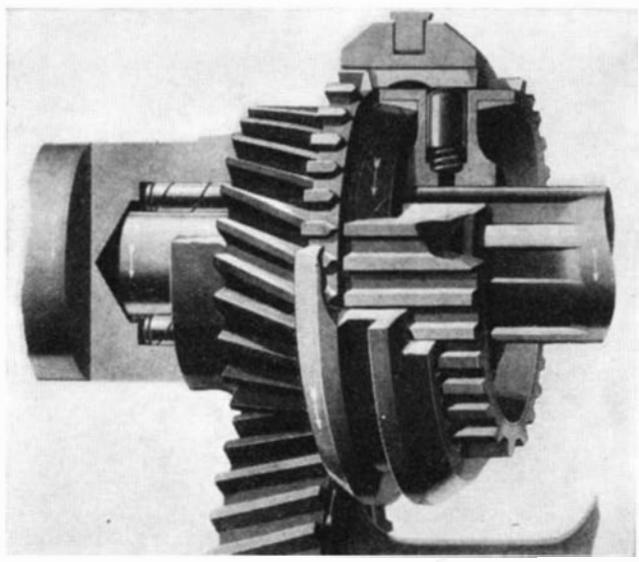
A further very important use will be for television transmission. The present difficulty with regard to television is the very large frequency range required for satisfactory definition of the object transmitted. It should now be possible to allocate as wide a band as is necessary for television without causing any ether congestion.

For navigation purposes and especially for radio beacons the simplicity of the transmitters has obvious advantages. Valuable applications seem possible in ship to ship communication, as the small size of the equipment would enable easy use to be made of its directional properties. In addition, the micro ray system affords a satisfactory method for virtually secret communication between war vessels.

How the Synchro-Silent Transmission Works

THE Synchro-Silent gear shift mechanism marks such an important step forward in the attempt of motor-car manufacturers to improve the performance of automobiles, that we have been repeatedly asked for details of this drive. At our request the Graham-Paige Motors Corporation prepared the two illustrations which are reproduced on this page and explained how this transmission works on the Graham





Sections of the Synchro-Silent transmission, the action of which is described in the text

Special Six and the two Graham Eights. Incidentally, the manufacturers claim that no other four-speed transmission has a synchronizing device for silent gear changing, and that some four-speed drives lack the all-important feature of silent running in third gear.

In describing the way this mechanism works, it will be necessary to refer to the lettered drawing on this page. When the gearshift lever is moved to engage fourth speed, the shifting fork moves the clutch collar and the synchronizing cone along the splined transmission main shaft until the synchronizing cone contacts with the cone on the main drive gear; the clutch action of the cones then causes the parts to rotate at the same speed. Continued movement of the shifting fork causes the clutch collar to depress the control plungers and slide over the splined synchronizing unit until the internal teeth of the clutch collar mesh with the external teeth of the fourth speed dog clutch, which is integral with the main drive shaft. In shifting to third speed, the units slide in the opposite direction to engage the dog clutch of the spiral (constant mesh) third speed gear which is not shown in the illustration.

New Rustless Iron

IRON can now be aluminized at 900 degrees Centigrade, according to a report of a method developed by Harry Johansson, a Stockholm scientist. The aluminum partly permeates the iron as well as covering the surface, so that the resistive and protective power is great. The Sandviken Iron and Steel Works has acquired the sole rights to the process for Sweden, Norway, Denmark, and Finland for cold-drawn and rolled tubes and cold-drawn band iron. The method is also being tested for the manufacture of kitchen ranges, stoves, ball-bearings, dairy appliances, meat grinders, et cetera. The invention is patented and is being exploited by the Aktiebolaget Stockholms Aluminiseringsfabrik.—*A. E. B.*

Sugar Consumption

PEOPLE of the United States consume more sugar proportionately than people anywhere else in the world, which is strange considering that they also own more motor cars and have more mechanized industry and thereby require less sugar for energy output than people anywhere else in the world. The maximum sugar consumption in the United States was reached in 1926, and the figure was more than 5½ million tons or 109.3 pounds per capita. Assuming that the average food requirement is 2700 calories per person per day, it is estimated that nearly one fifth of the requirement of food fuel in this country was supplied by pure refined sugar. Approximately 16 percent of the total requirement is provided by beet sugar and the remainder by cane sugar.

In 1930, the per capita consumption of sugar dropped to 99.37 pounds. Obviously a drop of 10 pounds per person in a country of 120 million people means the consumption of a great deal less sugar. It may explain partially the campaign now being conducted by sugar refiners to increase the consumption of this food.

In the way of providing energy, sugar is as cheap a form of energy as one can buy. Cane sugar is sold at retail at a price representing 400 calories for one cent, or 2½ cents for 1000 calories. However, man cannot live on sugar alone, since it provides only energy and does not take care of the protein requirement for growth and repair. It does not take care of the mineral salt requirements, including calcium, phosphorus, iodine, iron, magnesium, sulfur, sodium, potassium, and similar elements; neither does it contain vitamins A, B, C, D, and E, or apparently any other vitamins necessary for health and growth.—*M. F.*

Plate Glass Production

PRODUCTION of polished plate glass in the United States in March was 10,592,923 square feet, against 8,881,521 in February, and 10,415,644 in March, 1930.

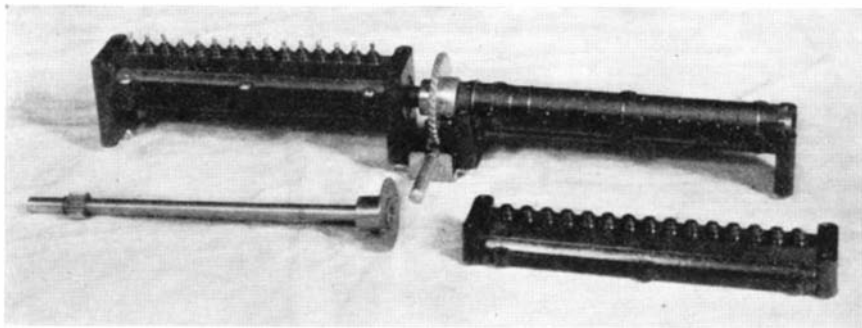
Molybdenum Increasingly Useful

THE production of molybdenum ore in the United States during 1930, though slightly less than in 1929, was substantially greater than in 1928 or in any preceding year, according to data collected by the United States Bureau of Mines. The production in 1930, as estimated from reports from the leading producers for 11 months' operation, amounted to approximately 6,167,000 pounds of molybdenum sulfide.

Since by far the bulk of the production was used in steel manufacture and since the production of steel dropped off 27 percent last year, it is evident that the production of molybdenum-treated steels increased relative to the total production of plain carbon and other alloy steels. Molybdenum is used extensively in aircraft and automotive steels. To a smaller extent it is also used in various special steels employed in bearings, steel castings, and in corrosion and high-temperature resisting alloys for various purposes.

A substantial outlet has recently been developed in the nickel-molybdenum-iron alloys containing as much as 20 percent molybdenum and capable of resisting the

action of hydrochloric acid. A surprising amount of molybdenum wire and sheet is used in the radio industry. Molybdenum wire, which is made by at least three companies, is used for supporting the filament in incandescent lamps and radio tubes. In the chemical field, a new development of importance is the use of various catalysts, several of which contain molybdenum oxide, in connection with the hydrogenation of oils and especially in the production of motor fuel from the heavier constituents of crude petroleum.—*A. E. B.*



Close-up of the cam switches used in the universal-range radio receiver described here. *Left:* Completely assembled. *Right:* Showing cams and split housing

Tire Production Increases

THE Goodyear Tire and Rubber Company has recently inaugurated a 5½-day week in the factory, and increased production from 53,000 tires to 76,000 tires per day.

This expansion in production, which is the third to be made since January 1, reflects the fact that Goodyear sales have substantially exceeded estimates, according to Pres. P. W. Litchfield. "Sales in April will exceed those of April, 1930. We have just completed a survey of tire stocks in the hands of dealers and find them low. Our spring sales have pulled down the company's inventory of tires and it is to build that inventory back to a safe figure that the present production increase was ordered." —*Barron's.*

Short-Wave, Broadcast-Wave Receiver

A NEW combination-wave radio receiver of advanced design and construction, known as the "Universal Super-Wasp," has been brought out by the Pilot Radio and Tube Corporation, of Lawrence, Massachusetts. It covers the wavelength range of 15 to 650 meters without the use of the plug-in coils that have characterized practically all short-wave sets. The shifting from one wave range to another, in seven steps, is done from the front panel by turning a knob. The receiver is available in both factory-built and kit models, for either A.C. or battery operation.

While intended primarily for use on the short waves, for the direct reception of foreign stations, the new instrument is also a good broadcast receiver, and in addition takes in the wave band used for ship-to-shore radio telegraphic traffic.

Supplied in a handsome walnut cabinet, the Universal Super-Wasp shakes off the laboratory air hitherto associated with short-wave apparatus, and takes on the appearance of a high-grade broadcast set.

The heart of this receiver is a pair of molded bakelite cam switches. Each switch carries 15 thin cams which make contact, in predetermined sequence, with 15 plungers sticking out of the housing like the spark plugs in an automobile. As the switches are turned, they change the electrical connections between four pairs of fixed tuning coils and two double-section variable condensers. There are seven combinations, allowing tuning throughout the following wavelength ranges: 15 to 23 meters, 22 to 41, 40 to 75, 70 to 147, 146 to 270, 240 to 500, and 470 to 650. Any one of these ranges may be selected instantly by a turn of a knob; a scale appears on the front panel to indicate which range is active. The convenience of this arrangement will be apparent to radio fans who have wrestled with recalcitrant plug-in coils and bruised their knuckles against the edges of shield cans.

Electrically, the receiver comprises one stage of tuned screen-grid radio-frequency amplification; a screen-grid detector using a new method of regeneration control that does not alter tuning; one impedance-coupled audio-frequency stage and one 245 push-pull output stage; six tubes in all including rectifier. The A.C. power pack is built on the chassis, which is of aluminum construction, 21 by 11 by 8 inches overall.

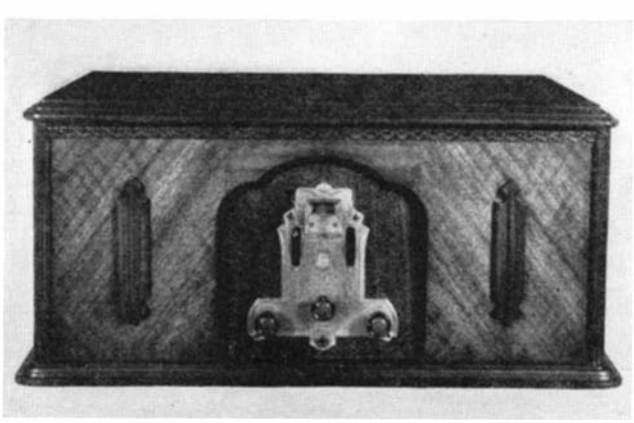
In performance the new receiver is a revelation to people accustomed to the "cranky" operation of elementary regenerative sets. While the receiver itself does not, of course, overcome the distressing undependability of the short waves, it does make possible dynamic loudspeaker results, under favorable conditions, from voice stations in Great Britain, Holland, France, Germany, Italy, Spain, Morocco, British East Africa, French Indo-China, Japan, Java, Australia, New Zealand, Hawaii, Central and South America, and Canada. Stations in these countries have been heard through Super-Wasps and other short-wave receivers.

Summer Camps for Diabetic Children

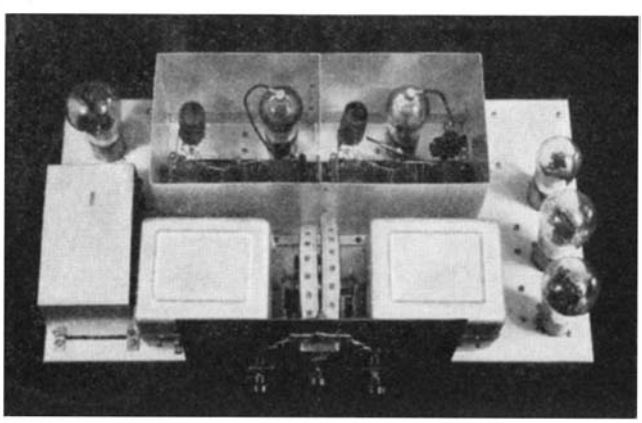
THE diabetic child was formerly considered an inevitable fatality. With the discovery of insulin it became possible to prolong these lives greatly and already several diabetic children, who would previously not have survived five years, have reached adolescence. Insulin is not, however, a specific remedy for diabetes. Its use is, instead, a substitution therapy whereby the insulin given by injection substitutes for the insulin that ought to be provided by the pancreas of the patient. Hence, the diabetic child must be continually in touch with competent advice.

In the summer when many children go to camp it obviously becomes more difficult to keep such children under good conditions. Several camps have been organized which care for diabetic children. One such camp now provides for 50 diabetic children. A statement of the diet, the insulin requirement, and the complications and condition of each child is obtained from the family physician or the parents six weeks prior to the opening of the camp. The laboratory of the camp begins operating on the same day that the children arrive. Facilities are available for every emergency arising either from too little sugar in the blood or from the diabetic coma resulting from acidosis. Because of the dangers of unconsciousness resulting from too little sugar in the blood following an error in diet or an overdose of insulin, every caretaker carries several wafers of dextrose which can be given immediately and which will overcome the difficulty. All of the food is weighed and each child's place at the table is labeled.

Exercise must be carefully controlled be-



Front view of universal receiver



Interior of the radio set

cause it uses up sugar. The expense appears to be 20 dollars per week per child, and the continued operation over several seasons indicates the success of the work.—*M. F.*

A New Composite Movie Process

ONE of the most important factors in modern photoplay production is the ability to impose one scene taken at one place and time upon another scene taken at another place and time, and so combine the two in such a manner as to create the illusion of simultaneous photography. This ability permits the creation of motion pictures that otherwise would either entail prohibitive expense or make the effort impossible. Such an imposition as that referred to is usually known as composite photography.

A 17 year old schoolboy, Dodge Dunning, son of Carroll Dunning, former vice-president of the Prizma Color Process Company, has worked out with his father's aid, a new process of true composite cinematography, now known as the Dunning process, and obtained a United States patent upon it. During more than two years it has been in general use in the larger California studios and I have yet to find a motion picture photographer who can detect its use.

Prior to this all efforts at composite photography left either obvious gaps between introduced figures and background, or produced what was called "phantom"; an effect in which either figure showed through background, or the reverse.

Suppose that a Hollywood studio has a story in which a group of a dozen characters, by twos, threes and fours, must walk up the steps of the National Gallery in London and disappear within while the traffic of London proceeds. The procedure is for an order to be given a London cinematographer to photograph such a number of feet of the National Gallery and to ship the negative to Hollywood. Arrived there the necessary action pertinent to the story is photographed by the Dunning process and coupled with the London negative.

In the picture "Anna Christie" all the interesting harbor scenes were photographed from a tug boat on the East River in New York, but the characters played by George Marion, Greta Garbo, Marie Dressler, and Charles Bickford were introduced a month later in a studio in California, and no one has complained of the quality.

Technically the process is simple, being based on the separation of color values. Probably had color photography never been achieved there would have been no Dunning process. The procedure is this:

First an original background scene of the desired character is supplied by the motion picture studio. How or where it is made is of little importance. It can be an actual, full-scale scene; a miniature or model scene; something culled from a "library", or anything of similar nature. Whether it contains action is also immaterial. Next a double-image transparent print is made from this negative, containing a positive image of red shade and a negative image of neutral gray. Experimentation determines the exact degree of density of this double-image print necessary to "fog" an unexposed panchromatic film placed behind it in the presence of white light.

An ordinary motion picture camera equipped with double magazines is then brought into use, and into this is put unexposed panchromatic negative with the double-image print in contact with it and in front of it. Plainly this furnishes a mask. Now the new action that it is desired to introduce is posited before a plain blue background. By lighting the figures, and such accompanying objects as are to be included, with a strong white light which is neutral to both colors of the transparent double-image print, and strongly illuminating the blue background with high intensity flood lights, the double-image print becomes a filter passing through itself the reflected white light from the new foreground action, while the reflected blue light from the background acts as a printing light that imprints the detail of the double-image print on the unexposed negative at the same time. Both images are photographed *together*. Thus phantom or surrounding lines or gaps, are impossible, and the result is a true composite photograph. This is developed and printed in the usual manner.

Now that sound is rampant in the film industry this process is peculiarly useful, for it permits separation of action and their later conjunction. Suppose that it is desired to record a bit of dialogue occurring on a busy street corner. Ordinarily it would be impossible because of the roar of the city traffic and the extraneous sounds the microphone would pick up. But it is easily feasible to shoot the street corner with all its racket, and then, returning to the studio, record the action and sound of the dialogue, and by the Dunning method combine the two, holding down the street noise to the point where it does not interfere with the clarity of the dialogue.

Actually any negative produced by this system is a "duped" negative, but the art of "duping" has now reached such perfection in Hollywood that it is difficult to tell a dupe from an original. There are many so far unsuspected possibilities in this method of composite photography, which may be expected to permit extraordinary results and a great economy in production. —*Campbell MacCulloch.*

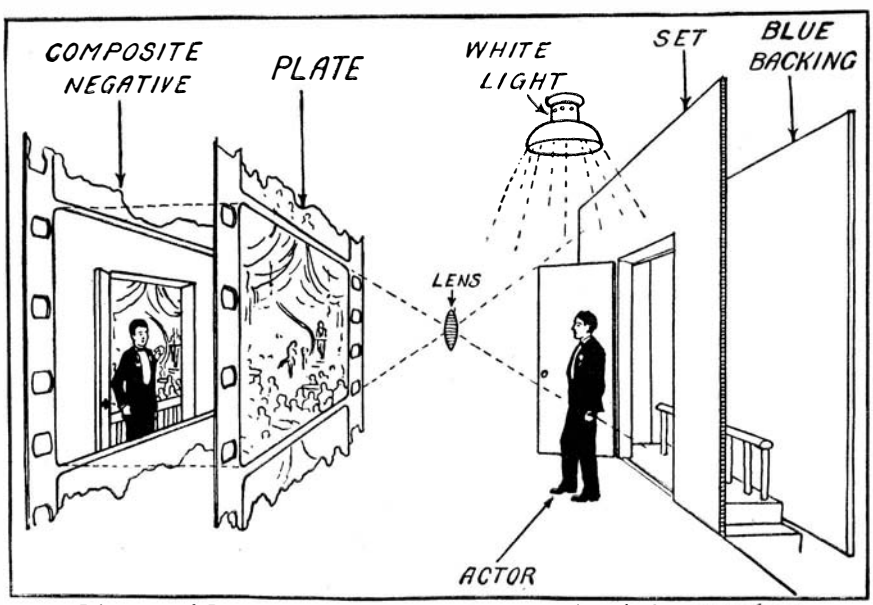
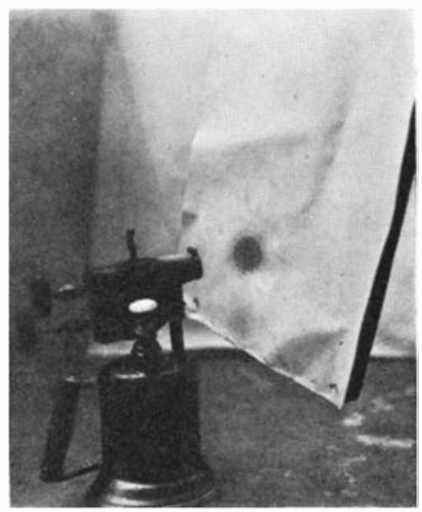


Diagram of Dunning composite movie process, described in text above

Fire-Resistant Motion-Picture Screens

IN their ceaseless efforts to reduce fire hazards, theater operators have repeatedly demanded a fire-resistant motion-picture screen material. Such a product is now announced as among the latest developments of the du Pont laboratories, according to E. H. Nollau, in a recent issue of the *du Pont Magazine*. Scores of formulas were compounded and discarded as unsatisfactory. Finally a new material was developed which has withstood rigorous tests both by the manufacturer and the Board of National Fire Underwriters.



Testing fire-resistant movie screen

Aside from the all-important fire-resistant feature, this new, approved motion-picture screen material has the advantages of a matte finish, which gives a highly uniform degree of reflection and a construction which permits of easy and clean perforation when the screen is to be used for sound projection.—*A. E. B.*

Frosted Foods in Wide Favor

GENERAL FOODS CORPORATION and Standard Oil Company of California are forming Pacific Frosted Foods, Inc., for commercial development of the Birdseye

quick-freezing patents in Pacific and western states. Standard Oil Company of California is interested because of its management control of the Pacific Public Service Company, which already has extensive interests in refrigeration. Through its subsidiary, Frosted Foods, Inc., General Foods Corporation has been engaged for the past two years in the experimental development of the patents on the Atlantic seaboard.

Pacific Frosted Foods, Inc., will hold the rights to the basic Birdseye patents in California, Oregon, Washington, New Mexico, Arizona, Colorado, Utah, Montana, Wyoming, Idaho, Nevada, western Mexico, Alaska, and Hawaii.

"One year's experience in stores in New England has demonstrated the practicability of the idea from every angle," reports the General Foods Corporation. "In New England the public, through its high percentage of repeat orders, has shown its acceptance of this new method."—*Barron's.*

Home Canners Warned to Guard Against Botulism

THE recent case of food poisoning in North Dakota, in which 12 persons died from eating home-canned peas, has prompted the United States Department of Agriculture to call attention again to a method of canning non-acid vegetables in the home to guard against the deadly botulinus poison.

The bacteria that cause botulism are abundant in many soils. Some may be present in most soils, and consequently may be on the vegetables to be canned. When these bacteria germinate in a closed container they form a deadly poison. They will not grow in salt solutions, however, if the percentage of salt is higher than 9 percent and they will be killed at boiling temperature if the solution is sufficiently acid.

In the canning of non-acid vegetables—peas, asparagus, beans, corn, beets, and spinach—the only safe course is to destroy all bacteria that may be present by canning under steam pressure, according to the Bureau of Home Economics. In the case of acid vegetables and fruits, such as tomatoes, apples, peaches, and gooseberries, the bacteria are killed at boiling temperature (212° Fahrenheit); but with non-acid vegetables there is no assurance that the botulinus organisms will be killed by processing in boiling water unless the material is heated for six hours or longer. Obviously, a six-hour treatment of peas or similar vegetables would result in a very unattractive product. A much shorter heating time is required at a temperature of 240° or 250° Fahrenheit such as may be obtained in a pressure cooker.

Pressure cookers are now standard equipment and are readily available at small cost. The department does not recommend any particular make, although it emphasizes the importance of having the pressure kettle equipped with a thermometer and pressure gage for proper control. There is now no excuse, the department says, for continuing to take risks involved in canning non-acid foods without adequate pressure cooking or curing or acidification.

Ordinary types of spoilage may usually be detected by the odor or appearance of the can or its contents, but the botulinous toxin may be present without any signs of spoilage. If present in small quantities this toxin is destroyed by boiling, according to the Bureau of Home Economics; therefore it recommends that all home-canned vegetables and meats when opened for consumption be boiled for at least 10 minutes before they are tasted.

Science "Knocks Out" Lightning Bolt

ENGINEERS recently shot enough electricity through an experimental lightning-rod to lift the Woolworth Building off its feet.

The giant "spark plug" at the new Westinghouse high-power laboratory blazed into action for the first time as over 132 million

Above: **Preparing to test a new lightning rod with "man-made" lightning.** ***Right:*** **The bolt has landed but the Torok lightning rod has delivered a knockout blow**

volt-amperes leaped across the terminals to the lightning-rod on test.

There was a burst of flame from each end of the rod and a report like that of a six-inch cannon as the experimental lightning-rod "knocked out" the terrific lightning bolt in less than 1/500 of a second.

"The results of the tests are so promising," said J. J. Torok, Westinghouse lightning wizard and inventor of the rod, "that we are working night and day to finish its development as rapidly as possible.

"We hope it will effect greater economies in present forms of flashover protective devices now in service to protect insulator strings on overhead transmission lines which supply cities with light and power. In addition, it is expected to provide permanent protection against the ravages of lightning and save the country millions of dollars a year.

"Now, after a lightning stroke, protective devices of the fuse type must be replaced. This requires constant patrolling of the lines. Because of the limitations of a single line, duplicate lines must be constructed. The new lightning-rod does away with this expense."

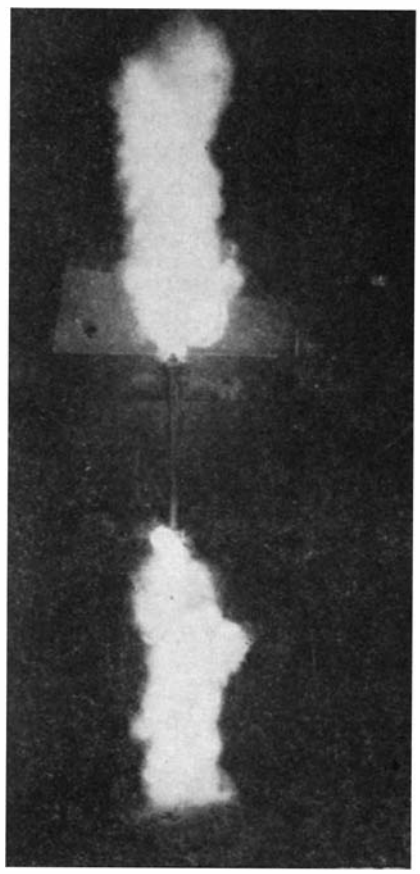
Its construction is simple. It consists of a tube about the size of a lady's umbrella. A piece of metal at each end serves as an electrode to entice the lightning inside for the "knock-out" blow. It is supposed to work so fast that the lights in a house will not even flicker.

This device, technically known as a "De-Ion" lightning protector, is used to protect insulator strings on transmission lines against flashover.

Engineers have estimated that if the Torok lightning-rod is as successful as it promises to be and had been available 10 years ago, the world would have saved a hundred million dollars.

High Blood Pressure

THE exactitude of blood pressure determinations has caused insurance companies to take this measurement as one of the most important factors in determining whether or not life insurance will be granted to any applicant. Doctor David Riesman has just reviewed the present medical attitude toward this subject. Whereas he used to be greatly distressed as to the patient's prospects when a blood pressure of 180 or higher was found, he now feels that there are many things worse than high blood pressure, because many patients with high blood pressure survived others for many years and enjoyed good life and undiminished vigor. Of course, not all the patients with high blood pressure were so



fortunate. The insurance statistics show that the mortality among people with high blood pressure far exceeds the normal death rate.

It must be recognized to begin with that there are various types of high blood pressure. There are also certain factors that seem to be common to most of the patients. They appear to have had a great deal of

(*Please turn to page* 63)

Presdwoodcanbepunched or die-cut with ordinary punch press; no special dies or clearances needed

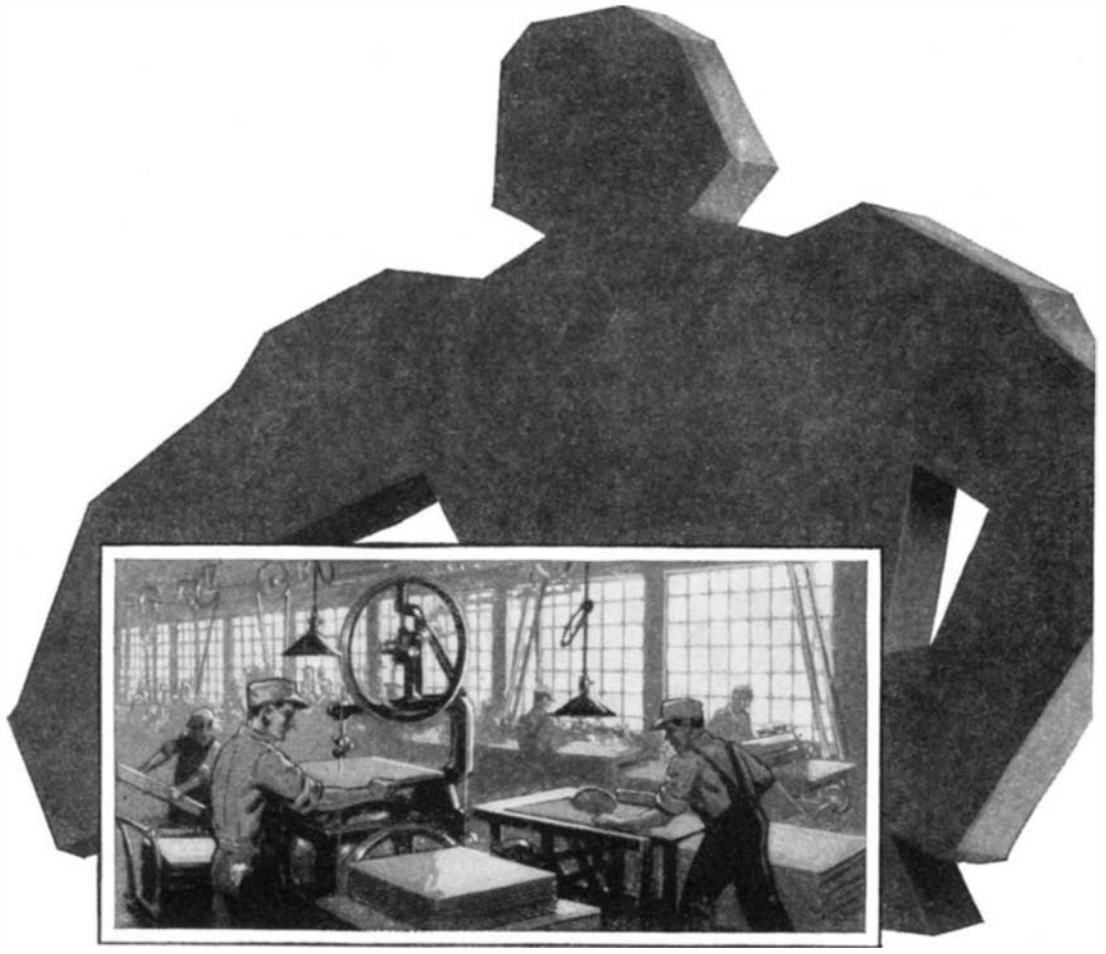
Presdwood adapts itself perfectly to multiple cutting on cutter presses; speeds quantity production

Presdwood, cut with band saw, will not chip, split or splinter

Presdwood, with the ordinary shaper, can be quickly given irregular outlines

Presdwood, when planing is required, needs no special machinery

Presdwood, at the workbench, requires only the usual woodworking tools —it's easy to work with



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Presdwood is one of the Masonite family—a smooth, rich brown, tremendously strong board. Of all its friends, none are more enthusiastic than the men who work with it daily.

"Give us Presdwood every time," they'll tell you. "It's a snap to work with. Put it on the saws, planer, die cutter, shaper or any of the other machines. Never a crack, chip, split or splinter. That's the way to step up production."

They're talking, too, these men, of the exceptionally durable, good-looking products Presdwood builds. Toys, auto trucks, refrigerators, radio cabinets, a thousand other articles. And the best part is: Presdwood is always cutting costs — material costs, labor costs, and the loss from waste and rejection.

You, too, should use Presdwood. Let us send you a sample for testing; also the booklet listing 80 of its many uses — no cost, no obligation. Or ask your lumber dealer.

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THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

ABOUT 30 years ago Professor Elihu Thomson, working entirely as an amateur like the various amateurs whose telescopes have been described from month to month in this department, made a ten-inch objective lens and mounted it in a telescope which is still in operation, as shown in the illustrations. As practical instructions concerning objective lens making are not plentiful we invited Professor Thomson

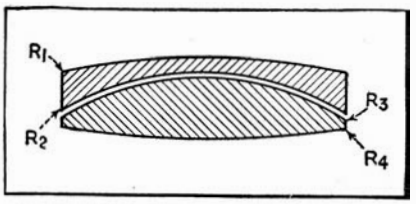
Professor Elihu Thomson

to put his experience in permanent form, regardless of the fact that the work performed was not recent. This he has done from his original notes, and the article is reproduced below.

Professor Thomson's activities have been almost legion but he never has forgotten that he is an amateur telescope maker, one of the kind described by Professor Hale in "A.T.M." (page 180). At present he is "amateuring" a rather larger job than any amateur seems likely to tackle for some time to come—the fused quartz disk for the 200-inch telescope. However, most of Dr. Thomson's activities have been in the electrical field. He is one of the founders of the General Electric Company, and is the recognized "dean of electrical engineers." He has taken out more than 700 patents, the third largest number granted to any individual. His account is as follows:

"AFTER having acquired experience in the making of two or three smaller objectives, including one of eight inches aperture, I determined about 1899 to construct a telescope of ten inches aperture, and mount it in a suitable observatory building.

"To this end, I obtained two guaranteed disks of glass made by Mantois in Paris, from their agents in New York. These disks of flint and crown glass respectively were 10½ inches in diameter. The crown glass disk had a density of 2.543, and the index of refraction for the D line (sodium) of the spectrum was 1.51709; (A line = 1.51139; C = 1.51446; F = 1.52335; G = 1.52848; mean dispersion C to F = .00892). For the flint glass disk, these values were: D line = 1.62842 (A = 1.60621; C = 1.61158; F = 1.62842; G



The objective lens (not to scale)

= 1.63866; mean dispersion C to F = .01684).

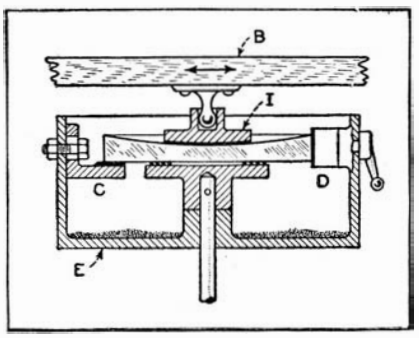
"It was decided to follow a form given by Steinheil, which gave a focal length of 135 inches, approximately, the flint disk to be the outer one. R_1 surface is convex, R_2 concave, R_3 convex and R_4 convex.

"Four disks of heavy plate glass (porthole glass) were secured for grinders, and a machine driven by a small electric motor set up with means for reciprocating an iron grinder for roughing, and below this on a vertical shaft, a face plate about 7½ inches in diameter to which the disk in work was cemented by three spots of pitch.

"A CIRCULAR iron catch box open at top contained the wet grinding powder; in this case, Carborundum No. 40 or 60. This catch box, E, was 16 inches in diameter, and to it was attached an adjustable edge grinder of copper, D, for truing the edges of the lenses of glass disks. The small iron grinder disk, I, (about 4½ inches in diameter) could be given a long or short stroke and set to move over either the center or the diameter of the revolving disk cemented to the face plate, or over chords of it. In this way, by changing the stroke, the roughing out could be made to produce either a concave or a convex form at will, and the radius of curvature could likewise be varied as needed. This small iron tool was used only for roughing out, as it could be given a stroke which would work on one part without unduly wearing down the other parts.

"There was also a third beveling grinder, C, set to bear up under the edges of the lens disks so as to produce a level edge. The figure shows the general arrangement. All three grinders are adjustable. The iron disk can rock on the pin, which is carried by the reciprocating wooden beam B; the grinder under the edge at C can be raised as it cuts away the under edge of the disk; while the edger at D is made to swing toward and from the disk edge, gradually reducing it to complete circular form. The progress toward proper curves was watched either by a spherometer or by templates.

"A very convenient way of making templates of desired radii is to affix a glazier's diamond to a radius bar and cut them from ordinary glass plates, such as window glass or photo plates. When long radii are concerned, this can be done on an open flat



The grinding machine. Redrawn from author's rough sketch

floor. In any case, the cut curved edges of the glass plates are ground together on a flat board until they match. This is a speedy way of securing such templates as are needed. In using such templates, the curved edges can be blackleaded by a pencil and applied to the lens surface, with a slight motion in the length, which will cause a mark to be made on the ground lens surface where the actual meeting contact is.

"After the disks have been roughed out and brought to approximate radii, the work is transferred to the proverbial barrel,

Professor Thomson's observatory, which houses a ten-inch refractor

around which one walks. Care must be taken to support the lens disks evenly and arrange stops (generally of wood) to bear on the edges of the blank to keep it in place. Calipering the edge to secure even thickness all around is a necessity, and the grinding must be governed to do more work on the thicker parts until all is uniform.

"In the case of my 10-inch, the surface R_1—the outer surface of the flint glass disk—was ground to an approximate radius of 74.65 inches, but allowed to become considerably shorter; below 73 inches. This was

The finished refractor

to enable color correction to be better obtained, as estimation showed the likelihood of this provision with the glass used. The rough shaping was by the use of No. 60 Carborundum, changing to No. 120 when near the desired curve.

"One of the plate glass grinders, ground down to present a convex side of about the radius desired for the concave side of the flint lens and the concave side R_2 of the flint lens, was worked on the barrel with this deep convex tool and soon brought to a fit. The curve was adjusted by care, with the aid of the spherometer as a guide, to approach a value of 28.98 inches = R_2. Local grinding at edge or center by small glass grinders enabled such adjustments to be made. Heavy glass tools, except for the rough grinding, were always used. They were generally a little less in diameter than the lens itself. A surface too concave is ground by strokes which avoid the center, while one too convex is worked so as to avoid the edges. In all cases the two fitting surfaces—those respectively of the lens and of the glass disk about eight inches in diameter which is used to produce the surface—are brought to exact fit before measuring. In this way, I have altered long radii of surfaces by small fractions of an inch at a time.

"THE crown glass disk was carefully brought to an even thickness all around, and the surface R_3 was brought to 28.56 inches radius, using on it the deep concave grinder which was used to form it, with No. 120 Carborundum. The last or back convex surface of the crown lens was then shaped to approximately R_4 = 230 inches.

"The next step was the 'smoothing' or

(*Please turn to page 67*)

HOW TO BEAT YOUR WIFE

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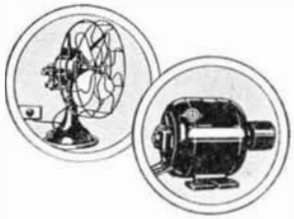

1931

FANS, MOTORS, HAND AND ELECTRIC HOISTS AND CRANES

CURRENT BULLETIN BRIEFS

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

LOCAL BIRD REFUGES (Farmer's Bulletin No. 1644 F, Department of Agriculture) by W. L. McAtee deals with the creation of bird refuges in wood lots, parks, cemeteries, golf courses, et cetera. *Office of Information, U. S. Department of Agriculture, Washington, D. C.—Gratis.*

UNDERWATER LIGHTING (Publication D. M. F. 5360) describes a contribution to swimming pool construction. *Technical Press Service, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.—Gratis.*

MATERIAL HANDLING AND POWER TRANSMISSION DATA SHEET No. 1 gives a belt conveyor trajectory chart and accompanying data. *Link-Belt Company, Chicago, Ill.—Gratis.*

NEW LIFE FOR YOUR OLD RADIO SET gives a fund of useful and practical data on the rejuvenation of radio sets. *De Forest Radio Company, Passaic, N. J.—Gratis.*

RADIO MARKETS OF THE WORLD (Trade Promotion Series No. 109, Bureau of Foreign and Domestic Commerce, Department of Commerce) gives full information on the subject. *Superintendent of Documents, Washington, D. C.—20 cents (money order or coin).*

PLATE GLASS MIRRORS (Commercial Standards CS27-30 Bureau of Standards) describes the standards of quality which have been established as a basis of common understanding in the industry. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

THE SURFACE DECARBURIZATION OF STEEL AT HEAT TREATING TEMPERATURES (Engineering Research Bulletin No. 18, University of Michigan) by W. E. Joining, is an elaborate study of the subject and is accompanied by valuable tables. *Director, Department of Engineering Research, Ann Arbor, Mich.—$1.00.*

THE NATIONAL LUMBER MANUFACTURER'S ASSOCIATION'S ANNUAL REPORT gives information concerning activities in this important industry. *Information Service, National Lumber Manufacturer's Association, 702 Transportation Building, Washington, D. C.—Gratis.*

SAFETY CODE FOR THE USE, CARE AND PROTECTION OF ABRASIVE WHEELS (Bulletin of the United States Bureau of Labor Statistics No. 527—Safety Code Series) gives the revised code for certain sections; in order to keep pace with progress it was found necessary to revise certain sections of the code. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE MAKING OF MIRRORS BY THE DEPOSITION OF METAL ON GLASS (Circular No. 389 of the Bureau of Standards) describes the best methods of making fine mirrors, particularly those for optical apparatus. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

"NI-RESIST" (Bulletin No. 208, The International Nickel Co. Inc.) is a special type of cast-iron alloy which is corrosion and heat resistant. *International Nickel Company, Inc., 67 Wall St., New York.—Gratis.*

BROWN AUTOMATIC CONTROL FOR TEMPERATURE, PRESSURE, FLOW (Catalog No. 8008, Brown Instrument Co.) gives much data of use to executives. *Brown Instrument Co., Philadelphia, Pa.—Free to Industrial Executives.*

PIONEER AND CONSOLIDATED MARINE INSTRUMENTS describes many items of marine equipment. *Pioneer Instrument Co. Inc., 754 Lexington Ave., Brooklyn, N. Y.—Gratis.*

GRAPHIC FACTS ABOUT AVIATION gives statistics in graph form, making a very interesting little brochure. *Carl Byoir & Associates, 10 East 40th St., New York City.—Gratis.*

MEASUREMENT UNITS AND STANDARDS gives data on units and standards and recommends *timex* and *spacex* as names for the Einstein specialization of basic time and space. *American Institute of Weights and Measures, 33 Rector St., New York City.*

EDUCATIONAL DIRECTORY, 1931—PART III (Bulletin 1931, No. 1, Office of Education, Department of the Interior) deals with educational associations, boards and foundations, research directors, and educational periodicals. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

CHESTNUT AS A CORE WOOD (Brochure 4 of the Appalachian Hardwood Club) by George C. Morbeck, describes the use of one of the most valuable woods as a base upon which to glue face veneer. *Appalachian Hardwood Club, Southern Railway Building, Cincinnati, Ohio.*

ROMAN SURVEYING INSTRUMENTS (University of Washington Publications in Language and Literature, Vol. 4, No. 4) by Edward Noble Stone, gives a short description of instruments used by Roman engineers in surveying. The "hodometer" is the precursor of the taximeter. *University of Washington, Seattle, Washington.—75 cents.*

AMERICAN STANDARD SAFETY CODE FOR MECHANICAL REFRIGERATION gives the result of ten years exhaustive research and intensive study, formulated by a joint technical committee representing 28 organizations. *American Standards Association, 29 West 39th St., New York City.—Gratis.*

FIFTY YEARS OF SERVICE TO INDUSTRY describes in detail the work of the *Pittsburgh Testing Laboratory, Pittsburgh, Pa.—Gratis.*

TYPE "K" METALLIZED FILAMENT gives engineering data on tests made on this resistance material. *International Resistance Company, 2006 Chestnut St., Philadelphia, Pa.—Gratis.*

REPRODUCTION ON PULPWOOD LANDS IN THE NORTHEAST (Technical Bulletin No. 223, U. S. Department of Agriculture) by Marinus Westveld, deals with the need for keeping the potential pulpwood lands in this country in a continuously productive state. *Superintendent of Documents, Washington, D. C.—20 cents (money order or coin).*

ENGINE PERFORMANCE AT HIGH COMPRESSION RATIOS (Engineering Research Circular No. 6, University of Michigan) by H. E. Zuck, gives the results of a research in which was studied the effect of compression ratio, mixture ratio, and spark timing, on the tendency of a standard motor fuel and the power developed with such a fuel. *Department of Engineering Research, Ann Arbor, Mich.—50 cents.*

AIRWORTHINESS REQUIREMENTS OF AIR COMMERCE REGULATIONS FOR ENGINES AND PROPELLERS (Aeronautics Bulletin No. 7-G. Aeronautics Branch, U. S. Department of Commerce) gives the official regulations. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

A NEW MATERIAL FOR INTERIORS describes a most interesting material called "Micarta" which has many of the properties of steel, but is quiet, and warm to the touch. It can be made to simulate wood, marble, tapestry, et cetera. *Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.—Gratis.*

OVERPRODUCTION OF RAW MATERIALS (Foreign Policy Association Information Service Vol. VI. No. 24 in two parts, Part I) by Lawrence B. Mann, deals with the overproduction of raw materials, one of the main causes of the downward movement of prices. *Foreign Policy Association, Inc., 18 East 41st St., New York City.—25 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 58)

stress and strain throughout life, to be heavy eaters of protein and salt and to have occasionally about their bodies minor infections that have not been treated for a long time. The patient with high blood pressure is usually overweight. Doctor Riesman feels that high blood pressure is not only an individual disease but a disease of American life. He says:

"What are the causes of this American disease? They are, I believe, connected with our striving for wealth. We have created false standards, have deprived ourselves of peace and leisure, and have lost the art of living wisely. We have had abundant material success, but have we not paid too dearly for it? It may be difficult to persuade the average American that the price has been too high, for he is still convinced that the civilization that he has created on this continent is the best in the world. There might be nothing wrong with such a sentiment if it did not blind us to some virtues still remaining in the Old World. Winston Churchill, the English statesman, accuses us of thinking that when we left Europe we took with us all the virtues and left all the vices behind. No doubt we took many virtues, but it must be admitted by every candid person that we have evolved a few vices of our own.

"Unlike the European, who, when he has enough for a comfortable living, retires to a life of leisure, the American, when he becomes rich, wants to become richer. He works hard and gambles with his savings. If he chances to be successful, he has in many instances shortened his expectation of life; he has surely done so if his ventures have ended disastrously.

"It might be contended that, notwithstanding our way of living, the span of life has been greatly lengthened—nearly 15 years since 1880. True enough; but when we come to analyze the relevant figures we find that the apparent prolongation of life to the age of 56 is due primarily to the saving of child life and not to the saving of adult life. Statistics clearly show that the span of life after the age of 45 has not been lengthened. It is highly probable that it has been shortened, and that is the price of success."—*M. F.*

New Process for Bonding Metals

FRANCIS R. GLENNER, general manager of the Homogeneous Equipment Co., Brooklyn, New York, has developed a new metallurgical chemical process, for which a patent is being granted, for producing an inseparable homogeneous bonding of metals and alloys which will withstand vacuum, severe vibration, mechanical shocks, and changes of pressures and temperatures close up to the melting point of the metals themselves without buckling, cracking, or peeling. A molecular fusion takes place between the metals throughout the entire surface treated, whereby the metals are inseparably bound together molecularly at every point and act as a single homogeneous unit.

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geneously with lead, tin, and so on, to withstand corrosion or other severe plant operating conditions.

This work is being done on autoclaves, kettles, plates, tanks, tubing, and various types of equipment suitable for the chemical refining and process industries.—*A. E. B.*

U. S. Chemical Industry Shows Balance of Trade

FOR the first time in the recent history of the American chemical industry, American foreign trade struck a balance in 1930, with both exports and imports valued at 172,000,000 dollars. With the exception of the war period, annual imports of chemicals and allied products have exceeded exports by many millions of dollars. Both the inbound and outbound trade has fluctuated during the past 10 years, but during the greater part of this time there has been a gradual approach to the balance.

It is also interesting to note that the exports for 1930 were well above the average for the 10-year period, and even considerably greater than the average for the last five years. The changes in the chemical industry, the rise to prominence of new chemical commodities, and the inter-commodity competition are all reflected in the chemical foreign trade statistics. Since 1921, chemical exports have advanced 56 percent, from 110,000,000 dollars to 172,000,000 dollars and imports only 33 percent, from 129,000,000 dollars to 172,000,000 dollars.

The marked fluctuations from year to year evident in the import trade are absent from the export, which for the most part has shown a rather steady upward movement.—*A. E. B.*

Shoe Dye Poisoning

FOR some 20 years medical literature has contained reports of cases of severe cyanosis, including some cases of death, following poisoning by shoe dye. Most of the reports concern persons who put on a pair of shoes recently dyed and within a short time suddenly began to turn blue and soon became prostrated. The condition is the result of poisoning by aniline and nitrobenzene, apparently absorbed through the skin, but possibly also to some extent inhaled.

In a case recently reported by Dr. S. J. Levin, the patient concerned was a baby only eight months old. One morning the child suddenly fell over backward in her highchair, turned blue, and in five minutes became unconscious. The physician who examined her noticed a strong, sweetish chemical odor in the room coming not only from the patient but also from the shoes which had just been removed and which were lying on the table. The canvas uppers of the shoes had apparently been painted with black dye, which was still moist. The mother said that the white canvas uppers were soiled so that she had dyed them black and after waiting an hour had put them on the baby. It was found that the blood of the child had changed because of the absorption of the aniline dye so that the blood was not able to carry a sufficient amount of oxygen. The poisoning was of the same type that occurs in illuminating gas poisoning or that following the inhalation of exhaust from a motor car, so far as concerns its effects on the blood.

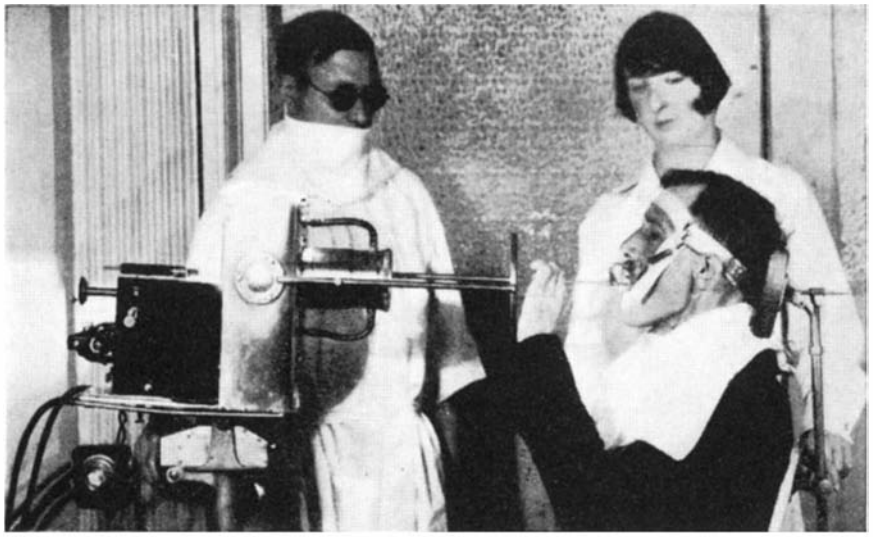
When the baby was given fresh air and oxygen it recovered fully in 24 hours. Both aniline and nitrobenzene are extremely poisonous substances; therefore, most manufacturers of shoe dyes have begun to use less toxic substances to dissolve the dye. In the case of the dye used on the shoes of this infant, the substance involved was 20 percent orthotoluidine. This substance is much less poisonous than aniline or nitrobenzene, but is apparently sufficiently poisonous to bring about serious disturbances in the blood of an infant.—*M. F.*

Artificial Sunlight for Laryngeal Tuberculosis

FORMERLY tuberculosis of the larynx and of the vocal cords was considered promptly fatal. With the introduction of the use of the ultra-violet rays, it has been possible to promise much to patients with this disorder. Formerly antiseptics were much used in attempting to control the development of the lesions in the throat; now antiseptics have been largely discarded for this purpose. The chief advantage of the antiseptics is to clean the lesion, to get rid of the dead tissues, and to influence the surrounding inflammations that are due to germs other than the germ of tuberculosis.

Obviously, it is an extremely difficult matter to apply concentrated artificial sunlight directly to the larynx. Several devices have been developed for this purpose. One device is a type of quartz rod along which ultra-violet rays pass to the larynx from a mercury vapor lamp or from the carbon arc. Another device is a series of mirrors whereby direct sunlight of high intensity is reflected into the larynx. This device is used by patients who have been trained in the use of hand mirrors. A third method

Direct irradiation by artificial sunlight, rays striking lesion directly



Indirect irradiation, the patient looking at his own larynx. Patient sits in front of a perforated mirror and can regulate the rays to fall upon any given lesion

involves the placing of the patient in a fixed position and the application of reflecting steel mirrors in such a form as to throw the light directly into the larynx. There are numerous case records available indicating that this method is of great value in controlling the disease.

A foreign investigator, Dr. Wessely of Vienna, has developed a special apparatus for the purpose and there are other devices prepared by various manufacturers. Dr. Joseph W. Miller reports 74 patients treated by this method—only two of whom failed to improve and 59 of whom showed complete healing.—*M. F.*

Electricity Only Thing Now Cheaper Than in '13

ANALYSIS of the "cost of living" since pre-War days reveals electricity to be the only household item showing a decrease in price, according to a bulletin of the United States Department of Labor.

While prices of all other major classes entering into the "cost of living" budget showed increases ranging from 37.2 percent for food, to 88.3 percent for house-furnishing goods, and to 108.1 percent for miscellaneous items, the cost for electric service declined 18.5 percent since 1913, the figures show. Clothing showed an increase of 53 percent and rent an increase of 46.5 percent during the same period.

General living expenses covered in 1913 by one dollar now demand $1.607, whereas electrical energy then bought for one dollar now costs but 81.5 cents. The figure for the relative cost of electricity is based on the average price of 20 kilowatt-hours per month for household use in the 32 major cities in the United States. Relatively, then, the cost of electricity has been cut in half since 1913 if use is restricted to the 20 kilowatt-hour basis. With the much larger consumption of electricity now predominant, the showing is even more favorable.

"Useless" Metal Worth 7000 Dollars a Pound

THE world's first pound of indium, one of the rarest of metals, has been made in Cleveland, Ohio, by The Grasselli Chemical Company. It is worth 7000 dollars —nearly 10 times the value of platinum. Yet, in spite of its price, it is "useless"—that is, there are no known commercial uses for it, because heretofore there has not been enough of it available for experiment to discover useful applications.

Indium was first discovered in 1863 by two German chemists, Reich and Richter. It was found in a sample of zinc ore by means of the spectroscope. The indigo blue line of its spectrum gave the element its name. It is a white, lustrous metal, very soft and ductile, slightly heavier than zinc, and you can melt it with a match.

Discovery by The Grasselli Chemical Company of a method of producing it electrically puts the metal within the reach of experimental use. The indium is obtained by electrolysis. A current runs through a solution containing indium and causes it to segregate and deposit. Success depends upon very accurate temperature controls and the use of the proper kinds of electrodes.

Whether this discovery will unlock Nature's storehouse of indium depends on whether its uses prove important enough to justify the price, according to a report to the American Electro-Chemical Society by Dr. L. R. Westbrook.

He believes commercial uses will be developed, and says: "Like many other rare metals which only a few years ago were mere laboratory or scientific curiosities, and which today have a definite field of usefulness, indium undoubtedly has a definite field of application."—*A. E. B.*

Foreign Body Through the Brain

IN the scientific museum at Harvard University, there is a skull through which an iron bar penetrated following an explosion. Now a physician of North Dakota has reported a case of a boy aged 18 who underwent a similar accident and who has apparently fully recovered. He had been placing lighted firecrackers in a pump barrel and holding the handle while they exploded. He put two firecrackers in the pump; the handle then slipped off and the piston shaft was shot through his head. He was brought to the hospital sitting in a wheel chair and apparently in a state of shock but not unconscious.

The piston shaft was cleaned with iodine and withdrawn. The patient was then put to bed and tetanus antitoxin was given to

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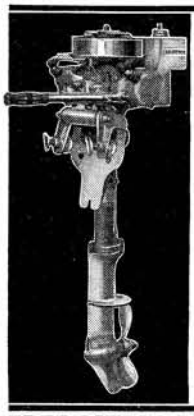

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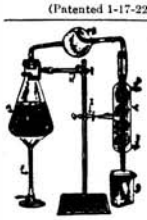

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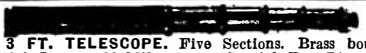

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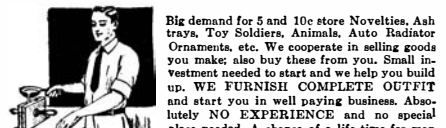

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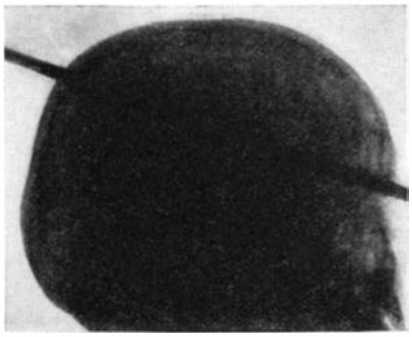
him. The shaft had entered the skull through the upper angle of the right eye without injuring the eyeball and had passed through the skull, protruding about six inches in the midline. During the course of his treatment, he developed some paralysis of the left arm and hand, but through very careful treatment, including the best of



A pump shaft penetrated the brain, but was removed and patient lived

modern medical science, the patient has almost fully recovered. He has a slight dropping of the right eyelid and some weakness of the left hand and forearm. He has completed another year of high school with success and has no mental impairment. —*M. F.*

Diatoms, Millions of Years Old, Serve Mankind

UNDER the name of diatomite, the tiny skeleton-like remains of microscopic water plants that floated in ancient oceans and lakes are now being made to serve mankind in numerous ways, says the United States Bureau of Mines. These small organisms, which have such interesting posthumous value, are found in all kinds of water, quiet or moving, hot or cold, saline or fresh. Some of them move freely, others attach themselves to various objects, but all absorb mineral salts from the water in which they live. They make skeletons of silica out of this mineral matter in much the same fashion that oysters make shells out of lime taken from sea water. Diatoms multiply rapidly, but their life span is short. After they die the organic matter decomposes, and the skeletons sink to the bottom where they gradually build up deposits of diatomite. It is estimated that there may be as many as 50,000,000 individual skeletons in a cubic inch of diatomite, which may be millions of years old.

Common names for diatomite are: diatomaceous earth, tripolite, kieselguhr, and infusorial earth, although strictly speaking the last-named material is not diatomite, says Paul Katmaker, in a report recently published by the Bureau of Mines.

Diatomite is widely distributed over the world. At present the United States has the largest commercial beds and leads in world production, with Algeria second. In the United States the most important commercial deposits are in California, although diatomite is produced in Washington, Oregon, Nevada, and some of the eastern states.

The cane-sugar industry at present is the largest consumer of diatomite, it being used mainly in filtering sugar solutions. Diatomite also is used to a certain extent in the beet sugar industry. Diatomite also may be used for filtering orange juice, lemon juice, and grape juice, vinegar, pectin, citric acid, glucōse, lactose, maltose, molasses, syrups, cottonseed oil, corn oil, fish oil, castor oil, lard, used crank-case oil, used transformer oil, petroleum, petroleum-water emulsions, beverages, antitoxins and serums, nitrocellulose, dyestuffs, glycerine, alcoholic extracts, adhesives, various emulsions, sewage, liquid soaps, and chemicals.

Owing to its extreme porosity and fineness of individual air chambers, diatomite in various forms is extensively used as insulating material. For insulating, diatomite may be used as sawed bricks which are cut from the rock in place at the quarry, as a granular powder, as bricks which are prepared with some bonding material and then calcined, or as mortars and cements. The bricks are used extensively for lining furnaces, in which they are usually placed behind a firebrick facing and are backed up by ordinary brick. Thus sandwiched in, they are very efficient in preventing heat losses.

The use of diatomite as a filler for battery boxes has increased rapidly in the last few years. The annual tonnage now so employed is considerable, and this market is one of the most important of the newer outlets which are being developed. Finely ground diatomite is also used as a filler in hard-rubber products, phonograph records, papier mâché, paints and varnishes, oil cloth, linoleum, insecticides, and for other purposes for which a light porous material is required.

Diatomite is used as an absorbent in the manufacture of acetylene gas. It is used also for absorbing chemicals such as bromine, alcohol, and acids, for liquid fuels, liquid manures, and disinfectants. It makes a good packing material for strong acids such as nitric and sulfuric acids because in case of breakage it tends to absorb the spilled acid.

Many metal polishes now on the market use diatomite as a base. The small, tough, freshwater varieties are said to be the best for this purpose. Polishes of this kind may be used for silverware and for scientific and surgical instruments.—*A. E. B.*

PROFESSIONAL METHODS IN AMATEUR ARCHEOLOGY

(*Continued from page* 40)

in places where excavations or stream cutting are exposing the strata of the rock. In all such localities, the face of the cut should be carefully studied and if human bones or stone utensils are found at considerable depths or associated with extinct animals, your state institution or the Committee on State Archeological Surveys should be notified at once.

Last but not least, every collector should make provision for the care and disposition of his collection in case of his death. The amateur collector has made himself custodian of information of great historical interest and he should guard it against loss or scattering.

The foregoing instructions are far from complete, especially those dealing with excavations. Opening a prehistoric site is a task which should only be taken in an emergency. Use your influence to preserve all mounds and village sites until you can have assistance or advice from a trained archeologist. The Committee on State

Archeological Surveys is anxious to aid you in recovering and preserving the story of man in America, and its Chairman will be glad to receive any inquiries, referring them for answer to the local authorities wherever it seems advisable.

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Fay-Cooper Cole, *ex officio*, 1929-30; Department of Anthropology, University of Chicago, Chicago, Illinois.

THE AMATEUR ASTRONOMER

(*Continued from page* 61)

fine grinding of all four surfaces, without permitting change of radii. Fine washed grades of Carborundum were used for the last 30 minutes during smoothing.

"Next came the polishing with pitch and rouge. Surface R_2 was first worked, then R_3. At this stage, R_1 was given a partial polish. I term this 'glossing.' Though the polish is not more than partial, still it is sufficient to enable optical tests to be made and can be produced in a few minutes.

"The same 'glossing' was given to R_4.

"Tests for color correction and spherical aberration were now made, using an artificial star in the usual way. There was found overcorrection for color and considerable negative spherical aberration. The surface of flint lens R_1 was then reground and given 71.8 inches radius, while R_4 was worked locally for spherical correction, as most of the fault seemed to be in that surface. Tested again, the color correction was found to be satisfactory—pale lilac and soft apple green overhanging. Completion of polish was now given to R_1 flint outer surface, leaving R_4 (back of crown) still partly polished. After quite a series of tests involving repeated trials and small corrections, surface R_4 received its final polish. Result: ring systems inside and outside of focus good, and definition excellent. Tests of focal length gave 139.5 inches; aperture full ten inches, a ratio of aperture to focus 1:14, very nearly.

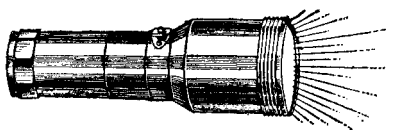
"The polishers were iron disks seven inches in diameter, faced with the usual pitch squares and worked with levigated rouge and water. The final measurements of radii gave: $R_1 = 71.8''$; $R_2 = 28.93''$; $R_3 = 28.5''$; $R_4 = 229.04''$.

"The lens was placed in its cell and mounted on a Warner and Swasey steel tube. The equatorial mounting was partly made from my drawings, and many of the patterns for the castings, including the heavy, hollow pillar, I made myself. In the pillar is the drive, which consists of a small fan motor (A. C.) controlled by a sensitive centrifugal governor which I constructed for the purpose and which I found very satisfactory. Through a relay it cuts the motor in and out at about one-half second intervals, and can be regulated closely.

"For the purposes of testing, I had made a 12-inch plane and used it with an artificial star in all the later stages of adjusting and figuring the 10-inch objective. To avoid dust and grit while the delicate polishing was carried on, the work proceeded in a closed room (no open windows) and in the hottest weather, a great advantage of which is that the temperature of the skin is very near that of the glass, and danger of distortion by irregular heating is diminished. Further, the extreme humidity, though very uncomfortable, permits the grinding and polishing to proceed without rapid drying of the water out of the powder being used.

"Tests on the stars showed excellent definition, and the characteristic interference rings inside and outside focus were developed symmetrically and were perfectly circular when a star was observed. The performance of the lens was as good as could be expected. It resolves double stars down to 0.5 second separation, and this is about the theoretical limit for 10-inch aperture. When the members of a pair of small stars are 0.3 second apart, it will show an oval, or when the two are of different magnitude, an egg-shaped image. Small stars at 0.6 second apart are seen very clearly separated. The outstanding secondary spectrum is at a minimum for the glasses used, and the lens shows stars of small magnitude, with a single interference ring around the image. On steady nights during favorable oppositions of the planet Mars and at times of best seeing, the so-called *canali* of Mars are plainly visible, with the other markings of that interesting object. The divisions in the rings of Saturn are distinctly observed, and at times a graininess of the inner ring, like the streaks from a paint brush, is seen.

"I have not dwelt on the mechanical details of the mounting, which is in essence the usual equatorial, nor have I dwelt on accessories, such as spectroscopes constructed by me in my workshop, helioscopes and the like—deeming the central problem and the one demanding most skill to be the objective lens itself."



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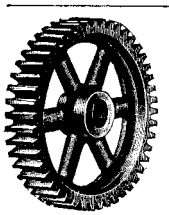

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COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

Patent Royalty Held Nontaxable by State

THE corporate income tax levied under authority of the North Carolina statute may not include income derived from royalties for the use of patents, the State Supreme Court held in a case entitled State *versus* Chemical Construction Company, reported in *The United States Daily*.

The Supreme Court of the United States has so held, the court declared, citing Long *versus* Rockwood, 277 U. S. 145. "In that case," the opinion said, "it was held that a State cannot tax royalties for the use of a patent issued by the Commissioner of Patents of the United States under the authority of an act of Congress. The Congress of the United States is expressly empowered 'to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.'"

Quoting previous cases on the subject, the opinion said: "A patent right itself is not taxable by a State. Letters patent issued by the United States give to the patentee a right of monopoly in the invention, and with this right the State can not interfere. The patent is the instrumentality by which the United States confers upon the patentee, his heirs and assigns the right to the exclusive use of his invention or discovery, for a limited time. As a State can not tax the patent, it can not tax the royalties received from its use. What the State can not do directly, it can not accomplish in an indirect way.

"We do not think that the decision in Long *versus* Rockwood is affected as an authority on the question presented in the instant case, as suggested by the Attorney General in his brief filed in this court as counsel for the relator, by the decision in Educational Films Corporation *versus* Ward, decided on Jan. 12, 1931, and reported in 75 L. Ed. at page 233." The North Carolina court said: "In that case a tax levied under a statute of the State of New York on complainant for the privilege of exercising its corporate franchise in said State was upheld, although the amount of the tax was determined by the income of the complainant derived from royalties for the use of patents owned by complainant. The decision of the question there presented was not controlled by the decision in Long *versus* Rockwood. The distinction is made in the opinion of the court delivered by Mr. Justice Stone."

"Ethyl" Mark Protected

FIRST Assistant Commissioner Kinnan has held that the Lyons Storage Battery Company, of Belleville, New Jersey, is not entitled to register the term "Ethyl" as a trademark for storage batteries, in view of the prior adoption, use and registration by Ethyl Gasoline Corporation, of New York, New York, of the same term as a trademark for motor fuel oil.

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.

The grounds of the decision are that the goods of the respective parties are such that, if the same mark were used on both, confusion would be likely and that the mark is a distinctive portion of the opposer's corporate name.

With reference to the goods, after noting that automobiles use gasoline as the motor fuel and storage batteries to furnish the initial start to the engine and to furnish the electric spark to ignite the charge and both are used on the same vehicles, the First Assistant Commissioner said:

"* * * there would appear to be a reasonable probability that one familiar with the trademark and goods of the opposer and seeing the same mark upon the battery would think the latter had its origin with the opposer company. In view of former holdings it is believed proper to hold that confusion of origin being likely, the goods of the respective parties belong to the same class."

With reference to the opposer's corporate name, he said:

"* * * there is no showing that this portion of opposer's name has been used by others in connection with goods of this class prior to the formation of the opposer corporation. It would seem in consequence that the applicant should not have adopted as its mark so distinctive a portion of the opposer's corporate name."

With respect to the argument of applicant that the term has a meaning in the language in connection with such classes of goods as alcohols and hydrocarbons and therefore the right which the opposer might otherwise have is restricted, he said:

"There is no contention, however, that the word is descriptive of the goods of either of the parties. It is believed the applicant in selecting its mark should not have chosen that which the opposer has been from a date long prior using upon its goods and in its corporate name."

New Alloys Extend Field of Zinc's Usefulness

METALLIC zinc has extended its services into new fields as a result of much thoughtful and painstaking research work. This has been accomplished through the discovery of new zinc base alloys having properties quite different than those of the commercially pure metal, says Robert M. Curts in a recent issue of *Chemical Markets*. The most important development which has taken place in the effort to establish uses for zinc is the discovery of greatly improved die-casting alloys. This applies primarily to "pressure" die castings, which are made by forcing molten metal into steel dies having cavities of the size and shape necessary to produce the desired object.

For a time an alloy composed of 4 to 5 percent aluminum, with 3 percent copper, and 92 to 93 percent zinc seemed to serve satisfactorily, but it was soon noted that after several years in service the castings made of it tended to become brittle and often underwent changes in dimensions which interfered with the proper functioning of the mechanisms of which they formed a part.

This prompted a rather detailed study of the copper-aluminum-zinc alloys which has led to a better understanding of the causes of such "aging" phenomena. It was found that growth and loss of physical properties could be attributed to two causes—intercrystalline oxidation and internal phase changes, both of which are effected by atmospheric conditions.

Out of all this work the "4-3-.1" alloy was evolved—United States Patent 1595-761. This alloy is composed of 4 percent aluminum, 3 percent copper, 0.1 percent magnesium, and 92.9 percent high grade zinc. With a tensile strength of 46,000 to 48,000 pounds per square inch, an initial impact strength of well over 100 foot pounds per square inch, freedom from growth through intercrystalline oxidation, and a decided retardation of internal phase changes, this alloy shows a vast improvement over the old 6 percent tin alloy and the 4 percent aluminum, 3 percent copper alloy.

It has been recognized as a satisfactory engineering material in many fields where, heretofore, zinc alloys were not considered acceptable. It is employed in the manufacture of automobile fuel pumps, carbureters, body hardware, radiator caps, lamp housings and supports, steering wheel parts, and so forth. It is used in the manufacture of parts for washing machines, check writers, postage meters, vending machines, printing presses, cash registers, weighing machines, fare registers, and pencil sharpeners.—*A. E. B.*

"No-Nox" Not a Trademark

IT was recently held by First Assistant Commissioner Kinnan that the Gulf Refining Company, of Pittsburgh, Pennsylvania, is not entitled to register, under the Act of 1905, the notation "No-Nox" as a trademark for motor fuels.

The ground of the decision is that the notation is merely descriptive of a character or quality of the goods.

In his decision, after stating that it is a matter of common knowledge that under some conditions a motor will "knock" and

that such "knocking" is generally attributed to pre-ignition of the charge, and that some grades of gasoline were until recently regarded as producing this "knocking" to a greater extent than others, and noting applicant's argument that the notation was intended to convey the suggestion that applicant's goods were non-poisonous or non-noxious, and referring to a number of decisions in which marks including the word "No" followed by a statement of function were held descriptive, the First Assistant Commissioner said:

"In the light of these adjudicated cases, the applicant's notation must be held merely descriptive of the character or quality of its goods if the purchasing public would obtain from it nothing more than the information that the applicant's gasoline would, when used in a motor, produce no knocks. It seems clear enough this notation would have only this effect upon the minds of users of the applicant's gasoline. 'Nox' is an obvious misspelling of 'knocks' and is, in fact, given in the dictionary as indicating the proper pronunciation of the latter. The notation appears to be but an equivalent in its meaning of anti-knocking or non-knocking when applied to gasoline."

"Perpetual Motion" Applicant Must Show Model

AN outline of Patent Office procedure, officially issued more than 100 years ago, stating that efforts to establish perpetual motion "ought never to be attempted until the sun rises in the West," established policies which continue to be followed in handling patent applications of the "perpetual motion" class.

The old rules, promulgated in 1811, specified that every application for a "perpetual motion" patent be accompanied by an "operative model" and the same requirement remains in force at the Patent Office, many years after the practice of asking that models be submitted with applications for other types of patents has been discarded.

The following additional information was recently made available by officials of the Patent Office:

Requests that the Patent Office issue patents on devices stated by applicants to embrace principles of so-called "perpetual motion" continue to be received periodically.

The section of the rules of procedure promulgated in 1811 relating to "perpetual motion" follows in full text:

"As it can be mathematically demonstrated that no human invention can produce a machine capable of undiminished power, or power regenerating itself, and forming what is called perpetual motion, an operative model will be demanded for every such attempt, before a patent can be granted; otherwise no proof can be given of its being what its name designates, and for which a patent is demanded.

"It is hoped that this will prevent many ingenious, but unlearned, men from attempting what the scientific know to be impossible. Some set out by searching, through levers and large wheels, to increase power, forgetting that this is to diminish velocity—then they multiply and diminish the power to give velocity; this brings them to the point whence they set out. Thus it is considered an axiom in mechanics, that to increase power is to diminish velocity, and vice versa. They must also consider that man, in all his operations, works against gravity and friction.

"A perpetual motion is therefore only considered as a perpetual motion; and ought never to be attempted till the sun rises in the West."

The form letter transmitted by the Patent Office to each person seeking patents of the "perpetual motion" class follows in full text:

"Replying to your recent letter, you are advised that the Patent Office understands the term 'perpetual motion' to mean a mechanical motion creating energy; that is, a machine doing work and operating without the aid of any power other than that which is generated by the machine itself, and which, when once started, will operate for an indefinite time.

"The views of the office are in accord with those of scientists who have investigated the subject, and are to the effect that mechanical perpetual motion is a physical impossibility. These views can be rebutted only by the exhibition of a working model. Many persons have filed applications for patent on perpetual motion, but such applications have been rejected as inoperative and opposed to well known physical laws, and in no instance has the requirement of the Patent Office for a working model ever been complied with.

"In view of these facts the office will not now permit such an application to be filed without a model, and this practice has been adopted in order to save applicants the loss of the fees paid with their applications. After an application for patent has been considered by the examiner the filing fee cannot be returned."

"Diamond Test" Refused Registration

ASSISTANT COMMISSIONER MOORE recently held that Nestor Johnson Manufacturing Company, of Chicago, Illinois, is not entitled to register a mark consisting of the words "Diamond Test," somewhat peculiarly displayed, as a trademark for ice skates in view of the prior adoption and use by the Shapleigh Hardware Company, of St. Louis, Missouri, of the words "Diamond Edge" as a trademark for the same goods.

The ground of the decision is that the marks are confusingly similar and the opposer was the first to adopt and use its mark.

In his decision, after referring to the record with reference to certain prior registrations attained by the opposer and the testimony to establish use, and holding that such use was prior to any use by the applicant, the Assistant Commissioner, with respect to the mark under consideration, said:

"Respecting the confusing similarity of the marks, it is believed that the word 'Diamond,' which is common to both marks, is the controlling characteristic, the characteristic which would be most likely to make a lasting impression upon the mind of the purchasing public, and that the two marks are otherwise confusingly similar as to the manner in which the words are displayed."

With reference to the contention based upon the use by others of the word "Diamond" the Assistant Commissioner said:

"With reference to the trademarks owned by others comprising the word 'Diamond,' noted by the applicant, it may be stated that such may not ordinarily be considered in an opposition proceeding (citing decisions). It may be proper to cite such registrations in order to show that the mark under consideration is public property, but no such condition exists in the instant case. While it is true that the word 'Diamond' is a common dictionary word, yet no reason is apparent why it may not be properly used arbitrarily as a trademark. Obviously it is not descriptive of the goods. The most that can be said is that it suggests the quality of hardness when associated with the goods."

"Tucork" Mark Allowed

THE Armstrong Cork and Insulation Company, of Pittsburgh, Pennsylvania, has shown no grounds upon which Tuco Products Corporation, of New York, New York, should be refused registration of the term "Tucork" as a trademark for composition flooring and insulating products, such as cold storage and refrigerating insulation, according to a decision in a case between these two companies, handed down by Assistant Commissioner Moore.

In his decision, after referring to the statute, which requires that marks shall be registered, except under certain conditions, and stating that it was not clear in what respect the opposer had brought himself within the statute, and noting that the opposer states that it associates the word "cork" and the term "cork board" with its goods, the Assistant Commissioner said:

"* * * * there is nothing of record showing that the opposer has the right to the exclusive use of cork, with its well known properties and characteristics, for insulating purposes, nor the right to the exclusive use of the word 'cork' as the name of the product."

He then stated that the opposer's main contention was that the mark was descriptive of the opposer's goods and false and misleading when applied to applicant's goods, which contention was based on the ground that the mark sought to be registered means "true cork" whereas the applicant's goods contains practically no cork. He then said:

"The applicant explains that its mark was not intended to mean, and does not in fact mean, 'true cork'; also that said mark was formed from the first part of its corporate name TUCO, with the letters RK added thereto, and that the word cork was included in its trademark as suggestive that its product possesses properties or characteristics similar to cork."

"I am of the opinion that the applicant's mark would not be interpreted by the members of the public as meaning 'true cork' but as an arbitrary and technical trademark."

"As to opposer's contention that the applicant has been guilty of deception and fraud on the public by using the mark 'Tucork' on its goods, it may be stated that this is a question between the applicant and this Office and does not affect the opposer any more than any other member of the public. In fact, the opposer should be the least interested as it does not purchase or use the applicant's goods."

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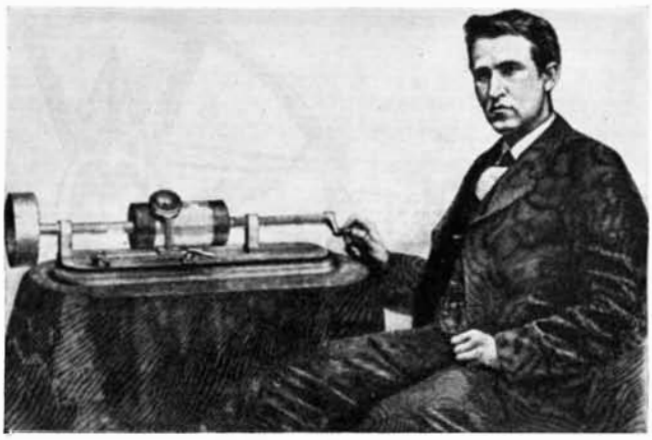

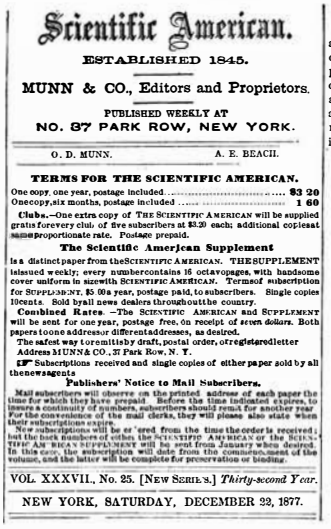

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VOL. XXXVII., No. 25. [NEW SERIES.] *Thirty-second Year.*

NEW YORK, SATURDAY, DECEMBER 22, 1877.

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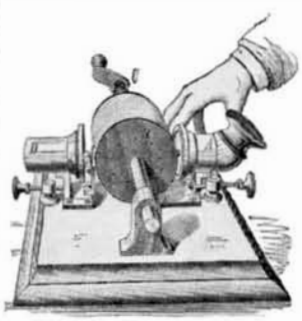

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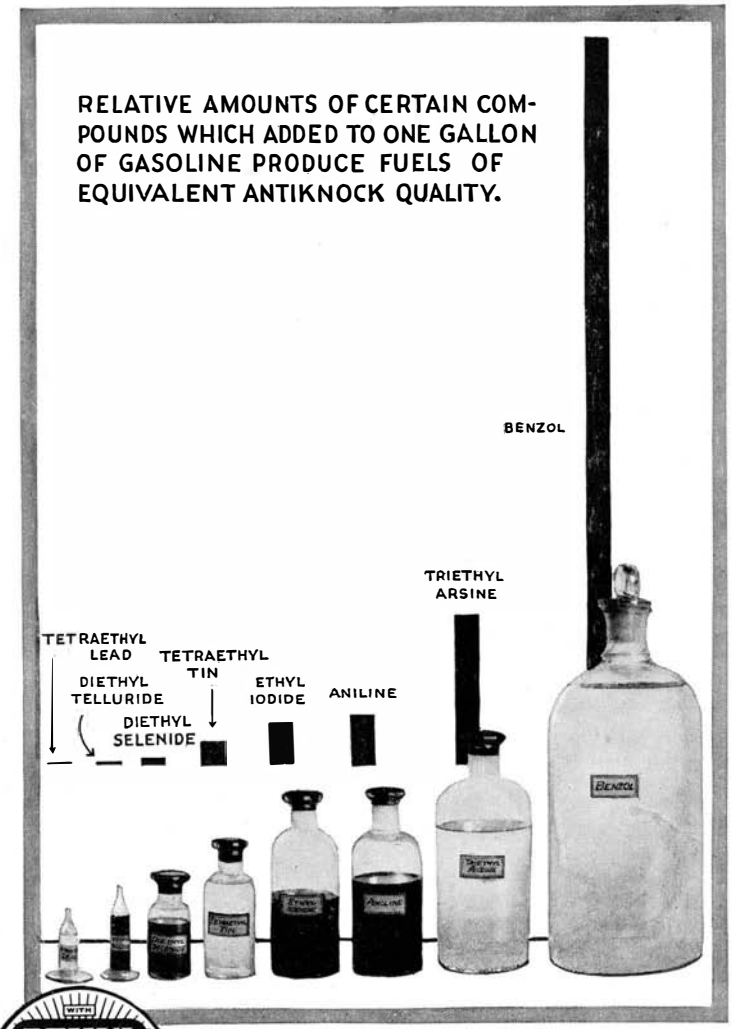

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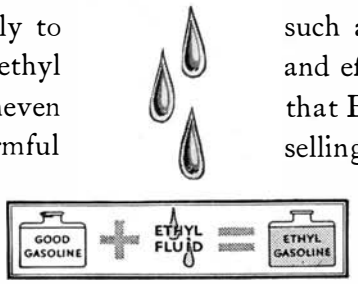

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