SCIENTIFIC AMERICAN

JUNE · 1932 35 CENTS

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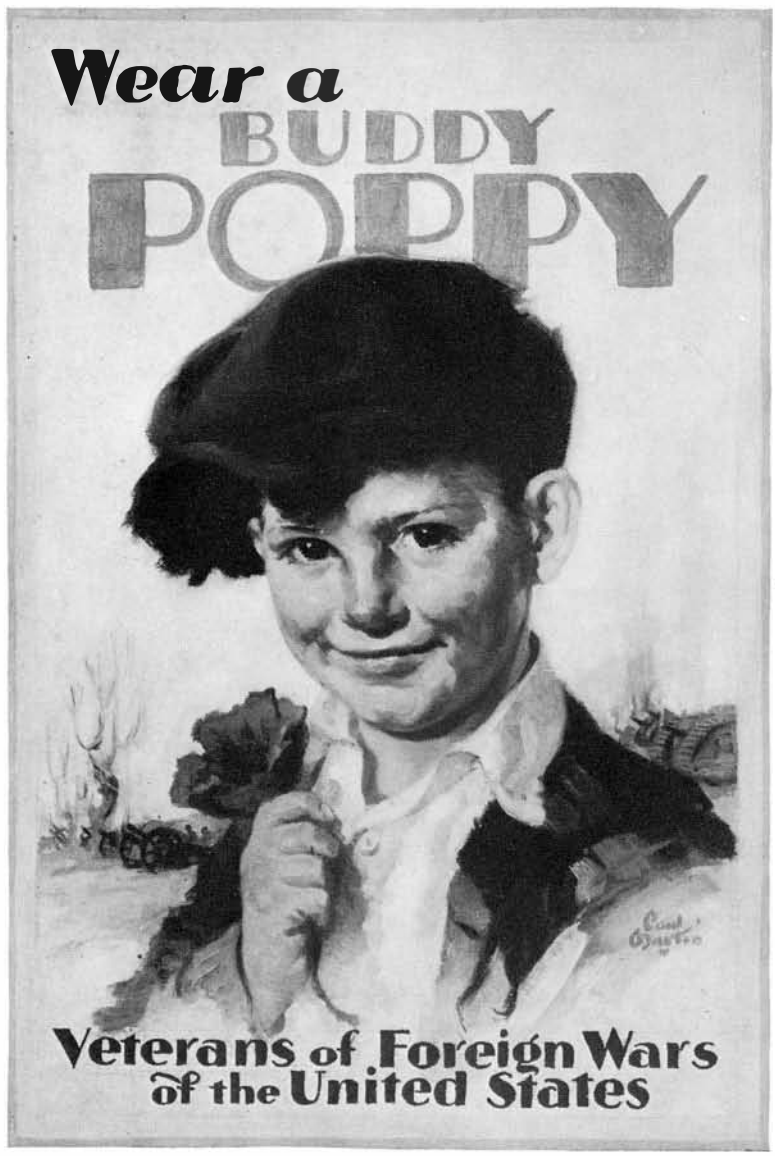
AND A DIGEST OF APPLIED SCIENCE

Wear a Buddy Poppy

on

Memorial Day



VETERANS OF FOREIGN WARS OF U. S.

Annual Sale

SCIENTIFIC AMERICAN

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EIGHTY-EIGHTH YEAR • ORSON D. MUNN, Editor

CONTENTS · JUNE · 1932

AT THE TOP OF THE HILL

A LONE figure in overalls surveys the fields of his labor. Freshly planted rows point their even lines around a gently rising hill. Seemingly the world and its people are far away. But this man is not alone!

His home is at the top of the distant hill. And in his home is a telephone. Eighty-five million miles of wire lead to it. His call is a command to one or more of several hundred thousand employees. Day or night he may call, through the Bell System, any one of nearly twenty million other telephones in this country and an additional twelve million abroad.

And yet, like you, he pays but a small sum for a service that is frequently priceless in value. The presence of the telephone, ready for instant use, costs only a few cents a day. With your telephone, you are never alone. It is an investment in companionship, convenience, and security. Through it you can project your personality to the faraway places of the earth, or bring familiar voices to the friendliness of your fireside.

Undoubtedly a great factor in the continued progress and improvement of telephone service is the intangible but real spirit of service that has become a tradition in the telephone business. This spirit expresses itself daily and in any emergency. And behind the army engaged in giving service is the pioneering help of a regiment of five thousand scientists and technical men, engaged in the sole task of working for improvement.

This group devotes itself exclusively to seeking ways and means of making your telephone service constantly better and better.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

ACROSS THE EDITOR'S DESK

SANITY, PROHIBITION, And The FEDERAL DEFICIT

OUR nation faces an emergency unparalleled in all its history. While in the throes of the world's greatest depression, it piled up a federal deficit of 903,000,000 dollars in 1931; another of over two billions is promised for the fiscal year 1932; and still another of around a billion and a half is promised for 1933. In this grave situation, the nation casts about for a real leader and finds none. It seems, therefore, to be up to the people to insist that sane action be taken to alleviate conditions; and we feel duty-bound to place before our readers several suggestions regarding what we consider the most equable and certain measures to that end.

The federal budget *must* be balanced! But how? The first and most important source of revenue that meets the eye is the liquor industry which has cost the government over 300,000,000 dollars for "enforcement," and from which, if legalized, the government could obtain up to 1,000,000,000 dollars annually! SCIENTIFIC AMERICAN therefore stands for an immediate amendment to the Volstead Act for the regulated manufacture of a beverage of higher alcoholic content with provisions for eventual repeal of the prohibition amendment, as an indispensable revenue measure. This would throw billions of dollars into the channels of legitimate business and at least hundreds of millions into the federal treasury—all of which now goes into the coffers of crookdom—*and without increasing the nation's present drink bill!*

INSTEAD of acting on a bill to submit the prohibition question to the people, Congress recently tabled that bill and passed on to a consideration of excise taxes and governmental economies as means of balancing the budget. We feel that, as planned, both of these measures are extreme. The taxes will have the effect of slowing up certain kinds of business, thus increasing unemployment and also decreasing the estimated revenue to be obtained; and the governmental economies are so drastic in their scope that thousands of federal employees will have to be laid off and many more thousands will not earn a living wage. Many bureaus have been ridiculously expanded, however, and the cost of living has decreased greatly, hence economies within reason would work no great hardship.

If the people would insist upon acceptance by the nation of the revenue that can be obtained from the liquor industry, both the increased taxes and the federal economies could be so moderated that they would scarcely be felt. On the point of moderation, our suggestions follow:

We urge a manufacturer's sales tax spread thinly over all industries. It is believed that such a tax, amounting to 2½ percent on the wholesale prices of all commodities, would raise over 600,000,000 dollars! In our opinion, such a general tax is far less harmful or burdensome than a discriminatory tax directed at specific industries.

We urge a reduction of all federal salaries that now stand above a minimum of 1200 to 1500 dollars a year, and an immediate survey of all federal departments and bureaus for the purpose of making consolidations in the interest of economy.

We do not think it wise or even patriotic to make further drains on the public treasury and we are unequivocally against any further payments under the bonus bill to ex-service men at this time.

IF our representatives in Washington will put aside party lines and political aspirations and devote themselves unselfishly to some such program, the result will be the restoration of confidence and the will-to-work throughout the country. Action of a positive nature on the prohibition question alone would have so great a psychological effect that it would slowly but surely lift us out of the chaos of depression. Inspired by this dramatic act of government, the people would resume their characteristic faith in the sanity of the country and their hope for the future, and pessimism would lose its hold by default.

We have hesitated to speak out on this vital question, but now we no longer feel that our stand may be impugned. There is now no shadow of doubt that the preponderant sentiment of the country is for legalized control of the liquor industry. SCIENTIFIC AMERICAN can and does, therefore, lend the weight of its venerable position as one of the oldest journals in America to the cause of temperance both in the drinking habits of the country and in the functioning of its government, the two being in this case so obviously interdependent.

We feel that it is time to relieve politics of the incubus of prohibition that has helped to bring the American people into the dire straits in which they now find themselves. We hope that our readers will be with us and will confirm our stand in letters to their Congressmen. *April 20, 1932.*

Editor and Publisher

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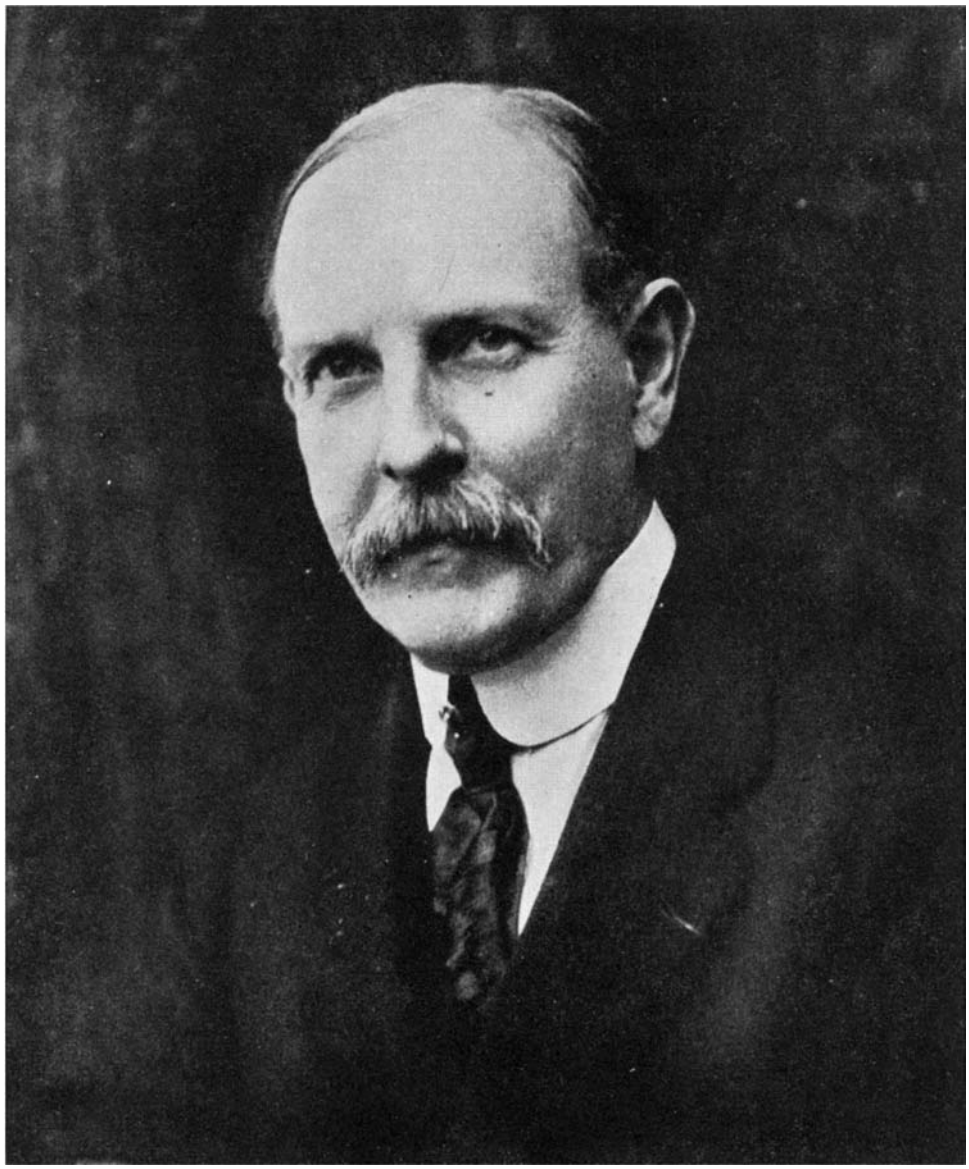
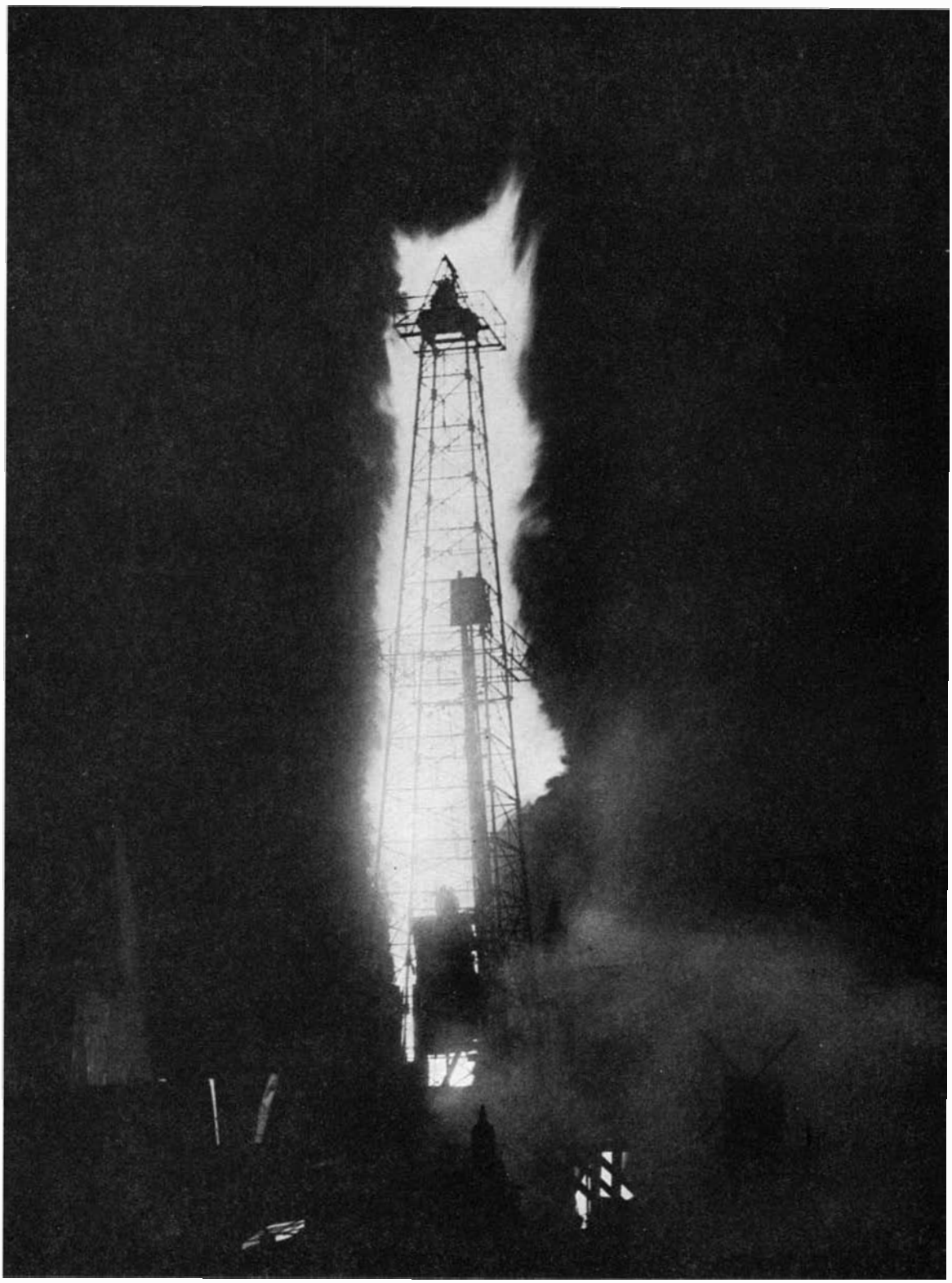


A. E. KENNELLY

RADIO readers will remember the name of Dr. Kennelly in connection with the Kennelly-Heaviside layer, the ionized section of the upper atmosphere which is now playing such an important part in radio research. In recognition of Dr. Kennelly's extensive work in radio, which dates back to the early days of wireless, the Institute of Radio Engineers recently conferred upon him its 1932 Medal of Honor. The medal citation noted particularly Dr. Kennelly's studies of radio propagation phenomena and his contributions to alternating current theory and measurement that now have extensive radio applications. Dr. Kennelly was born in Bombay in 1861 and his listing in "Who's Who" shows a constant application to electricity from the age of 15. His early work took him to many out-of-the-way parts of the world on telegraph and cable jobs.

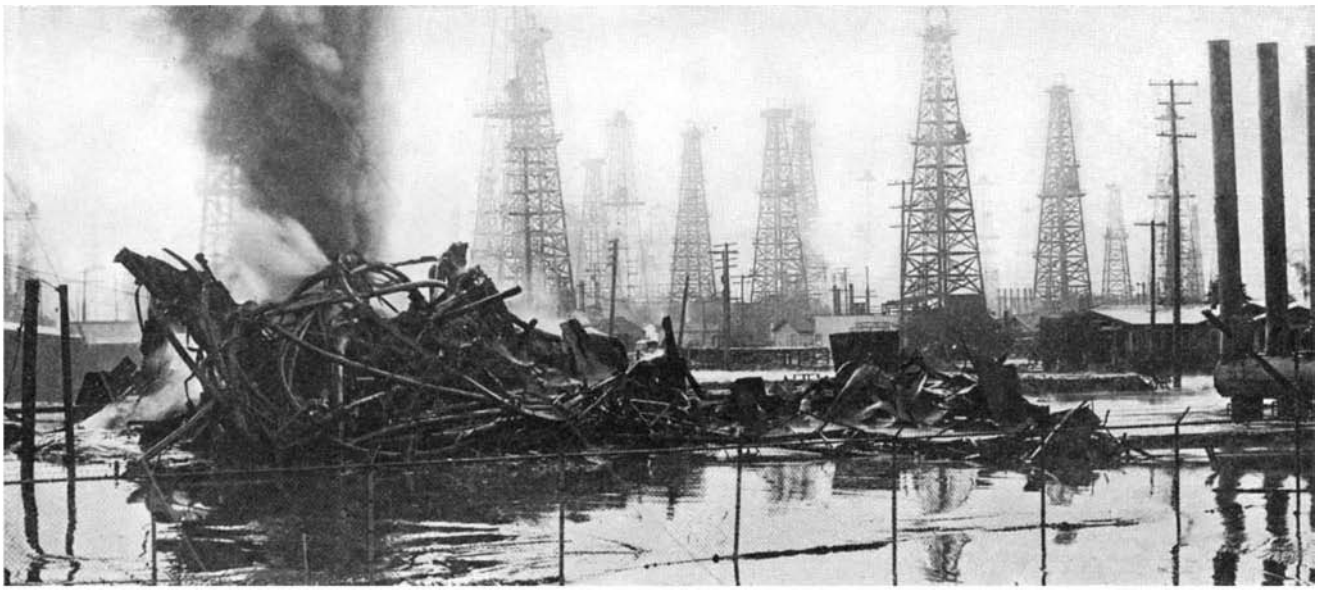
From a position as consulting electrical engineer, Dr. Kennelly went, just after the turn of the century, into the educational field as professor of electrical engineering at Harvard and later at Massachusetts Institute of Technology. During the World War he served in the Signal Corps as a civilian liaison officer.

Dr. Kennelly is at present professor emeritus of electrical engineering at both Harvard and M.I.T.



A FLAMING TORCH OF GAS THREATENS DISASTER TO AN OIL FIELD

THE roaring stream of burning gas and oil is coming from a well on the far side of the derrick through which it is viewed. This is the gasser at Bellevue, California, mentioned in the text of the article starting on the opposite page, which took fire and was eventually extinguished. A courageous workman, protected by air blowers and streams of water, crouched at the opening of the well and electrically welded into place a high-pressure pipe which diverted the flow of gas from the flames.



When an oil well is being drilled, and it suddenly "comes in" with abnormal pressure, things happen fast and furiously. Equipment is often reduced to a mass such as this, where 80,000,000 cubic feet of gas belched daily for nine days

What Happens When

A GASSER BLOWS IN

When an Oil Well is Being Drilled

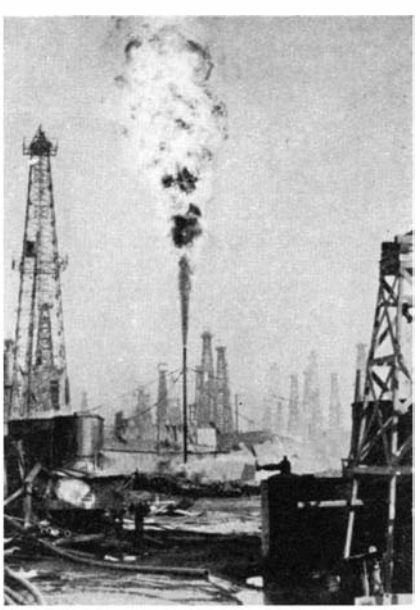
By ANDREW R. BOONE

GRIMY-VISAGED experts of the oil fields find their resourcefulness taxed to the limit when a small hole extending possibly a mile into the earth suddenly shakes and shimmies and sends rumbling into the air perhaps a hundred million cubic feet daily of gas. Within a radius of possibly half a mile the earth heaves in great waves while the SOS call goes out for fire fighters and machinists. Each gasser presents a new problem and threatens an entire field both with extinction below ground and with that dread surface scourge—fire!

Millions of dollars have been spent in capping gassers and extinguishing gas fires. A combination oil-gas well blowing cold or shooting flames hundreds of feet into the air is much like a warm bottle of beer suddenly uncapped after first having been shaken thoroughly. Everything blows out, unless the well is capped, denuding the underlying sands and robbing other well owners of potential fortunes. During one wild rampage in a California field, the production of a nearby gusher dropped from 3000 barrels daily to 1000.

Sometimes weeks are required to close down a gasser, even in the absence of fire. Flame complicates the problem, especially in a densely populated field. A gas fire may be extinguished by one or a combination of five methods. It may be snuffed out, diverted and slowly closed out, blown out by steam and mud, dynamited, or shut off by an involved, costly, and slow process of tunneling under the surface of the earth and applying an intricate system of valves to shut off the flow.

When the gas flow is small and the fire not difficult to handle, the flames may be put out much like snuffing a candle with an inverted tin cone. Again, a large pipe may be lowered over the hole. This pipe acts as a chimney and transfers the flame from the mouth of the hole to the top of the pipe. Then the pipe is permitted to topple over slowly. This carries the flames horizontally away from the well.



A gasser burning through a damper, before valves shut off the flames

Another method consists of fitting a damper to the top of the pipe and closing it slowly, thereby shutting off the flame and forcing the gas out through another pipe which is tapped in to the side of the chimney.

STEAM has extinguished many large fires. In this scheme several boilers are brought near the well. A large volume of steam is spouted toward the well just above its mouth. This cuts off the oxygen and usually is successful. Occasionally carbon tetrachloride has been used, somewhat in the manner of a giant fire-extinguisher.

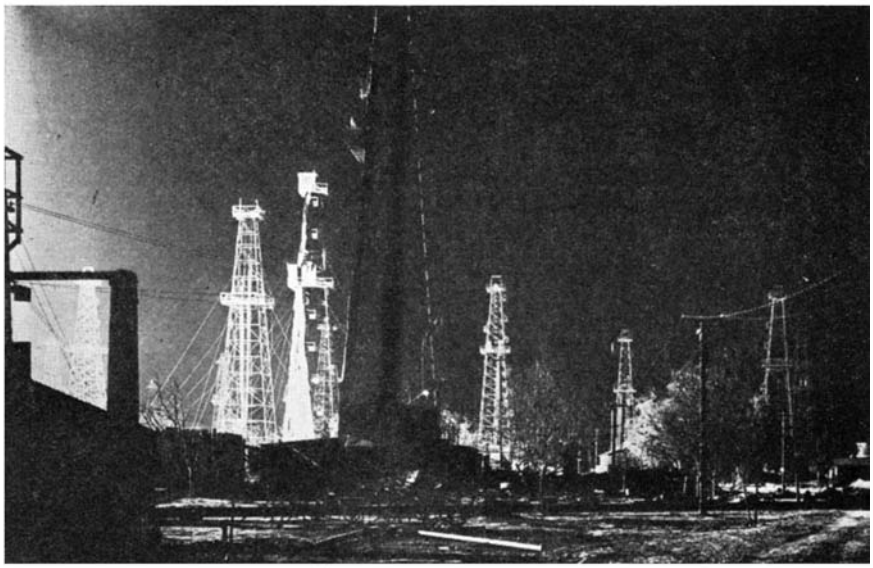
An interesting method developed in California, where several crowded fields abut the residences of Los Angeles, consists in dynamiting the flames out. Wooden towers are erected on opposite sides of a burning well and a steel cable is strung between them, passing above the well about 200 feet in the air. A heavy charge of dynamite is towed out on this cable and exploded close to the flame column. Several times this has extinguished the fire at once.

Sometimes, however, gas fires occur under such terrific pressure that these methods fail entirely. Imagine a gasser blowing in with a pressure of nearly 3000 pounds to the square inch at the mouth of the well, shooting up with such force that it does not begin to burn until it rises 20 feet into the air, hissing so loudly that men cannot talk and must wear grease-soaked cotton in their ears. On some occasions they have worn football helmets to protect themselves against falling rocks and other debris, and to hold the sound-excluding cotton in place.

These tremendous gassers have been known to blow huge craters in the ground, burying entire derricks in the debris left in their wake. To meet these emergencies oil companies band together, pooling their financial and human resources to protect properties worth many millions of dollars. The Howard well near Los Angeles blew a crater 250 feet wide and deep enough to hide the derrick. It commenced by undermining the concrete bases on which the derrick rested, then for 10 days spewed from 70,000,000 to 100,000,000 cubic feet of gas into the air every day.

SO savage was this blowout that no one could stop it. Finally, the well petered out and quit of its own accord. No one could get through the debris, which later was found to be 300 feet deep in the crater. Rocks as big as a man's head were blown 1000 feet into the air by the tremendous pressure of the dry gas.

What causes these gassers? Why and how do they sometimes catch fire with such disastrous results? How are the big ones put out? Hugh Matier, one of the veteran oil men of California, has been in on most of the big fires. He knows the tremendous cost of these disasters. On more than one occasion, he has stood within 30 feet of a gas flame shooting 200 feet into the air, helping push its angry tongue back into the earth. The company he represents has helped pay the costs of some of these fires, a few of which have approached the 200,000-dollar mark; more than the cost of drilling the hole itself.



An eerie glow is cast over an oil field by a burning gasser. This photograph was taken at night when a well near Santa Fe Springs was on a fiery rampage

"Nearly anywhere in California," Mr. Matier explained, "a well will pierce a vein of gas somewhere between the 1900- and the 2400-foot level. This was true of the Alexander and Howard wells, both famous for the trouble they made. The Alexander did not burn, but she blew her drill pipe 1000 feet into the air, and sections of it fell a quarter of a mile away. Nearly 80,000,000 cubic feet of gas a day surged from this hole, under a pressure approaching 3000 pounds to the square inch.

"The Howard well burned, apparently because the mud had gotten low in the hole. There you have the cause of most gassers. Expert oil men—and that includes all the big companies—keep their holes full of mud at all times. They send this mud to the laundry once a week, cleaning out rocks and shale. There are two reasons for this: clean mud is heavier and, if she should blow, there will be less chance that rocks and flint from the shale, which overcaps the oil sand, will strike some metal as they blow out the top and set the roaring column on fire.

"Sometimes long lengths of drill pipe are blown out; again the pipe breaks off, leaving a ragged edge. As soon as equipment can be brought up, two tractors towing wire lines and grabs chug together across the area to pull away the debris. Then the dynamite men, tunnelers, and machinists go into action to determine exactly how they'll stop the gas or put out the fire."

A shovel starts the excavation for a tunnel from which a gasser will be shut off

Because of its sensational nature, the Alexander gasser, near Santa Fe Springs, reveals the thrills and technique and general danger of these wells going wild, either cold or burning. The crew had drilled in shale to a depth of 2060 feet when the gas, under high pressure, erupted and within a day wrecked everything in the vicinity.

"Over half the drill pipe had been pulled out when things suddenly began to happen," said Mr. Matier. "The thick mud began boiling in huge jets over the floor of the derrick and then 800 feet of drill pipe in the hole, weighing 20 tons, tore lose from the clamps and, accompanied by a terrific roar of gas, ascended until it towered high above the rig and was shaking in mid-air like a straw in the wind.

"A BOMBARDMENT of mud and sand commenced and the crew had to run for their lives. Fortunately the driller, with rare presence of mind, had put the fires out. All were out of the danger zone except one man, Robert Ferris, who had been working on the top of the derrick. When he realized what was happening, he hastened to climb down through the torrent of mud, but when he reached the 40-foot level the top of the rig was blown off and Ferris, unconscious, was thrown 60 feet away into the mud sump. Miraculously, he was unhurt.

"Meantime the rotary drill pipe reared its head like a huge snake until, towering several hundred feet, its own weight bore it to the ground. The end dug into the mud and the remainder writhed overhead in huge curves until all of it was ejected from the well.

"The gas apparently was blowing out dirt from a large subterranean area as the derrick disappeared into the ground, together with the heavy rotary engines, mud pumps, and other apparatus. Gas was spurting up through the wet soil in many miniature craters as far away as 1000 feet. Through the day and night the eruption continued. Morning revealed huge piles of dirt surrounding an immense pit which still belched gas.

"A shallow water well, 200 feet away, which supplied a ranch with water, soon began to pour out gas at the rate of several millions of feet a day, the gas probably traveling through the subsurface water zone from the main source. This gas increased in volume until the well derrick and a water tank disappeared from sight beneath the heaving mud. Yes, when a gasser begins to blow, nobody knows what may happen."

WHEN the Bellevue well, blowing oil and gas, caught fire, a machinist, protected by movie wind machines and two columns of water, actually sat at the base of the column, 20 feet below the flames, and electrically welded onto the drill pipe a high-pressure pipe, dropped into place from the arm of a crane. He braved the great danger of virtually hugging a stream of gas rushing out at the rate of five million cubic feet an hour.

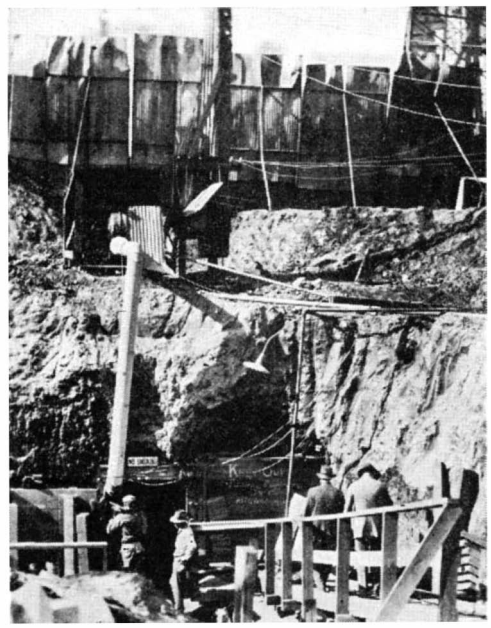
Again, when McKeon No. 2 blew in with 10,000,000 feet of gas, threatening the Santa Fe Springs field, two years ago, motion picture wind machines, air chisels, an electrical gas detector, and canary birds figured in the spectacular fight. Tractors and scoops aided in tunneling to a point 43 feet beneath the surface, where a cellar 18 feet high and 15 feet square was dug for the fire-fighters to shut off the gusher beneath the ground.

When the Getty No. 17, in Santa Fe Springs, burned, a large crew was marshaled and operations very much resembled a combination of placer and sub-surface metal mining. Gas was flowing from the well both inside and outside the drill pipe. This complicated proceedings considerably.

Wooden rigs and buildings were torn down in the congested field, sprinkler systems were placed in operation on nearby structures that might be saved, corrugated iron shields were thrown up to minimize the heat which workmen suffered, levees of dirt surrounded the fire, and salvage pumps were installed, ready to pump out possible pools of oil and water that might form once the fire was put out.

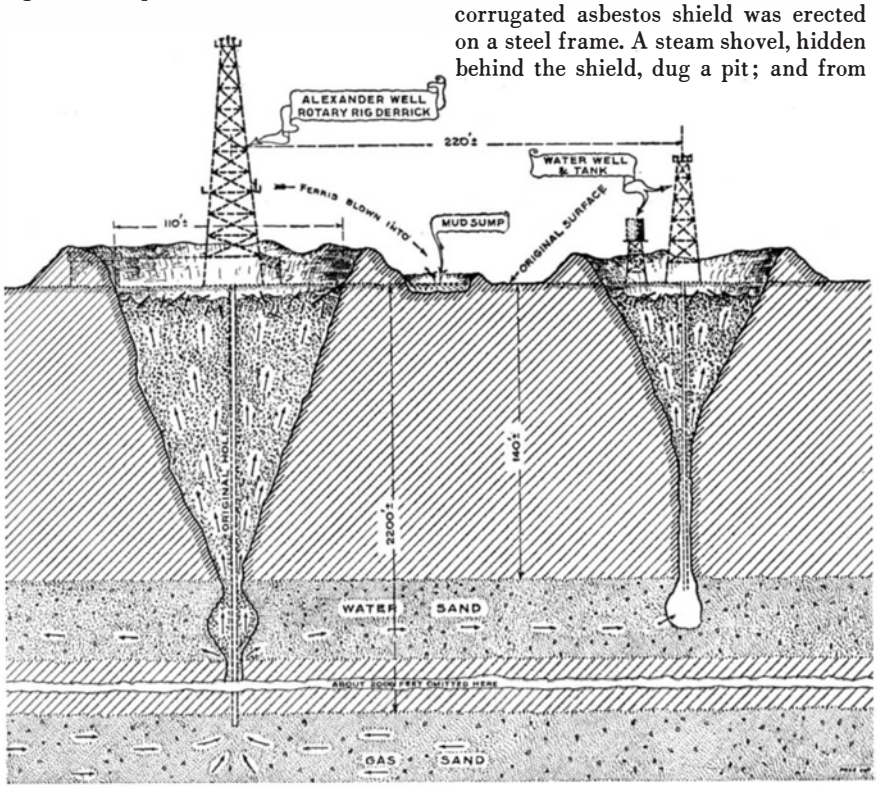
Thirteen steam and mud lines were run in to one side of the well, but before these could be used to blow out the flame so much oil was coming out with the gas that the fire hazard threatened to be greater after the main flame was out, so this method was abandoned. Then it was decided to drill beneath the surface and attack it below.

Two hundred feet from the well a corrugated asbestos shield was erected on a steel frame. A steam shovel, hidden behind the shield, dug a pit; and from a point 255 feet from the blaze, a tunnel was bored to the pipe beneath the fire. Through quick-sand and loose dirt, they bored and at last a chamber nine feet high was dug around the drill pipe.



A pump withdraws any gas from the tunnel being driven to shut off the gasser

Here machinists set clamps around the 15½-inch casing and poured concrete around the clamps. When this had set, they cut away the pipe, revealing an 11-inch casing. The process was repeated. Again, it was repeated for the next, a nine-inch casing. Finally, they uncovered the four-inch drill pipe. Packing material was placed between the various stands of pipe. At last, a connection was made and the pressure at the surface relieved by drawing off the gas and oil below. Then a steel bell was dropped over the flames to snuff them out.



The drawing shows what happened at the Alexander gasser, described in the accompanying text. The derricks and tank sank into the craters which were formed

THE fire hazard in new oil fields is tremendous. Each field is a gamble, and a very costly one. Most gassers and the occasionally attendant fires have very simple beginnings. A too-shallow column of mud, permitting the tremendous pressure to force it upward too soon, starts most gassers to blow.

Every precaution is taken to prevent these disastrous, but highly spectacular, conflagrations. During drilling, steel safety wires lead from various levels of derricks to the ground. When the earth begins to shake and the stench of gas fills the air, you can see the tower man, bunched up like a monkey, with hands and feet wrapped around a wire, skinning down to terra firma. Sometimes, though, he's too late. Fourteen men perished when a spark ignited gas and oil pouring out of the Hughes gusher in Texas. But such are the tribulations of the men who thrill at the news of new oil field production.

WHERE DIAMONDS EARN THEIR KEEP

By EDWIN P. NORWOOD

ONCE on an average of every 60 days there convenes in the township of Dearborn, Michigan, a unique gathering. Surrounding a table, the "Diamond Committee" of the Ford Motor Company selects those stones needed in connection with the manufacture of automobiles.

To attend this meeting in the Rouge Plant administration building is to see diamonds from the plateau or the river valleys of Diamantina, in Brazil; stones from the Belgian Congo; "grays" and "browns" from the famed Premier mines of the Transvaal; and "Jagers" from Jagersfontein. Displayed in rows and groups they await the decision that will eventually send a portion of them into the shops and the rest back to the vendors who have submitted them. Subsequently set in tools, those retained will give precise alignment to hundreds of grinding wheels used in the manufacturing of car parts, and add the finish bore in articles where accuracy is vital. Others, acting as "nibs," will serve as points for master precision gages or in machines required for testing the hardness of steel.

The "Diamond Committee" consists of men from the company's purchasing department, from the shops, and from the cashier's office. The latter is the custodian of the stones. There are no vendors present. Those offering diamonds for sale have at an earlier date deposited their packages on consignment. As these are received, the cashier counts the stones in each package, weighs the contents, and makes certain that the traders' names and carat quotations are on the outside of the bundles. The conference day arriving, he opens the many packets but so spreads the wrappings against the table top as to conceal the vendors' names but not their respective asking prices.

WITH magnifying glasses and the naked eye the committee grades each lot according to requirements. Its members bear in mind weight and kind. Generally speaking, size counts for little. As with luxury gems, value is not determined by quantity but by quality.

Segregation having been made by placing the chosen stones along the edges of the respective wrappers, prices are consulted. Other points being equal, the vendors with the lowest quotations make the sales. When the several traders return they are paid at the carat rate for the diamonds accepted. The cashier keeps all these in a vault.

Whenever the superintendent of the tool-supply department needs diamonds he sends in requisitions and gets them. He then assigns a number and a record card to each individual stone. To illustrate with but one of more than a thousand that are in constant service, let us assume that stone No. 850 meets a particular requirement as to weight and estimated hardness as shown by the record card.

A group of South African "grays," averaging two carats each, worth a total of about 3000 dollars

Having been set in the end of a holder, No. 850 will go into service. But hard as it is, it will in time wear down. When contacting against the face of a grinding wheel for truing or cleaning that face, there comes a day when the crown of the shank is likewise exposed to the wheel. The tool then goes to the mounting room. Here a lathe will cut away all of the holder that may be safely removed without striking the diamond with the lathe cutting tool. The remaining metal around the stone is then eaten away by acids. The diamond is again weighed and the new figure is placed on its record card.

The diamond holder suggests a small metal cylinder. The end of this holder is drilled out, it is then clamped upright, and the diamond laid in the hole and held to the center of the opening by means of a spindle from above and lightly pressed against its face. A gas torch is next applied to the outer wall of the holder's cup-like top. Once this is at white heat, a stick composed of copper and zinc is inserted. Just enough of the alloy melts to fill the space surrounding the stone. As this cools, it tightly embraces the diamond, covering all but the upper part of it. Roughly described, the effect is that of the spike that protrudes from a spinning top. Thus presenting a fresh cutting edge, the tool is ready to go to work again.

HOW many times may a diamond be reset? No one can foretell. One, to all appearances sound and hard, may be worn to the scrapping point after the fourth resetting. Others are reset as many as 40 times. But whether few or many, the date of each unseating is noted. By consulting the record cards one may learn the history of each. Here is No. 850. Many entries record its gradually diminishing weight. Starting its life of service at three and a half carats it has finally become too small for use and been scrapped—perhaps to be ground into diamond dust.

These cards become the tool supply superintendent's evidence as to what has become of the stones obtained through the original requisitions. Taking the history cards to the cashier's office, he trades them for new diamonds. These will be given the same numbers as those which designated the vanished ones and go into work accompanied by fresh cards which will, in time, list their individual stories.

●

The difficulty of mounting diamonds satisfactorily in tools is overcome by an apparatus, for which the late Thomas A. Edison was granted a patent after his death, which electroplates nickel on diamonds. After being electroplated, diamonds can be more rigidly mounted than by other methods. Edison also proposed to mount diamonds in this manner for use in phonograph needles.—*The Editor.*

OUR POINT OF VIEW

We Publish a Correction

AS most newspaper readers will recall, a dose, or rather, a heavy overdose of the wrong kind of publicity —from their own selfish point of view —was received by the purveyors of radioactive waters in certain forms when the recent death of a prominent man due to drinking this form of dynamite brought this infernal business into public gaze.

Just a few weeks before this occurrence claimed the front page of the newspapers the SCIENTIFIC AMERICAN published a definite warning against radioactive waters and radio-active emanators. This warning appears to have quite "got these purveyors by the ears" and they registered violent objections against it, requesting that it be corrected. Accordingly a "correction" is now published, in order that we may keep our promise, but it is doubtful whether it will be the exact kind of correction these persons had in mind.

Most or all of these "remedies" are either radium or an emanation, usually radon or thoron. If they are radium they are a potential menace because, as the Federal Food and Drug Administration states in a warning released last March, "certain individuals seem to have the power to accumulate enough radioactivity to produce harmful results. Radium in active dosage is potent for harm as well as for good." If they are radon or thoron they are a "fraud" and "treatment by such means is charlatanism," to quote the American Medical Association.

Most of these remedies as sold to the public are radon, a gaseous emanation given off when radium disintegrates. These radon remedies—or rather alleged remedies—are made by contact with a source of radium, either by the purveyor of the bottled product or by the user who in this case purchases a generator of radon and immerses it in ordinary drinking water. As the Association named has pointed out on previous occasions, the gaseous emanation flies off the water into the air before virtually any of it can be swallowed; and even if it could be swallowed there is no value in the internal use of water containing radon.

Radium in any form is a poor plaything for any except experts—sometimes even for experts. But what a magic word it has been—potent for pilfering the public pocket! The aforesaid purveyors appear now to have hastily crawled into a hole and drawn the hole in after them, but they doubtless will emerge again when the present storm has blown over and resume poisoning such of the dear people as like to be humbugged.

Philippine Independence

SINCE the passage by the House of Representatives recently of a bill to make the Philippines a free nation after eight years, many criticisms, with which we agree in principle, have filled columns of newspaper space all over the country and in the Philippines as well.

In the first place the constitutionality of any cession of land to the sovereignty of another nation is doubted by some. Lacking a judicial opinion on this phase of the question, we shall not discuss it. Granted that such an act is constitutional, however, and granted that we do wish to be a big hearted big brother for the inflation of our self-esteem, or wish to heed the clamor of certain groups in the islands, *who* is qualified to say arbitrarily *when* the Philippines will have so successfully completed their political apprenticeship that they can govern themselves? Certainly not the Congress that consistently botches everything it touches!

A period of eight years of political turmoil, followed by economic ruin, if not complete extinction, is seen by some as the inevitable result of the successful passage of this bill by Congress. Filipinos of vision and foresight are particularly vehement in their criticisms of it. Some of them have said that it will cause the Philippines to forfeit the gains they have made under the guidance of the United States, and there is no question that these gains have been enormous—intellectually, economically, and politically.

Filipinos have also said that independence will mean attack and subjection of the Philippines by Japan. The latter country, overly anxious it seems, quickly stated that she would be glad to enter into an international treaty to guarantee perpetual independence for the islands. Filipinos, however—and many others, it may be noted—look with skepticism on such proposals by the Pacific power, in view of recent events in Asia.

Fortunately at this writing, as the *New York Herald Tribune* has said, Congress "has not jettisoned the Philippines. The Senate, the President, and finally, a public opinion which, though slow in action, knows how to deal drastically with a betrayal of confidence when aroused, have yet to be reckoned with. . . ." That public is deeply concerned with this question, and it feels that if the Philippines are to be granted their independence at all, the time for this action will not be determined by a high-handed Congress but by proof that the Filipinos are properly equipped to take care of themselves.

Frightfulness in Warfare

EVER since the World War, the world has been inundated with a flood of predictions to the effect that future wars will be carried on by such frightful methods as to make the blood run cold in contemplation of them. Gases so deadly that they will destroy the populations of entire cities will be used, so the prophets tell us; disease germs to decimate the populations of countries will be broadcast; and "death rays," powdered glass, and monstrous machines of the air, land, and sea, are to add their frightfulness with the result that civilization itself will be destroyed. Writers have, indeed, given their imaginations free rein principally because the public devours sensationalism.

Recently, however, a saner view of the question was given by Hoffman Nickerson in an article in *The New York Times*. Mr. Nickerson, an authority on certain phases of the military, answers the prophets of doom with what seems to him the "constant law of war; namely that to every new device a counter can in time be found." The use of gas during the World War was defeated by gas masks. Such frightfulness as unrestricted submarine warfare brought in the United States as Germany's foe. Air raids on London, for example, struck at British civilian morale but London soon became somewhat indifferent to them.

One conclusion stands out and that is that to achieve any permanent military advantage, any frightfulness embarked upon by a belligerent in a future war must be launched suddenly and overwhelmingly to render the foe *hors de combat*. Otherwise, "Whenever some future violation of the laws of war is under discussion, some realistic man will arise and say: 'Remember Imperial Germany. Suppose our scheme doesn't work.'" Frightfulness can be—often has been—the worst kind of a boomerang.

The main cable section of the operating room of the "nerve center" of communication. From this point are controlled 15 cable circuits to Europe, South America, and the Orient. Messages are distributed and collected by automatic conveyors

How Your Radio or Cable Message Speeds Through

A NERVE CENTER OF COMMUNICATION

By MILTON WRIGHT

YOU are in Chicago, we will say, and you feel a sudden urge to send a cablegram or a radiogram to a friend in Vienna. No sooner said than done. You drop into a telegraph office, write out your message on a blank, hand it to the clerk behind the counter, and in almost no time at all your friend 5000 miles away is reading your message.

Maybe your message went part way by overland wires, part by undersea cable, or part through the air by radio. As to just how it got from Chicago to Vienna is something you give little thought to, so commonplace has long-distance communication become. The precise manner in which that message was handled, however, is a subject that has occupied some of the best engineering brains the world has yet produced, has called forth the most advanced knowledge of science, and has been the cause and the purpose of gigantic mergers of capital.

Long-distance message traffic finds its expression in a unique establishment recently placed in operation—the communications center of the International Telephone and Telegraph Corporation located in that corporation's skyscraper at 67 Broad Street, New York City. Here in the largest operating room in the world is carried out the perfection of co-ordination between methods of communication.

To appreciate the value of a center for such operations, consider for a moment the structure of this international system of communications. This American-owned organization reaches to all the world. In various countries and cities abroad—Spain, Rumania, Shanghai, Cuba, Buenos Aires, and so on—it maintains operating telephone companies. In many countries where the telephone is a government monopoly—Japan, England, France, Germany, and elsewhere—it operates manufacturing plants which produce telephone, telegraph, and other electrical equipment.

In the United States, however, its concern is with what is known as record communications—that is, forms of communication by electric impulse of which a record is made; in other words, radiograms, cablegrams, and telegrams as distinct from telephone conversations.

LINKED together in this record communication business are the Mackay Radio and Telegraph Company, with radio circuits across the United States and to countries in Europe, Latin America, and the Orient, and also to ships at sea; Commercial Cable Company, crossing the floor of the Atlantic; Commercial Pacific Cable Company, the only cable from the United States reaching across the Pacific; and All America Cables, Inc., linking the countries of Central and South America with those of North America.

A complex network of communications this and one necessitating close co-ordination if the utmost speed, accuracy, and economy of operation are to be obtained. The importance of an operating center to concentrate these activities is not difficult to realize. In establishing it early this year it was frankly announced that the two main objects in mind were (1) to provide for the interchange of message traffic with the greatest possible dispatch, and (2) to effect the greatest possible economy of operation consistent with efficiency.

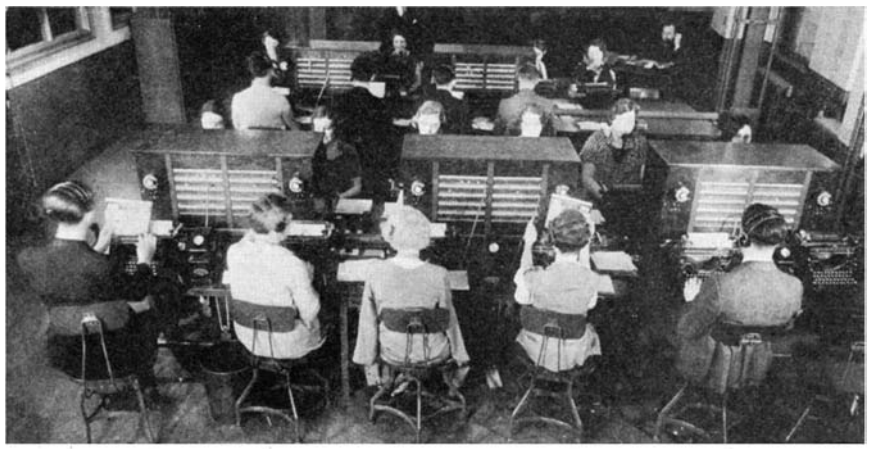
Direct sub-sea cable circuits entering 67 Broad Street run to England, France, and Germany through the Commercial system and to Buenos Aires and a long list of other South and Central American cities and to Cuba through the All America system. Altogether 63,858 miles of submarine cable circuits feed into this one building. In addition, there are land lines running to San Francisco where messages are retransmitted to Honolulu, Manila, Tokyo, and Shanghai.

Mackay Radio maintains four stations on the Atlantic Coast—at Rockland, Maine; Sayville, Long Island; New York City; and West Palm Beach, Florida. On the Pacific Coast its stations are at Portland, San Francisco, and Los Angeles. From these stations,

communications are flashed through the air to Europe, South America, and the Orient.

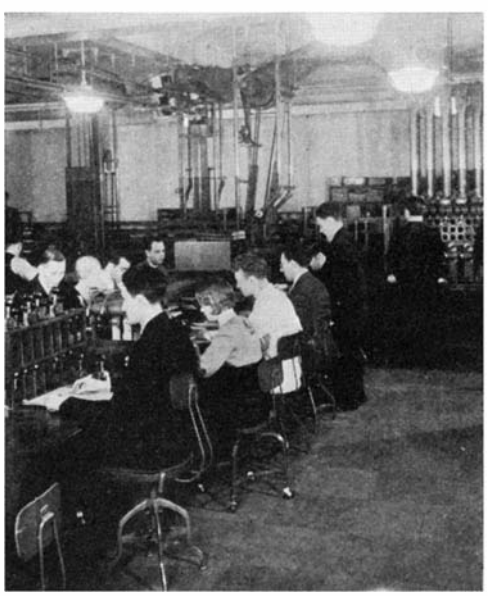
Each of these radio circuits, by the way, may have several channels operating at once, depending on the volume of business, and the number of transmitters. Between New York and San Francisco, for example, three circuits in each direction are kept normally in operation. All of these circuits are duplex; that is, messages can be sent in both directions at the same time, and the number of circuits can be enlarged when business warrants it.

In addition to the trans-oceanic service and the domestic point-to-point operation, there is a marine station with a marine operating room in the operating center. The function of this station is to contact ships at sea. Properly equipped, no vessel need be out of radio communication with the shore at any time. In fact, lifeboats on the new vessels of the United States Lines are now being equipped with radio transmitters.

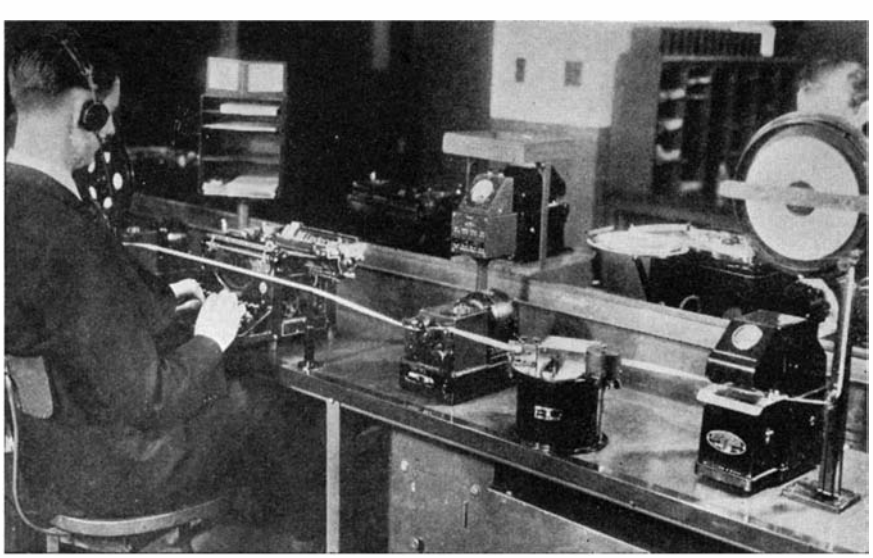


The terminal boards of special telephone circuits for the reception and transmission of fast cable business with important banking and other organizations. The installation consists of five 200-line double-turret boards which accommodate 20 operators

Special wires lead from the room at the right to 40 important offices throughout the country where cable traffic is collected. These wires connect to printing telegraph machines from which the messages go on their way to various foreign lands



All messages passing through the "nerve center" are checked at the positions shown at the left. Parts of the conveyor and pneumatic tube installations can be seen



Messages received in radio code are sent to the message center, still in code, where they are recorded on tape by a siphon recorder. The operator types the message in words and routes it for further handling over a conveyor belt

To handle the huge volume of message matter, approximately 600 operators and check clerks are employed in the operating room. In the busy hours, 200 to 300 of these are at work.

Every device possible has been installed to speed up operation. Prominent among these is a new system of message conveyor belts—the fastest of any in the world—to transfer messages from one system to another. A message comes in from London, for example, to go to Montreal. Upon its receipt it is dropped on the conveyor belt, passed through the checking system in order that its time may be noted, inspected to see that everything about it is in order, and dropped off at the Montreal circuit termination.

All of this distribution is automatic, including not only the cable terminations and wires to 40 different American cities, but also a number of branch circuits to customers who are large and consistent senders or receivers of overseas messages.

ECLIPSES AND THE SUN'S ATMOSPHERE

By HENRY NORRIS RUSSELL, Ph. D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

FOR 70 years it has been known that the dark lines of the solar spectrum were produced by absorption of light by the gases of the sun's outer atmosphere. Could we observe these alone they would give out light of all the kinds which they absorb, and produce a spectrum crowded with bright lines. This was first observed by Young at the total eclipse of 1870. Light from the edge of the sun, just at the point where the last speck of its disk was due to disappear behind the advancing

A solar prominence 162,000 miles in height, photographed by Hale

moon, was brought into the spectroscope. At the moment when the photosphere was hidden, but the sun's upper atmosphere still projected beyond the moon's limb, "the whole length of the spectrum was filled with brilliant-colored lines which flashed out quickly and then gradually faded away, disappearing in about two seconds—a most beautiful thing to see."

This "flash-spectrum" could obviously not be well studied by visual methods, but its light is intense and photographs can be obtained showing a wealth of details utterly impossible of recognition by the quickest eye in so short a time.

The earlier photographs (from 1896 onward) were made by placing a prism in front of a suitable long-focus camera. No slit is needed, for the thin and narrow "crescent" of luminous gases visible beyond the moon's edge gives a sufficiently sharp image to permit the separation of even fairly close spectral lines. The exposure must, however, be made at exactly the right moment. If it is begun too soon the brilliant surface of the photosphere will still be in view and its spectrum will drown out that of the atmosphere. If in his anxiety to avoid this the observer starts his exposure a second too late the moon will already have covered up the lower layers of the sun's atmosphere and important data will be lost. With watchful care these dangers may be avoided and plates obtained which show a thousand lines and more.

This method of observing, however, gives an integrated effect over the whole time of the exposure. It cannot record the changes that took place from instant to instant while the moon was advancing. To investigate these, Campbell devised a plan for taking what amounts almost to a moving picture of the spectrum. Right in front of the sensitive plate and almost in contact with it he placed an opaque screen with a narrow straight slot 1/16 of an inch wide, extending in the direction of the dispersion. The central part of the relatively wide spectrum of the solar crescent passed through this slot, giving a narrow spectrum—yet one plenty wide enough to show the dark or bright lines crossing it at right angles. The plate itself was mounted on a sliding carriage and moved steadily at a rate of about four inches a minute in a direction at right angles to the slot—or parallel to the spectral lines. In this fashion a new portion of the plate was uncovered every second and hidden again the next. The plate, when developed, showed a wide spectrum (Figure 1) beginning at the bottom with the dark-line spectrum of the unobscured portion of the sun's limb. Successive horizontal strips represent conditions at later instants and it can be seen at a glance how the bright background faded out almost abruptly, how some of the lines turned bright at an earlier stage while others remained dark as long as any background was left, and how some lines remained visible much longer than others.

The latter differences evidently indicate that some lines are emitted up to higher levels in the atmosphere than others. These "heights," which are of considerable theoretical importance, can also be determined from photographs taken on a fixed plate, since the higher layers of atmosphere stick out farther beyond the moon's limb and give longer bright crescents. But the remarkable changes which occur before the continuous spectrum disappears can be followed only with a moving plate.

Admirable photographs of this kind were obtained by the Lick Observatory eclipse expeditions in 1900, 1905, and 1908. The pressure of other imperative duties year by year prevented Dr. Campbell from working up his results, and finally upon leaving the observatory for the presidency of his university he placed the material in the hands of Dr. Menzel, who has recently published an admirable monograph upon it.

A volume of 300 pages crowded with the results of seven years' work can hardly be summarized in the space available here, but some of Menzel's principal results at least can be indicated.

The lines of course were first measured—more than 2000 of them—and their positions and intensities recorded. Then they had to be identified. This means to the modern investigator not merely that we must know what sort of atoms produce the given line, but what

The same prominence a few minutes later. It is still very rapidly rising

these atoms are doing when they produce it. Are they neutral or have they lost an electron apiece and become ionized? When the atom has got rid of the energy radiated in this particular line is it fully unloaded, or still in an excited state with an abnormal store of internal energy? We know enough about most of the atoms whose spectra appear in the sun to permit definite answers to these questions, and these

answers furnish the basis for further work.

For example, the flash spectrum photographs can at best be made but a few inches long from the green to the ultraviolet. With this relatively low dispersion, many pairs or groups of lines which can be observed separately with high dispersion in ordinary sunlight appear as single lines, perhaps widened but not resolvable. To determine which of these lines contribute most to the observed blend is not easy, but when we know the structure of the spectrum we can estimate the intensities of the separate components of the blend by comparison with unblended lines of the same element and very frequently solve the problem.

WHEN the results are collected, interesting things appear. For example, the lines which remain dark until the very last instant at which the photosphere is completely hidden by the moon are all lines of neutral atoms. The lines which turn bright while a narrow strip of the sun's disk is still visible all come from ionized atoms. This was observed years ago at Mount Wilson in the spectrum of light from the sun's limb without an eclipse, but the eclipse plates show it more fully. No one yet knows why this happens. The theory of the production of lines by the solar atmosphere is greatly complicated by the differences of temperature and density at different levels, but it is good to have unexplained facts to test new theories as they arise.

Menzel has measured the intensities of the lines at different heights above the sun's surface—more precisely the intensity of the light given out by that part of the atmosphere which lies above the level at which the moon cut off the view. From this he finds that the density of the upper atmosphere—the sun's chromosphere—is halved for every 70 miles of vertical ascent within it. This is very much what would be expected in an atmosphere composed mainly of hydrogen, at the sun's temperature and under its gravity.

Different lines of the same element often belong to "multiplet" groups, in which the relative intensities can be theoretically calculated. For example, one of the yellow sodium lines is just twice as strong as the other. By applying these relations it is possible to find how many more atoms are required to produce a strong line in the flash spectrum than a weak one, and so to make a quantitative analysis of the chromosphere. Menzel's calculations indicate very much the same relative proportions of the various metals as the present writer found a few years ago for the lower and denser atmosphere where the dark lines are mainly produced. The most abundant of these are iron, magnesium, and sodium. Hydrogen, however, shows still more strongly in the chromosphere than in the absorption spectrum, and is evidently far more abundant than all other elements together. It appears to form at least 99 percent of the chromosphere and very likely more. That the brightest known atom should rise highest is not surprising.

In 18 minutes after the first photograph it reached 281,000 miles

The lines emitted by highly excited atoms are weaker in proportion to those given by less excited atoms in the chromospheric spectrum than in that of a lower atmosphere. As the proportion of highly excited atoms increases with the temperature, this means that the sun's atmosphere is cooler at the top than at the base. Menzel concludes that the difference of temperature is about 1000 degrees Centigrade. This makes the temperature of the upper atmosphere about the same as that of a small body heated on one side by the sun and radiating heat away in all directions, and so is a wholly reasonable value.

MANY solar problems remain to be solved. For example, no one knows for certain what forces hold up the prominences which rise to enormous heights, often exceeding 50,000 miles, and have been known to last for weeks; nor why other prominences of the so-called eruptive type are repelled violently from the sun and move with enormous and increasing velocity till they are dissipated into space. Radiation pressure due to absorption of the sun's light by individual atoms might hold up some of them and set others in rapid motion, but in this case we might expect atoms of different kinds to be driven at different rates, while the observations indicate that they all go together. So much has been found out, however, during the last generation that we should not repine if a few problems are left for the next generation to tackle.

—Princeton University Observatory, April 6, 1932.

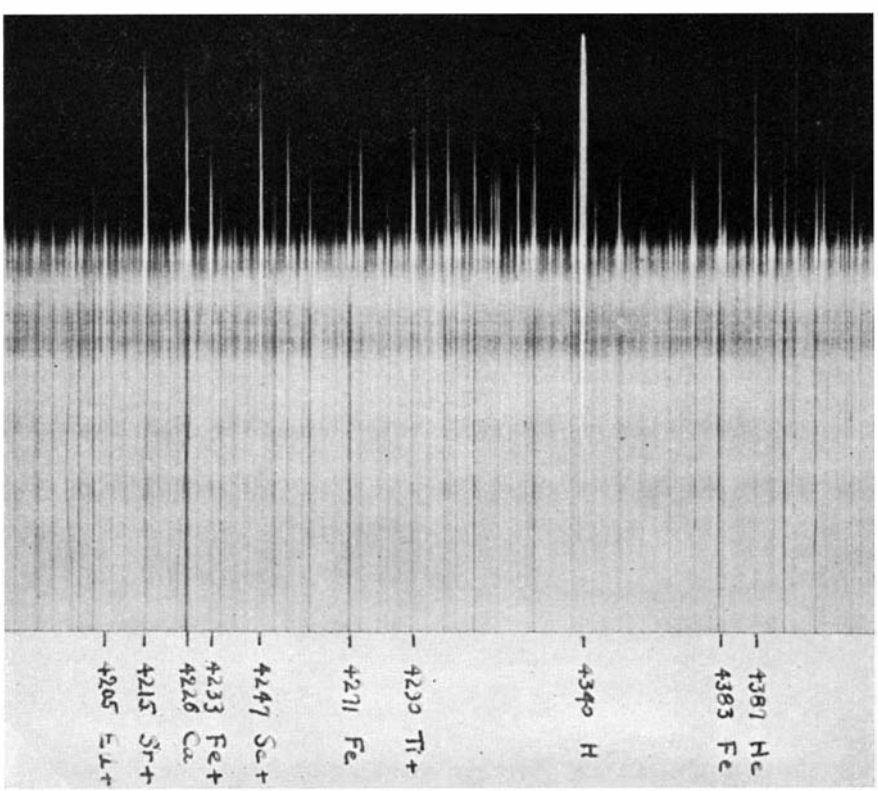


Figure 1: **The flash spectrum described in the text, photographed on a moving plate by the Lick Observatory eclipse expedition at Alhambra, Spain, August 30, 1905. The lines of the neutral metallic atoms do not turn bright until the sun's disk is at the point of disappearing. Those of the ionized atoms (denoted by a plus mark after the chemical symbol) turn bright much sooner, as do the lines of hydrogen and helium. The line of the rare earth europium at 4205 Angstrom units is reversed very early. See the text for further facts and explanations**

FLYING AS FAST AS SOUND

By J. L. NAYLOR, M.A.

MAN is becoming so accustomed to the idea of attaining very high speeds in the air, on land, and on the sea, that a review of the future possibilities and of certain limitations on improvement has considerable interest. Many have queried the physiological strength of the individual to stand up to very high speeds, and this is the direction where there are no signs of a limit to progress at the present time.

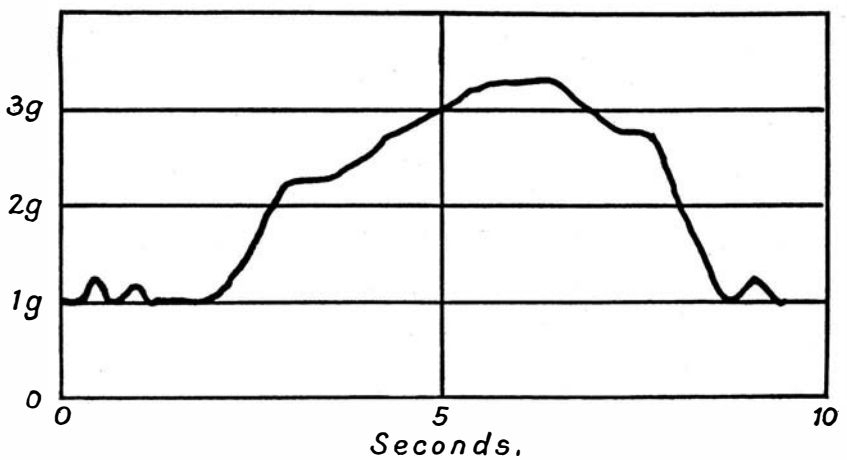


Figure 1: **Acceleration in a fast plane during a turn. For about two seconds the pilot weighs as much as if his body were temporarily turned to densest granite**

There are limitations which may retard progress, but these are either due to aerodynamic causes or to the difficulty of obtaining a greater horsepower from an engine with a proportionately small frontal area. We will first deal with the human element.

A few men have run 100 yards in 9⅘ seconds and so have attained a speed a little greater than 21 miles per hour over this distance. At first sight it might appear that the human body as a whole had some limitation which would prevent its reaching a greater speed than this, and no doubt prehistoric man thought so, although he must have realized that other animals and a few birds with a structure of bones and flesh similar to his own, moved at speeds about three times as fast. His next stage was to ride a horse and thus to double his speed without any undue discomfort, though his risk of fatal injury was greatly increased.

Now the same fact in general is true to-day and man feels no discomfort, apart from the noise of the engine, when traveling steadily at 400 miles per hour, a speed exceeded during the recent speed trials on the Solent. There is this difference to be noted, however, namely, that the man on the horse has the full force of the wind when the animal gallops, whereas in the racing seaplane he must not put out into the full air stream say a hand or he will have it so violently blown backward as probably to break his wrist. The pressure on his hand would amount to about 70 pounds at 400 miles per hour. Seated in his cockpit he will, however, experience a pressure either less or greater than that of the atmosphere, according to the arrangements of the design to let in or exclude air, which can be varied from the head-on pressure of three pounds to the square inch to a negative pressure exceeding this figure. Incidentally, apart from any heat given out by the engine he will experience a temperature rise due to his speedy passage through the air of about 15 degrees Fahrenheit.

Looking ahead to still higher speeds there does not appear to be any factor among those already mentioned which is likely to have an adverse effect on the human frame until somewhere near the speed of sound is reached at 740 miles per hour (1080 feet per second); then, owing to the formation of pressure waves and the rapidly increasing resistance, it is difficult to predict what will happen. Already the pressure effect of the passage of the wings through the air is shown on days of high humidity by a stream of mist behind each wing of a Schneider racing seaplane. A speed as high as 740 miles per hour maintained continuously for an appreciable time seems unlikely to be reached by the present generation for a number of other reasons.

THE question might reasonably be asked whether the speed of sound might be reached for a short time, say one minute, as many small and a few large projectiles start their flight at speeds greater than that of sound. The human frame is always subject at rest to gravity forces or in aeronautical terminology to an "acceleration of 1*g*"; that is, the normal force of gravity. From experience in airplanes it seems that for about two seconds 8*g* can be experienced without injury, but that 10*g* *or* 11*g* will result in permanent injury at least. There are on record single exceptional cases which are difficult to understand when this acceleration has been exceeded, such as the man who fell in September, 1931, from a height of 60 feet on to a heap of ballast on the site of the Hotel Cecil and who was

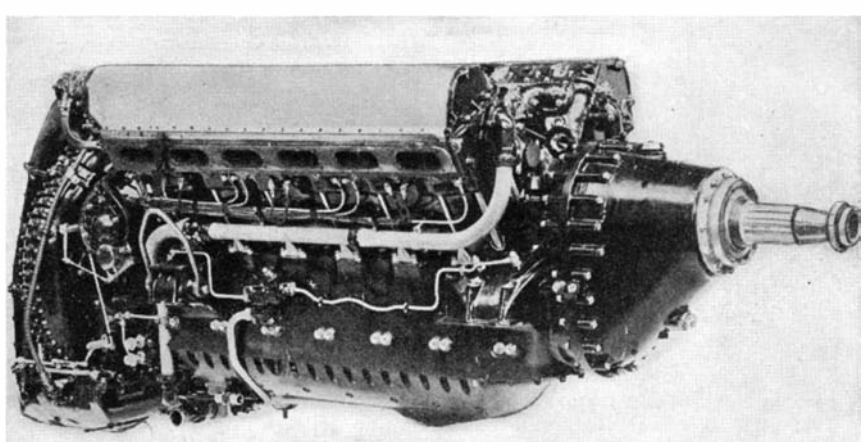


Figure 2: **The "R" (Rolls-Royce) engine used in the seaplane *S.6.B.* shown on the opposite page. "By far the most efficient airplane engine in the world"**

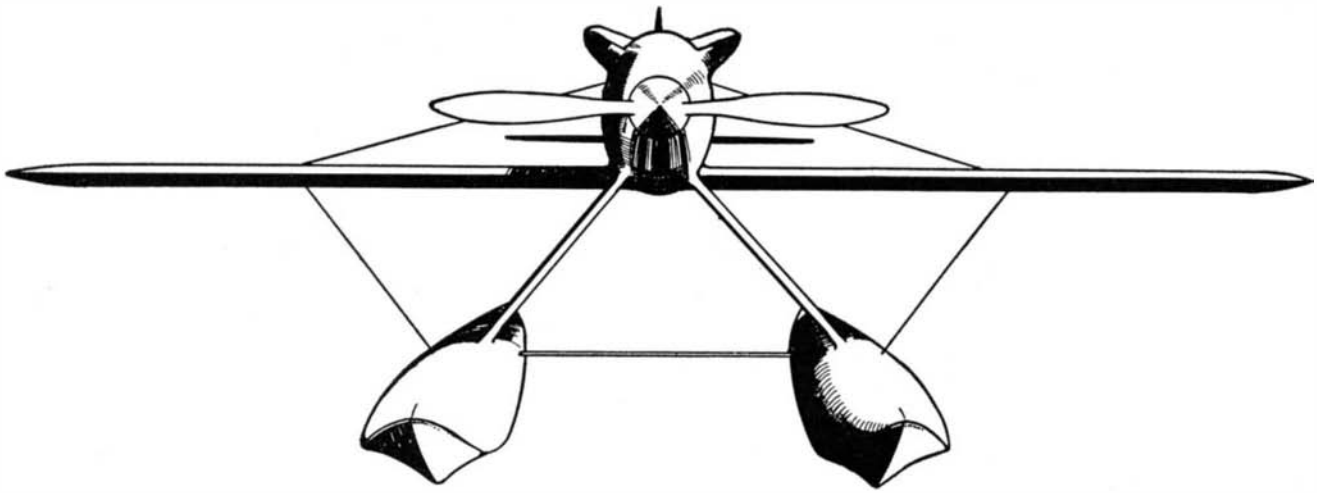


Figure 3: **A head-on view of the *S.6.B.*, showing the small frontal area presented to forward motion**

later reported by the hospital authorities to be uninjured; he walked home afterward. To attain or exceed the speed of sound by any known method except a rocket will need a high acceleration for many seconds, so that experiments in this direction are not likely to produce good results. Moreover, even with rockets the difficulty of landing safely will be great even with an airplane structure; in fact, Herr Opel's experiments on rocket cars and airplanes have not been so successful as to warrant a vigorous prosecution of this line of research.

In another way high accelerations are sure to be incurred as it is necessary to return at some time to a starting point. Figure 1 shows the amount of acceleration experienced in a fast modern airplane during a tight turn. It is a measure of the pilot's feelings rather than the speed of the aircraft, as he is trained not to exceed certain stresses so as not to break the structure. This shows a maximum of about 3*g*. Considering the simple turn it is immediately obvious that turning on the same circle at 400 miles per hour will put on stresses nine times as high as 133.3 miles per hour, a fast cruising speed for a civil airplane. The alternative is to turn in a wider circle, which in view of the speed reached means a very wide sweep. Therefore very high speed aircraft are going to need large maneuver areas, apart from any considerations of the distances required to take off and land even under ideal conditions.

IN the high-speed car problem, the runs have been along straight stretches, the car losing most of its speed before turning for a run in the opposite direction; as in only a few parts of the world are there long straight flat stretches of ground, very high speed motors must remain a pure sport without any commercial development other than a stringent test of materials, manufacture, and design. The aircraft, once it is in the air, does not suffer from this restriction, but it is dependent on the care needed not to overstrain the human body. Although pilots can lose their sense of sight for perhaps as long as a second under 4½*g* to 5*g* when rounding a pylon at high speed, and still retain their muscular sense, this is possible only for the highly trained person. The high-speed aircraft for the average flyer will therefore have to be flown with care and have large areas in which to maneuver. Apart from this need for care, there is at present no limitation imposed on high speeds by the mere human factor.

UNTIL races are inaugurated on pilotless aircraft controlled by wireless or some other means, the first essential is to carry a pilot. Anyone who has seen the small space allowed for the driver of the racing car and the smaller space for the racing plane pilot will realize that very close attention has been paid to presenting the minimum resistance to the air. If we take the frontal area of a man sitting down as four square feet, then his resistance at 400 miles per hour is of the order of 2000 pounds—nearly one ton. By comparison, the resistance of the Supermarine *S.5* seaplane, if it had flown at 400 miles per hour, would have been approximately the same figure. The body has a greater cross-sectional area and is approximately five square feet in the maximum section, a dimension partly dependent on the size of the engine. Now the resistance of a good streamline body, such as an airship without fins, is only about 5 percent of a disk of the same area at the same speed. The man's frontal area is therefore streamlined and its resistance is reduced to about 14 percent of its original value. This is not the only consideration as there must be controls, rudder and elevator to direct the craft, the rudder adding some 40 percent to the resistance of the body and engine alone. In spite of this, its resistance is only one fifth of the same cross-sectional area when not streamlined and it has been given directional stability when it is propelled through the air.

The resistance of the best streamlined bodies is entirely due to the friction of the air flowing over the surface and is called skin friction. The body of the racing seaplane of to-day at its minimum resistance very closely approaches the figure for the skin friction calculated for an area equal to the total surface. This is not the case for the wings, which drive the air downward so as to create lift and thus add an induced resistance which is about half the total. Considered from this point of view, it might appear that as a motor-car has its weight borne by the earth, its resistance should be much less, provided it is so designed that all areas are properly streamlined. The reason is that the frontal area of a racing car is larger than that of the *S.6.B* and both contain the essential human being. Moreover, the car has wheels which have a high resistance. In addition there is the tractive resistance of the wheels on the ground which is so great that the tires have to be renewed every few miles. Perhaps on this last account only, it is probable that wheeled vehicles are never likely to attain such high maximum speeds as craft which are wholly air-borne.

HAVING reduced the resistance of the body carrying the man and his power unit to a minimum, it is essential to have as much horsepower as possible; as it has to be air-borne to get the maximum speeds, the weight per horsepower must be as low as possible, since every extra pound carried will mean so much extra induced drag and consequently a still greater increase of horsepower to overcome this drag (about 10 percent). Our illustration (Figure 2) shows the "R" engine fitted to the *S.6.B.* (Figure 3). It is by far the most efficient aircraft engine in the world, and the recent British triumphs are in a great part due to the excellence of its design. This engine weighs only 0.75

pounds per horsepower and a few of its main characteristics are worth enumeration. In the first instance its frontal area does not greatly exceed that of a sitting man (Figure 4), being 40 inches high by 30 inches broad, dimensions

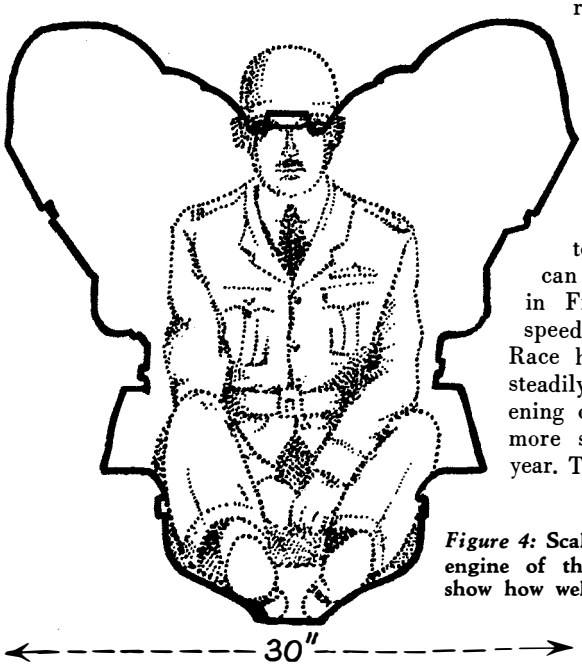


Figure 4: **Scale drawings of the pilot and engine of the *S.6.B.*, superimposed to show how well streamlining is permitted**

which permit of a streamline body to enclose the pilot suitably behind it and a view forward between the two banks of cylinders. It gains its 2300 brake horsepower at a weight of 1630 pounds, representing a power increase over the 1929 engine of 21 percent for a weight increase of 6½ percent. This result was attained by raising the engine speed for the Schneider Trophy race to 3200 revolutions per minute, by raising the supercharger gear ratio, and by increasing the size of the air intake. From a calculation based on the improvement attained in the speed record it would seem that in the "sprint" engine at least another 300 horsepower must have been developed for approximately the same total weight by running the engine at a higher speed—a remarkable achievement.

THE high power developed by the engine means a great expenditure of heat, and this has to be dissipated rapidly or else the engine would overheat and fail to function. A rough idea of the rate of fuel consumed can be gaged when it is realized that the gasoline is burned faster than it can be poured out of a two-gallon can. In fact, whereas the outer surfaces of the aircraft were almost sufficient in the seaplane which won the Schneider Trophy Race in 1929, this is no longer the case and louvres have had to be fitted to direct air between the upper and lower surfaces of the wings so as to gain a more rapid cooling of the wing radiators. The whole aircraft has almost become one huge radiator for dissipating the 40,000 British thermal units per minute and thus cooling the water and oil used in the engine. This tended to limit the maximum speed in the 1931 race. For the speed records flown a fortnight later some of these louvres were removed, as the speed was maintained for only short bursts on the approach to and over the three kilometer course, the engine having time to cool between each run.

At present there seems to be no limit in sight to the maximum speed that can be reached. The curve given in Figure 5 shows how the speeds attained in the Schneider Race have each year increased steadily, and the apparent slackening off in 1931 is due to the more severe conditions of this year. The speed record has, however, jumped forward in the two years by at least the same amount as previously. What then are the limitations? We see that the pilot is streamlined already as much as possible and that there is some difficulty in getting rid of the heat generated by the engine, which is already small in cross-section for its horsepower. On the other hand, means have been devised during the past two years to overcome this difficulty of heat dissipation. If the engine designer can continue to construct engines which will run still faster without a proportional increase in weight, so that the weight per horsepower is still further reduced, then the aerodynamist will devise means, perhaps using wings whose area can be altered at will, so that the engine can be taken into the air, be pulled at still higher speeds by the airscrew (which has by no means reached its limits of design), cooled by devices for making more efficient the available surfaces of the craft, and no doubt if the power available be large enough, design a much larger body into which the floats with their load of fuel can be absorbed after the craft has left the water. Already there are airplanes flying in which arrangements have been made to retract the undercarriage wheels into the body, and floats may well be expected to follow. The saving in resistance, if floats and struts were omitted, would amount to as much as one half the total for the whole aircraft. Given the necessary incentive and the funds, there appears to be no reason why speeds should not continuously increase until they approach the velocity of sound at 740 miles per hour, when owing to the rapid increase of resistance of all objects near this speed it is impossible to predict the precise behavior.

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EDITOR'S NOTE. Apropos of the foregoing discussion, it is of interest to review the speed records that have been set for various modes of travel. In the 1931 Schneider Trophy Races mentioned, Flight-Lieutenant J. H. Boothman of the Royal Flying Corps covered a 50-kilometer course at an average speed of 340.08 miles per hour. Just after this event, Flight-Lieutenant G. H. Stainforth set a new world's record over a three-kilometer course, with a speed of 415.2 miles per hour.

The world's automobile speed record stands, at the time of writing, at 253.968 miles per hour, set by Sir Malcolm Campbell, of England, at Daytona Beach, Florida. This record supersedes Sir Malcolm's own former record, set last year, of 245.733 miles per hour.

Up to last February, the motor boat speed record was also held by an Englishman, Kaye Don, who drove *Miss England II* at a speed of 110.223 miles per hour. On February 5, the motor boat speed record was brought to America by Gar Wood, when he drove his *Miss America IX* at 111.712 miles per hour.

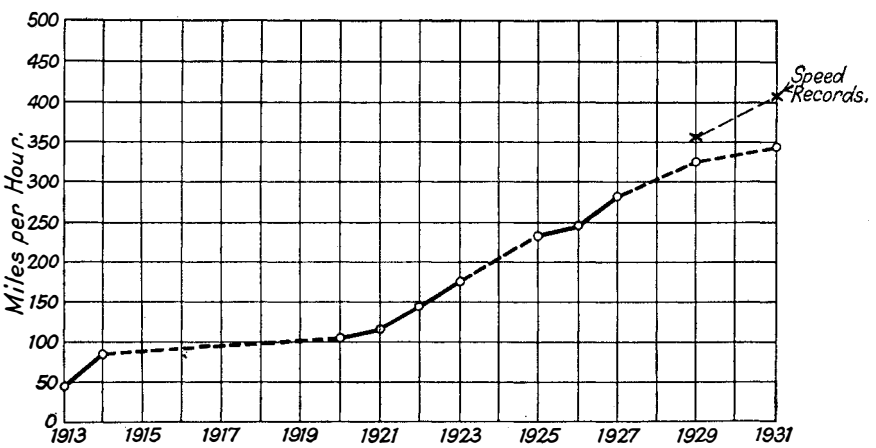


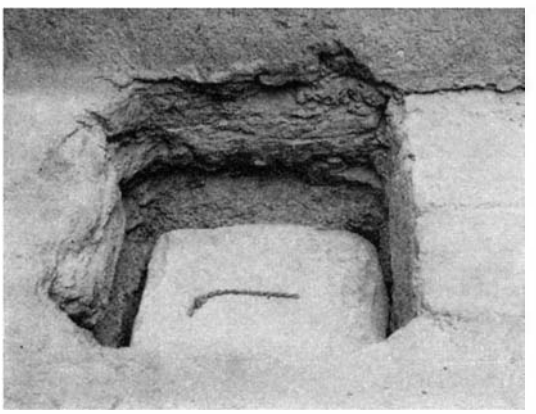
Figure 5: **Airplane speeds have increased since 1921 at virtually a constant rate, despite fears that the limit was "about reached." What, then, is the real limit?**

AN EARLY CHRISTIAN CEMETERY

In the Libyan Desert of Egypt

THERE are five large oases in Egypt. The Khargeh Oasis, or the Great Oasis as it is known, is in Libyan Desert and is southwest from Luxor. Here are the ruins of a necropolis of vast extent, including more than 250 chapels. These ruins were studied in 1907 but owing to the war, work was not resumed until 1926. The results are chronicled by Walter Hauser of the staff of The Metropolitan Museum of Art in the Egyptian section of their *Bulletin*, which has just appeared. He says: "Christian and pagan must have lived side by side and we have reason to think that the cemetery, though full of Christian symbols and inscriptions, is partly pagan. Our work during the last season has revealed some interesting architectural facts. In the largest structure careful clearing failed to show any burial pits which would make it a tomb chapel. It would seem, rather, to have been a triple-naved church. Externally it was a rectangular building with a covered peristyle, the columns of which, made of quadrant-shaped bricks, were topped with composite capitals, modeled in mud, and supported a flat roof. The rear walls of this peristyle on the west and south were decorated opposite each intercolumniation with the triangular lamp niches so characteristic of the necropolis and from which, on the evenings of holy days lights may have glowed out across the surrounding plain." What a dramatic picture of early Christianity!

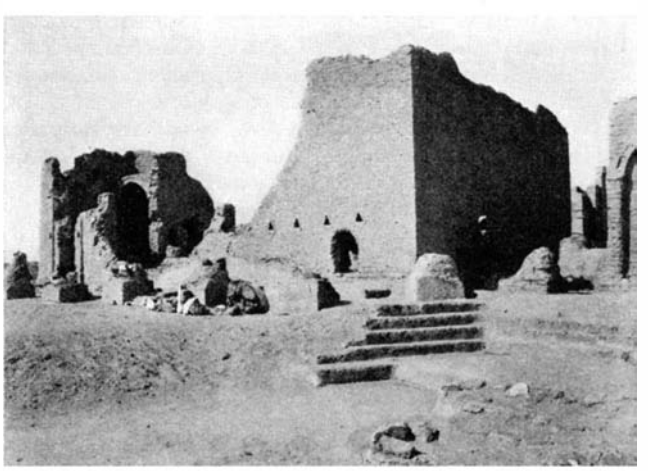
TO the north is another large group of buildings including a smaller three-aisled churchlike structure, the best known of all the tombs. One of the pits in the southwest has a brick mouth built with a ledge to support a sandstone covering slab, flush with the floor level, and provided with a handle of twisted palm-fiber rope to facilitate its removal. Mr. Hauser says "Our excitement was great. Here at last was a definitely untouched burial place in a tomb of some pretensions which might tell us something of the life of the people who had built the necropolis." The archeologists were not disappointed. In the burial chamber were three wooden coffins with their heads to the west and on each of the inner two were wrapped bodies resting as on couches. In one of the coffins were bodies of a woman and a new-born baby. During this season the wrappings and garments will be studied. The necropolis possibly dates from the 3rd Century A.D. The chapels were probably begun by the pagans who later embraced Christianity.



Tomb pit mouth with a sandstone covering slab, provided with a palm-fiber rope handle. The slab was cemented in and was found covered with sand

The largest chapel in the Christian necropolis of the Great Oasis in the Libyan Desert in Egypt. There are 250 chapels and innumerable small pits and graves

***Below:* Interior of a triple-naved brick church. It was two-storied in parts. Buildings may date from 3rd Century A. D.**



Largest chapel from the southeast. The triangular niches were for lamps which shone across the desert on holy-days

VISCOUNT GREY AND LORD HALDANE

By W. D. PULESTON*
Captain, United States Navy

(*Concluded from our May issue*)

HALDANE, on taking over the War Office, knew nothing of military organization and little of strategy and tactics, but he was capable of great application. Aided by Colonel Ellison, he commenced to study Clausewitz, von der Goltz, and von Schellendorf on war and war-making. He made rapid progress and very soon developed plans for the reorganization of the army.

These plans were embodied in a bill and in 1907 Haldane passed them through Parliament with half of his own party indifferent to the success. He was aided by King Edward and also by Balfour, the leader of the Conservative opposition, who took the patriotic view that, as his party had not completed the army program while in office, it could only offer its support and constructive suggestion to the Liberal Party in their effort. Thanks to this help and to Haldane's own powers of conciliation, the bill was passed that provided for an expeditionary force of 160,000 regulars, a territorial force of 14 infantry divisions and 14 brigades of cavalry as a second line and a Special Reserve for the Regular Army that reached 145,000 men in 1913. It still remained to make this paper army into a real one, but Haldane started with a definite program and parliamentary approval and had the organizing ability to concentrate the entire energies of the British Army on this one purpose, so the expeditionary force that was destined to intervene at Mons quickly took shape.

TO appreciate Haldane's work at the War Office, it is only necessary to recall that in 1907 the British could put an expeditionary force of only 2½ complete regular divisions in the field whereas in 1914 Haldane turned over to Kitchener six infantry divisions and one cavalry division ready for rapid transport to France, with a territorial force of 14 infantry divisions and 14 brigades of cavalry as second line troops, plus an adequate system of reserves for his regular divisions to furnish replacements. This is the reason Haig called him England's greatest War Minister.

SELDOM have we been so fortunate in obtaining articles of so great interest to our world-wide group of foreign readers as we have been in the case of Captain Puleston's illuminating articles on World War personalities. Favorable comment from this group as well as from many American readers indicate to us that the public has an intense desire for concise analyses of the events and diplomatic incidents leading up to the last great conflict of nations so that the lessons to be learned therefrom might be applied in solving future international difficulties. War has not yet been outlawed, and the better people understand its specific causes, as opposed to the specious generalities of the propagandist, the better able will nations be to avert future, more deadly wars and still retain their national honor.—*The Editor.*

Lord Roberts was leading a campaign in England for compulsory service on the ground that once England was involved in a war, she would be compelled to see it through and with the huge European armies her small expeditionary force would be ineffective. The French Government also held this opinion and in the spring of 1908 Clemenceau endeavored to persuade the British Government to adopt conscription. Both Grey and Haldane felt that the British public would not permit compulsory service and knew their own party would be helplessly split if the question were put to Parliament, so Haldane contented himself with making the expeditionary force an exceedingly efficient weapon.

CLEMENCEAU was still unreconciled, and in the fall of 1908 after some violent articles in the British press about Germany's navy, he told King Edward at Carlsbad that the British military preparations were entirely inadequate and that if war suddenly occurred between Germany and England, Germany would immediately attack France. Clemenceau considered in 1908 that the British alliance did not help France but actually was an additional peril.

This view somewhat surprised the British but Clemenceau advanced various facts in support of it. He observed that the Territorial Army was just being commenced, that even were the men available, neither weapons nor munitions existed, and that none of these things could be improvised. He stressed the fact that the British Fleet stood between England and the German Army, but that on the outbreak of a war between England and Germany, the German forces would invade France by way of Belgium, and seek in France an indemnity for their losses at sea. It would do France no good for England to destroy the German Fleet for there was no German Fleet in 1870, yet the Germans took Paris. France needed English soldiers.

As for England, Clemenceau continued, if she stood by and saw France smashed by Germany, she would either have to bow her neck to Germany or incur vastly greater military obligations, and he again emphasized his view that England could not maintain her position in the world without an adequate army, repeating his favorite example that Waterloo as well as Trafalgar was required to overthrow Napoleon.

IN 1910, Haldane permitted the British General Staff to study the problem of a conscript army for Great Britain; he states that they recommended against the system because it would take several years to shift from a voluntary to a compulsory army. During the transition the efficiency of the Regular Army would be greatly impaired and the General Staff feared the German Army would be tempted to strike. It is significant that at this time von Tirpitz feared the British Fleet would attack the smaller German Fleet before its growth while the British General Staff were apprehensive that the German Army would bring on the war and attack France before they could be ready to assist France.

Haldane was not consistent in his attitude towards compulsory service; in November, 1910, he gave the following reasons for adhering to the voluntary system: that, first in importance to Great Britain, was sea-power, supported by properly garrisoned oversea bases; and second, an expeditionary force, kept at home but available for immediate transport by fleet to any distant point of action. He reminded the British people that their forefathers created the Empire by fashioning their instruments for the offensive and maintaining the world's largest fleet and a mobile regular army. In other words,

*The opinions and facts in this article are the personal ones of the writer. They are not to be construed as official or reflecting the views of the Navy or Navy Department.

Haldane opposed conscription, not because it would militarize Great Britain, but because he did not believe it would provide an efficient army instantly available for striking a quick blow overseas.

As early as 1903, conversations had taken place between King Edward, Benckendorf, the Russian Ambassador, and Lansdowne concerning an Anglo-Russian agreement. Again in 1904, King Edward discussed the subject at length with Isvolsky, then Russian Ambassador at Copenhagen, but the unsettled condition in Russia prevented further progress. Thus it was that Grey inherited the nebulous idea of an accord with Russia from the former government just as he did from the French entente, but Grey had to lay the foundations of the Russian agreement.

IN the spring of 1906, Asquith, Grey, Haldane, Lord Morley, then Secretary of State for India, and Sir Arthur Nicolson, the recently appointed British Ambassador to St. Petersburg, held a long conference in London concerning the proposed agreement, during which Nicolson was thoroughly acquainted with the views of his government. In June, 1906, Nicolson made the first advance in St. Petersburg; Grey controlled the negotiations from London and it required a year to bring the issue to a successful conclusion.

The basis for this agreement was the partitioning of Persia into three parts, the northern part being given to Russia, the southern to England, and

Viscount Grey

the central part being left to the nominally independent Shah. Grey had some difficulties with his conscience about the dismemberment of Persia; for he states that he desired a strong independent Persia, but as that was impossible because of previous Russian encroachment, it were better for the sake of peace in Europe to join Russia in a fairly even division of the spoils, one that would insure the defense of India. Grey concluded this treaty in 1907 and for seven years worked in outward harmony with his new ally.

In November, 1907, shortly after the Anglo-Russian agreement had been reached, Emperor William visited King Edward at Windsor. Among his suite was Baron von Einem, Minister of War. Haldane was also a guest at Windsor, and in conversation with the Emperor, stated that England would no longer oppose Germany's construction of the Bagdad Railway provided England could control the final section of the road between Basra and the Persian Gulf. The Emperor indicated that Germany would be glad to discuss the subject with a view to an agreement along these lines. Haldane consulted Grey, who replied by a memorandum setting forth that France and Russia would have to be brought into the discussion. The Emperor returned with this memorandum to Berlin, but von Bülow held that while they were willing to discuss the matter with England, they could not include Russia and France for a failure of negotiations would increase the dangerous tension existing between Germany and these two countries.

HALDANE took a prominent part in entertaining the Emperor and his suite in return for the courtesies previously shown him in Berlin. In 1912, after King George's accession, the Kaiser again visited England and Haldane once more was conspicuous as an imperial host. The papers carried large accounts of these royal parties and Haldane became fixed in the public mind as a friend of Germany and her Kaiser.

Grey had scarcely settled the terms of the agreement with Russia when Austria brought Europe to the brink of war by her formal annexation of Bosnia and Herzegovina. Russia was incensed because the annexation was considered by Serbia a serious blow, and the Pan Slav Societies in Russia demanded war. Germany was disconcerted by the sudden move of her ally, for she had been assiduously wooing Turkey in order to obtain the remaining concessions for the Bagdad railway, and Austria's precipitate action temporarily prejudiced Germany's influence at Constantinople. Nevertheless, on von Bülow's strong insistence, the Emperor ranged Germany on the side of the ally.

Germany's action was decisive, for Russia, in no condition to fight, had to content herself with diplomatic notes, and France was somewhat relieved, for French interests were not involved and she did not wish hostilities. The Algeciras incident had already disclosed to Germany the solidity of the Anglo-French ties, and the Bosnia-Herzegovina incident revealed to the world Germany's readiness to support her ally Austria. The lines of the opposing alliances were growing tighter.

Beginning in 1907, France gradually extended her domain in Morocco until she exceeded the provisions of the Algeciras convention and in March, 1911, a French military detachment entered Fez. On July 1, Germany despatched the cruiser *Panther* to Agadir, and Europe faced another crisis, for either the Triple Entente or

Lord Haldane

the Triple Alliance had to give way. On July 4, Grey warned Metternich that England would not recognize any changes in the status of Morocco unless she were consulted in advance. Germany ignored the British statement and opened secret negotiations directly with France, who, however, kept England fully informed. Germany claimed compensation from France in French Congo for acknowledging a complete protectorate by France over Morocco.

Many notes were interchanged between London, Berlin, and Paris. Grey knew that France had greatly exceeded the scope of the Algeciras agreement, and he advised her to buy Germany's consent to a French protectorate in Morocco by a generous cession in French Congo. This was done and once again Europe deferred the threatened war.

DURING these negotiations, Cambon again asked Grey what England would do if Germany refused to settle the question peacefully and again Grey could only say that public opinion would be more in favor of France if a conference were rejected by Germany. He reiterated that no man and no government could pledge England in advance to go to war. This constitutional inability of England to give assurance of her future action lessened her alliance value in the European market. Therefore Sir Arthur Nicolson, who had then become Permanent Under Secretary of State, advocated changing the Triple Entente into a Triple Alliance and announcing it to the world, for he thought Germany as leader of the Triple Alliance would be

(*Please turn to page* 374)

POWER FROM PIPE LINES TO WIRES

By J. B. NEALEY

WITHOUT losing perspective as to the relative positions of the various fuels used in industry, it may be said that the utilization of natural gas is undergoing a phenomenal expansion. It is becoming an increasingly large factor in the fuel situation of the entire country; this is due primarily to recent discoveries of enormous reserves of this particular fuel and to the development of cheap transmission for it. In fact, the development of pipe line transmission for natural gas has reached a point where this fuel can be carried from one point to another at less than half the cost of transmitting a similar amount of energy in the form of electricity.

Courtesy Lincoln Electric Company

Natural gas is brought 213 miles from Kettleman Hills through a 26-inch welded pipe line

The growing use of gas in the generation of electrical power is a particularly significant development, for the consumption of natural gas in steam-electric plants showed a gain of more than 160 percent in the 11-year period ending with 1930.

This phase of its utilization is well exemplified by the situation in southern California which is served with electricity by the Southern California Edison Company. A few years ago most of the steam-powered generating plants in this territory were considered as stand-by units for the hydro-electric systems but this position has now been reversed. In fact, the Southern California Edison Company has already abandoned some of its water power filings, on the creeks and rivers in the High Sierras, which it had been holding for future development.

The present tendency toward steam rather than hydro-electric generation is due largely to improvement in steam-plant efficiency and in part to the use of the large available supply of fuel—natural gas. The demand for gas for domestic use is very seasonal, being high in the winter and low in the summer. The electric load of the Edison company is high in the summer and low in the winter. This condition, combined with the fact that there is more stream flow hydro-electric power available in the winter, presents the possibility of a high annual load factor for gas transmission lines serving the dual purpose of supplying both gas and electric utilities.

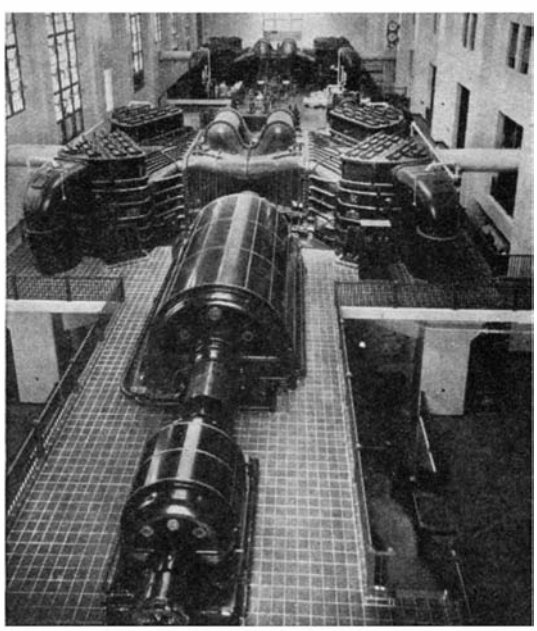
There immediately arises the question of the economy of the Boulder or Hoover Dam project on the Colorado River, as more than 9 percent of the energy to be generated has been allocated to the Southern California Edison Company and this energy will have to be transmitted 250 miles, the longest electrical transmission line ever constructed. In this project, power will be a secondary consideration, the first being water for irrigation and domestic use in a territory where the ground water level has been falling for years. However, the power will have to return a part of the cost —165,000,000 dollars—and so was allocated, by the government, to the nearby states, public utilities, and municipalities.

This power will not be available for approximately five years and its cost delivered at Los Angeles will probably be greater than that at which electrical energy can then be produced in southern California with gas fuel. The amount of energy produced will be easily absorbed in the rapidly increasing volume of energy consumption in that territory. In fact, the ultimate development of the Long Beach plant calls for 1,000,000 kilowatts, while its present capacity is 415,000 kilowatts.

THE Long Beach plant of the Southern California Edison Company is the largest central steam-electric generating station west of Chicago and with unit 12, now under construction, its capacity will be increased to 515,000 kilowatts, or 690,000 horsepower. Natural gas is brought from Kettleman Hills, a distance of 213 miles, through a pipe line 26 inches in diameter which was completed early in November last year and which has capacity for 130,000,000 cubic feet in 24 hours. This will take care of the swelling demand for this fuel for some time and the decreasing supply from the Southern Basin fields, which are being depleted.

This gas line was constructed at a cost of 6,500,000 dollars by the Southern Fuel Company, which is owned jointly by the Southern California Gas Company and the Southern California Edison Company interests. The capacity of this line can be increased to 200,000,000 cubic feet daily by the installation of extra compressor plants along the line.

The power plant is divided into three



Turbines and generators in the Long Beach power plant where natural gas is the fuel used

sections. The Number 3 plant, with 200,000 kilowatts capacity, is one of the most efficient ever built anywhere. Steam is generated in six Babcock and Wilcox sectional cross drum type boilers with water walls, air preheaters, and superheaters, and each is rated at 3400 horsepower. These boilers are operated at 450 pounds steam pressure and 300 degrees of superheat. With the consumption of approximately 10½ pounds of steam per kilowatt-hour when operating at full load, the 21-stage turbines of this plant each require about 25,000,000 pounds of steam daily. At the present time the Long Beach plant is producing per day about 7,500,000 kilowatt-hours and is using 90,000,000 cubic feet of gas.

THE superheaters consist of three boilers, 3-pass, interdeck, 6553 square feet; and three boilers, single pass, multiple entry type, interdeck, 6996 square feet. The furnace walls are composed of Bailey refractory faced cast-iron blocks mounted on water cooled tubes, with a total surface of 3240 square feet. The furnace volume is 19,800 cubic feet while the air heaters are tubular with the hot products of combustion inside the tubes, the external surface amounting to 51,232 square feet. There are two forced draft and a single induced draft fan for each boiler and the combustion control is completely automatic. The heating value and density of the fuel gas are measured continuously by recording instruments.

Air for fuel combustion is taken from the top of the boiler room where it contains the heat of radiation of the boilers and in passing through the air heaters is heated to 400 degrees, Fahrenheit, and carried to the burners at this temperature. Every operation is automatically controlled and only 15 men are required per shift. These men are observers only, except for starting and stopping and in case of trouble.

Each boiler is fired with 20 burners which are combination gas and oil burners. The boiler efficiency when burning oil is approximately 4 percent higher than when burning gas, due to higher "hydrogen losses" with the latter fuel. This lower efficiency is probably offset by higher furnace maintenance charges when using oil.

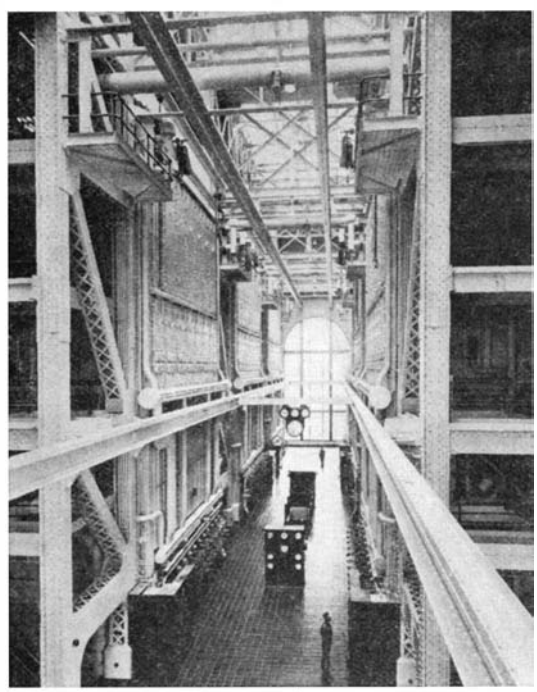
A problem now confronting steam-boiler engineers is the design of units in which greater heat liberation per cubic foot of furnace volume can be obtained. Tests at the Long Beach Plant were conducted with a maximum heat liberation of 27,300 British thermal units per hour per cubic foot of furnace volume and it was the opinion of the engineers in charge that heat liberation rates as high as 60,000 British thermal units per cubic foot per hour might be satisfactorily maintained in that furnace. The stack losses totaled 15.28 percent. Excess air for combustion was kept down close to 15 percent as it is not advisable to get it below this point due to formation of carbon monoxide and resulting incomplete combustion.

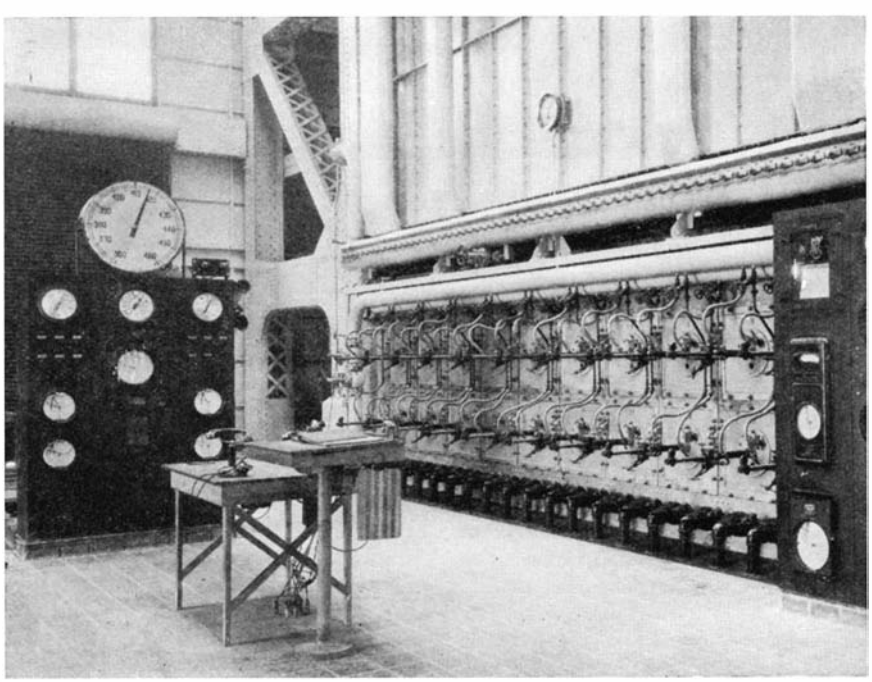
Temperatures of superheated steam are slightly higher with gas fuel due to lower water wall heat absorption and larger flue gas volume.

These tests continuously showed a higher rate of heat liberation with gas than with oil, with the maximum at a rating of 400 percent. The combined efficiency of furnace, superheater, and boiler with air heater showed a decline of approximately 1 percent over the range 100 percent to 400 percent of rating.

The American Gas Association is collaborating in a program of research to solve the problems now standing in the way of greater heat liberation, which, in great part, depends upon the development of burners completely free from stratification of air and gas, and which, at the same time, can be operated under extremely close regulation, and upon refractories or furnace cooling.

The burners used in these furnaces consist of two spaced circular plates closed about the periphery with a segmented air shutter and containing a hollow ring for the gas. The gas leaves the burner through a series of small holes around the inner circumference and mixes with the air which is drawn through the tilted segments of the circumferential shutter. The mixture fires directly into the firebox of the furnace. The segments of the shutter revolve about bolts spacing the two plates and the volume of air admitted is controlled by adjusting the width of this opening between the segments. The outlet is so designed that the gas enters the burner throat at a high velocity. It is met by the necessary air for combustion that has entered as described. Due to the angle of the segments the entering air is in the form of a rotating column, resulting in a rapid and complete mixing of the gas and air.





This looks too clean to be the boiler room of a large power plant, but there is nothing messy about the use of gas. *At left:* Close-up view of gas burners

WATCHING THE CREATION OF THE STARS

By SIR JAMES JEANS
Former Secretary of the Royal Society
Research Associate, Carnegie Institution of Washington

(*Concluded from our May issue*)

WE have so far spoken of the nebular equator as being of circular shape, as it undoubtedly would be if the nebula were alone by itself in space. But an actual bursting fly-wheel of course first breaks at its weakest point; if it were of absolutely uniform strength it would begin to break at all points of its circumference at once. In the same way, if the equator of the nebula were a perfect circle, and if the substance of the nebula were disposed symmetrically around its axis of rotation, the ejection of matter would necessarily start from all points of the equator simultaneously; there could be no conceivable reason why it should start at one point rather than any other.

In nature we do not expect to find perfect balances of this kind; if the main factors are of exactly equal weight, some quite minor factor invariably intervenes to turn the balance in one direction or another. In the present problem there could be no choice as between one point of the equator and another if the various minor factors were absent, but as soon as minor factors come into play a discrimination at once takes place.

WE have so far spoken of the rotating nebula as though it were alone in space. Yet it must have neighbors and these will raise tides on its surface, just as the sun and moon raise tides on the surface of the rotating earth. Wherever the neighbors are, there will always be two points of high tide antipodally opposite to one another, and two points of low tide intermediate between the two points of high tide. The equator will not be strictly circular, but slightly elliptical.

It is in all probability this tidal pull that determines the choice of points for the ejection of matter. Matter will be ejected at the points at which the gravitational pull of the nebula is weakest, and so at the two ends of the longest diameter in the equator of the nebula. After the nebula has passed its critical landmark, it ought still to retain the lenticular figure which formed the landmark, but with the additional feature of matter streaming out from two antipodal points on its equator.

This is exactly what we see in the types of nebulae which we describe as "spiral." In N.G.C. 5866 we see a nebula in which the ejection of matter is probably just beginning; we notice the bulge along the equator and a dark band which probably represents ejected matter which is already cooling. A more advanced state of development is shown in N.G.C. 4594; and a still later one in N.G.C. 891 in which the ejected matter already dwarfs the central nucleus in size, although probably not in total mass.

Messier 51, the Whirlpool Nebula, about one million light-years distant. It was the first spiral nebula found

These are all photographs of nebulae seen very approximately edge-on. The well-known "whirlpool" in Canes Venatici (M. 51) is a spiral nebula which may be very similar physically to that shown in N.G.C. 891, but is seen face-on; we are looking along its axis of rotation. Again, the central nucleus occupies only a small part of the picture. In two other spiral nebulae, M. 81 and M. 101, the evolution has proceeded still further, so much so that in the last of these there is very little nucleus left, and by far the greater part of what we see is what we believe to be ejected matter forming the spiral arms. In these last nebulae, we can see that the spiral arms proceed from two antipodal points, exactly as required by dynamical theory.

Yet this does not quite end the story, since the arms spread farther into space than we should expect if rotation alone were responsible for their spreading. There must be other factors at work, and these we do not yet understand; the spiral formation of the nebular arms remains a mystery. It seems possible that the theory of relativity may explain it all to us in time, but it has not done so yet.

GAS set free out of an ordinary nozzle into a vacuum would immediately spread into the whole of the space accessible to it. Why then does not the jet of gas shot off from the equator of the nebula do the same?

The explanation is to be found in the gigantic scale on which this latter process takes place. As we increase the scale of the phenomenon the mutual gravitational attraction of the particles of gas becomes of even greater importance until finally, when we come to very large scale phenomena (but before nebular dimensions are reached), gravitation overcomes the expansive influence of gas pressure and holds the jet together as a compact stream.

But dynamical theory predicts that when this happens a further phenomenon ought also to appear. The influence of gas pressure is in the direction of keeping the density spread out uniformly along the filament, while that of gravitation is toward making the stream condense into compact globules. When nebular dimensions are reached the latter tendency prevails, so that the

jet of ejected matter breaks up into drops, much as does a jet of water issuing from a nozzle, although for a very different physical reason. In the photographs reproduced—N.G.C. 891 (shown in the sequence at the right), M. 51, M. 101, and M. 81—we can trace this process going on.

The nebula shown in N.G.C. 891 exhibits a lumpy or granulated appearance in its outer regions. In M. 51 this takes the form of pronounced condensations, and in the outer regions of M. 101 and M. 81 these condensations have further developed into detached and almost star-like points of light; indeed many of these are known to be stars or groups of stars.

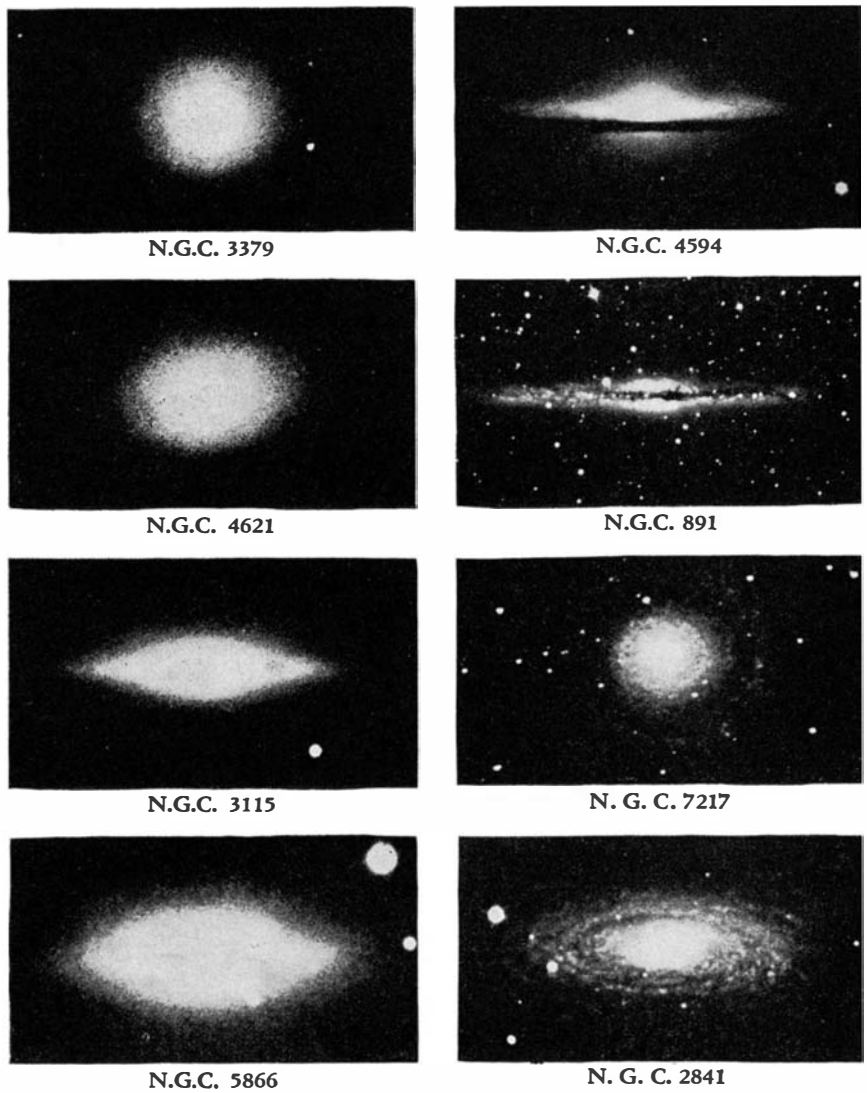
Dynamical theory not only predicts that these globules of gas must form, but can also predict their sizes and masses. The calculation of the masses leads to an extremely interesting and significant result; the calculated mass of a single condensation proves to be approximately equal to the mass of the average star.

THIS provides an excellent confirmation of our theory and gives, I believe, the key to the evolutionary process we have been considering—we have been watching the creation of the stars.

In N.G.C. 3115 we saw the raw material of the process—a gaseous mass of extreme tenuity, already molded, as a result of shrinkage and consequent increase of rotation, to the stage at which disintegration is about to commence. Further shrinkage takes place, and in N.G.C. 5866 and 4594 we see the ejection of the jets of matter from which the future stars will in due course be made. In N.G.C. 891 and M. 51 individual stars are beginning to form, although at present only as vague condensations in what is still a continuous nebular mass. Finally, each condensation forms a separate star, until the whole nebula is transformed into a star cloud. Thus the great nebulae prove to be the birth-places of the stars.

Long before this complete evolutionary sequence was known, I had taken a preliminary step in the reverse direction, and had shown that the stars had in all probability been born out of a uniform mass of tenuous gas by a process which I designated "gravitational instability." If all the matter of our own system of stars were uniformly spread throughout the space occupied by the system, it would form a gas of density about 10^{-23}; that is, it would be one-100,000,000,000,000,000,000,000 as dense as water.

I showed that such a medium would be unstable, and that its instability would cause it to break up into condensations whose distances apart could be calculated mathematically, which calculation showed that these distances



A sequence into which the majority of extra-galactic nebulae can be arranged. It is believed that this sequence represents stages in the mechanical evolution of the universe. Reproduced from last month, for the reader's convenience

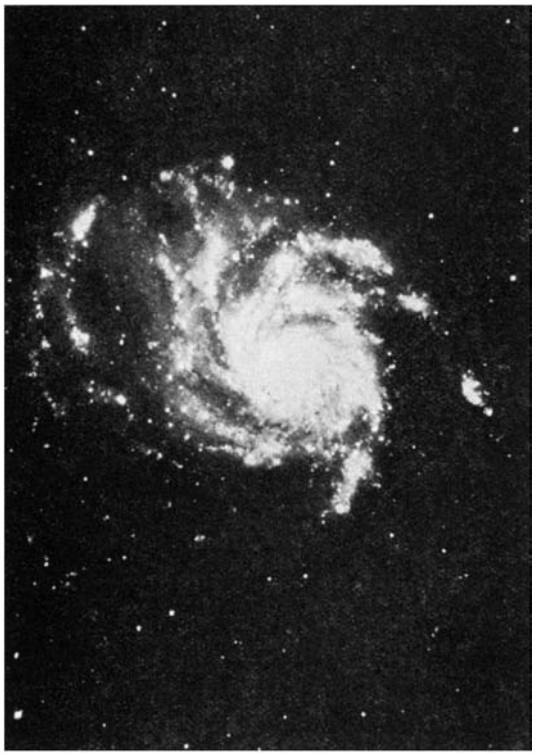
would be about equal to the actual average distance of the stars. Thus the single supposition that the stars had been born out of a uniformly spread mass of gas was found to explain at a single stroke why the stars all have approximately the same mass, and why these masses are what they are.

A similar situation has recently arisen with respect to the nebulae. In a telescope, they appear to differ widely in shape, size, and brightness. But Dr. Hubble has shown that differences in size and brightness between nebulae of the same shape are almost entirely due to a distance effect. If all the nebulae were put in a row at the same distance from us, nebulae of the same shape would be found to have approximately the same dimensions and luminosity, while even nebulae of different shapes would exhibit only comparatively small ranges of dimensions and luminosity, especially the latter.

Because of this, it is possible to estimate the distances of all nebulae, even the very faintest, with fair accuracy; their faintness gives a measure of their distance. The faintest which can be observed photographically in the 100-inch telescope prove to be at the amazing distance of about 140,000,000 light-years. Some two million nebulae lie within this distance.

Dr. Hubble finds that these are fairly uniformly spaced at an average distance of about 1,800,000 light-years apart. To construct a model, we may take 300 tons of apples and space them at about 10 yards apart, thus filling a sphere of about a mile diameter. This sphere is the range of vision of the 100-inch telescope; each apple is a nebula containing matter enough for the creation of several thousand million stars like our sun; and each atom in each apple is the size of a solar system with a diameter equal to, or slightly larger, than that of the earth's orbit.

Thus the arrangement of the nebulae in space reproduces on an incomparably grander scale the uniform spacing of the stars in our galactic system. It



Left: **Messier 101. Here there is still a nucleus, but much of the matter has streamed out into the arms, which are well developed and show the "spiral" to good advantage**

Right: **Messier 81 is perhaps the most beautiful of all the spiral nebulae, and has a "soft," smooth appearance. Most of the material of the nucleus has moved out into the arms**

is natural to inquire whether the uniform arrangement of these larger masses cannot again be explained by the supposition that the nebulae themselves came to birth as condensations produced by the gravitational instability of an earlier and even more tenuous mass of uniform gas. The test of the conjecture is of course by numerical calculation.

The masses of two nebulae are known with fair accuracy; one has 3500 million times the weight of the sun, the other 2000 million times. If all the nebulae have masses of about this magnitude, the average density with which matter is spread in space must be something like one gram to 10^{30} cubic centimeters. The theoretical formulae show that instability would cause such a medium to form into condensations which would be at approximately equal distances apart, and that these distances would be of the order of hundreds of thousands of light-years. While the calculated distance comes out rather less than Dr. Hubble's observed distance of 1,800,000 light-years, yet it is near enough to it to make our conjecture seem reasonably probable.

THESE nebulae provide one of the great puzzles of astronomy. The theory of relativity suggests that the whole universe may be expanding, and recent astronomical observations, made mainly at Mount Wilson, have suggested that it is actually doing so, and this in no half hearted way. If we may take the observations at their face value, the nebulae are even now rushing away from one another at almost incredible speeds. The last nebula which Mr. Humason investigated at Mount Wilson, at an estimated distance of about 105 million light-years, appears to be receding from the earth at the rate of 19,700 kilometers a second—about 12,300 miles a second! (Still higher velocities have since been detected by Humason and Hubble.—*Ed.*)

The mathematical work of Lemaître and others has suggested that the mere condensing of the primeval gas into nebulae in the way just explained would of itself suffice to cause space to start expanding. Before the expansion started there would be approximately the same amount of matter in the universe as now, but it would be packed into a smaller space; the density of the primeval gas would be greater than we have calculated for it. Consequently the distance apart of the condensations which ultimately formed nebulae would be less than we have calculated. After they had formed, their rushing apart would increase their distances, with the result that by now these distances would be nearly but not quite as far apart as those given by a calculation which ignores the expansion of the universe entirely.

The upshot of the whole matter is that, whether the universe is expanding or not, the actual condensations of a primeval gas ought to represent the present nebulae fairly well.

If this account of the origin of the nebulae is accepted, it becomes possible to trace out the mechanical evolution of the universe from its origin as a uniform gas spread throughout primeval space. We have in succession:

1. A uniform tenuous gas of density of the order of 10^{-30} and of diameter at least thousands of millions of light-years.

2. Condensations developing in this gas at points hundreds of thousands or perhaps millions of light-years apart, and forming separate nebulae with masses of the order of thousands of millions of suns.

3. Condensations developing in turn in the arms of these nebulae, and forming stars with masses about equal to that of our sun.

FURTHER, according to the "tidal theory" of the origin of the solar system, we may add to this:

4. Condensations developing in the arms of gas pulled out from the stars by the tidal action of other passing stars, and forming bodies of planetary mass.

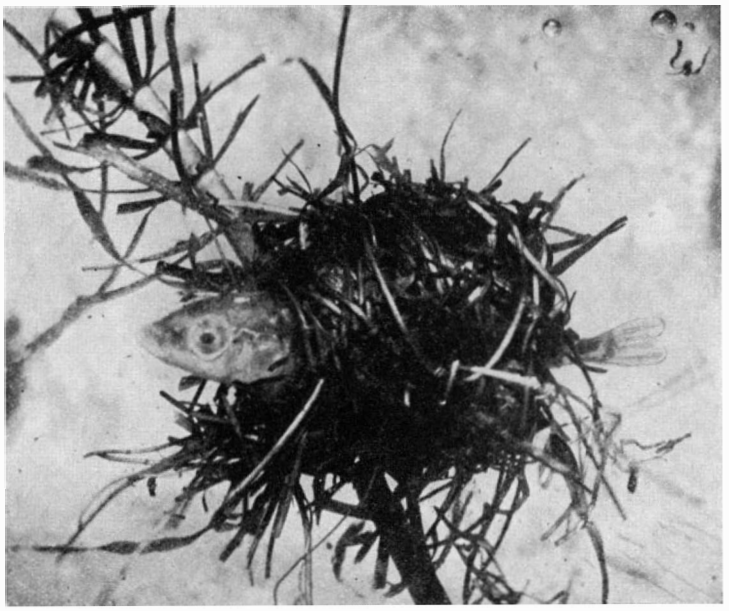
5. Condensations similarly developing in the arms of gas pulled out tidally from the planets, and forming bodies of a mass comparable with the satellites of the planets.

This scheme covers five complete generations of astronomical bodies, having masses of the order of 10^{55}, 10^{42}, 10^{34}, 10^{29}, 10^{25} grams respectively, the birth of each generation from the preceding generation being through the agency of what I have described as "gravitational instability."

Owing to the repeated action of this agency, sometimes by itself, but more often in conjunction with other agencies, we see the universe gradually evolving from a single chaotically spread primeval gas of extreme tenuity, down to comparatively small dense bodies such as our earth which form possible abodes for life.

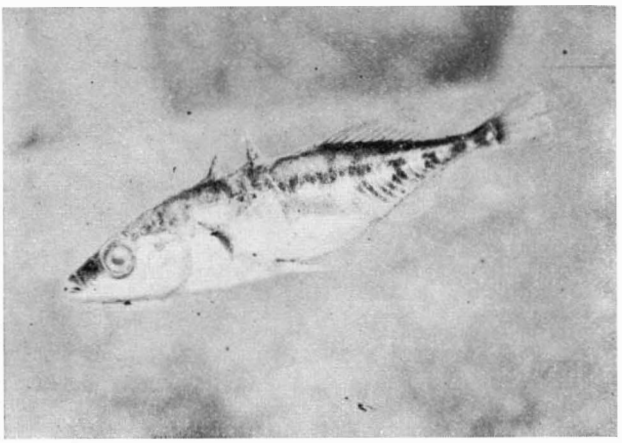
UNUSUAL FISHES

That Build Nests, Walk on Land, Live in Dried Mud, and Breathe Air

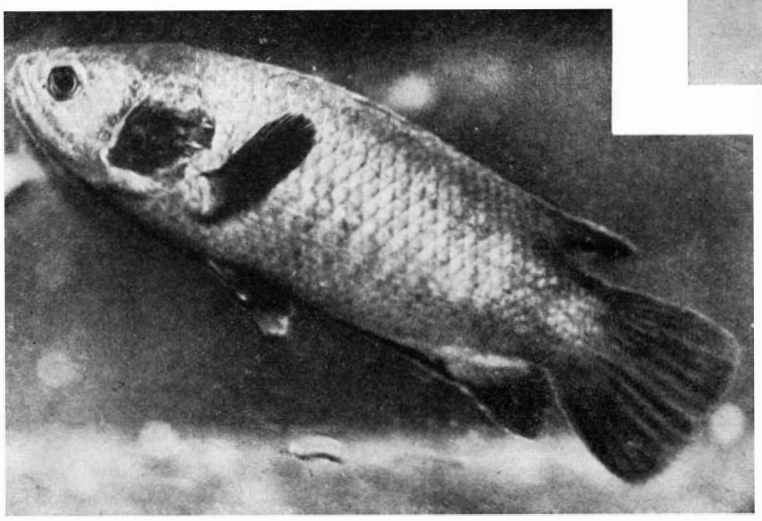


Right: The stickle-back, varieties of which are found in parts of Europe and North America. The male builds a nest of grasses, in which the eggs are laid and hatched. The grasses are woven together and serve not only as a repository for the eggs, but also to protect them from enemies. Photograph shows the male stickle-back "at home"

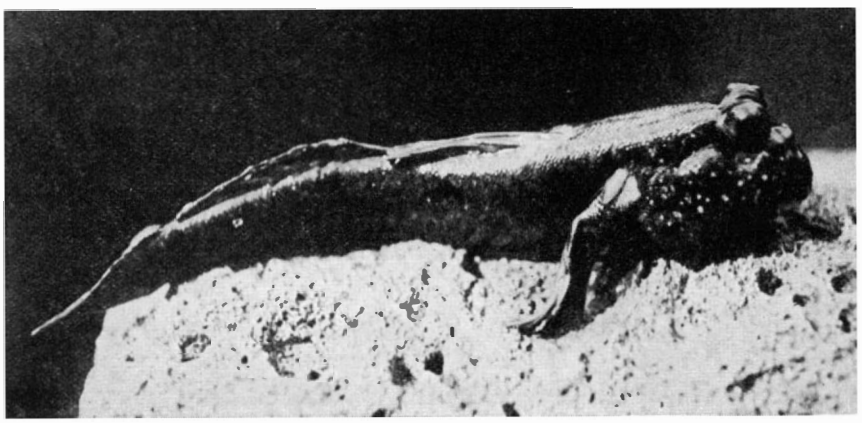
Right: Another view of the stickle-back, shown above in its nest. The male guards the eggs after they are laid, and also cares for the young after birth. He keeps the water in constant motion around them in order to insure proper aeration



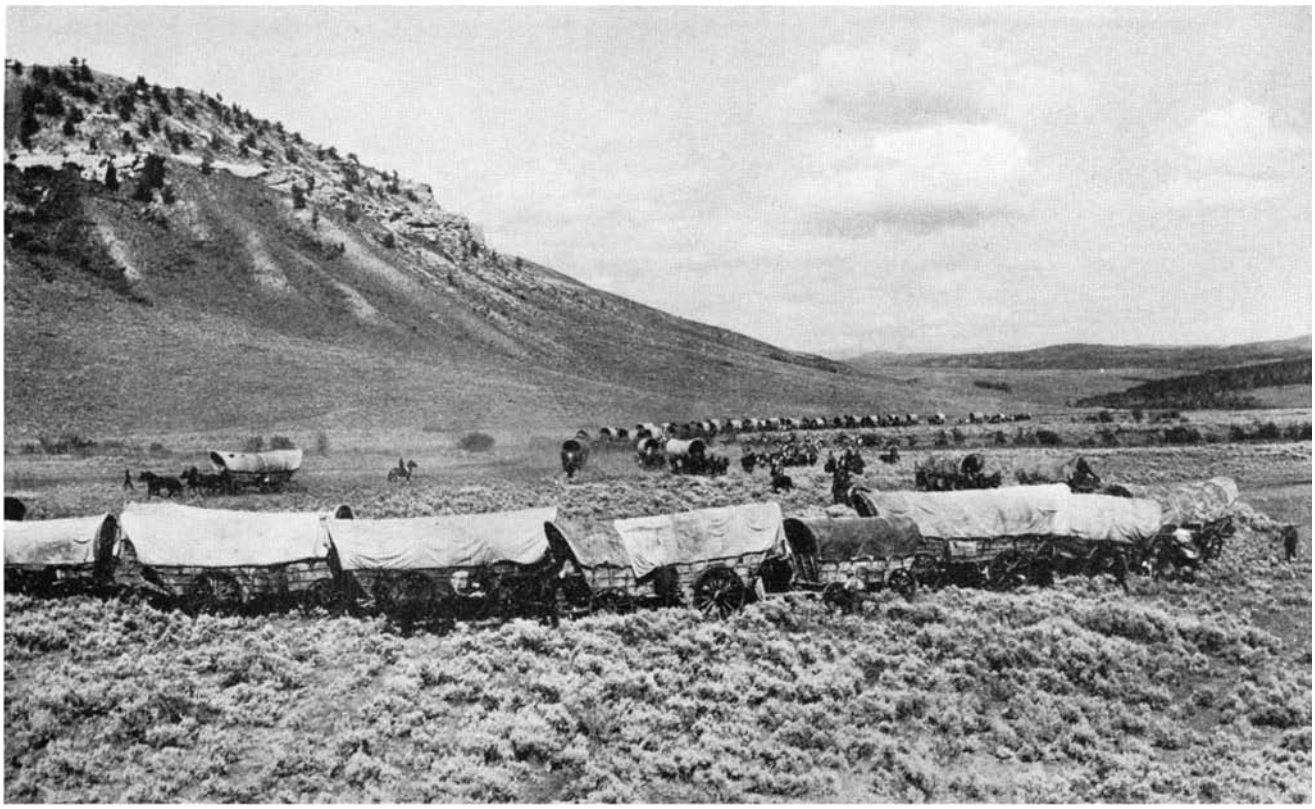
Below: Anabas scandens, a fish that leaves its home pools when they start to dry up, and travels long distances in search of fresh water. Respiratory organs back of its eyes make it possible for the fish to live out of water; in fact, it will die if compelled to stay under water for any length of time. It must breathe fresh air at intervals to live



Misgurnis anguilli candatus, of Chinese waters, that passes whole summers in a state of lethargy, buried in a hole in the hard-baked mud of a dried-up river bed



Left: Periophthalmus is provided with a pair of front fins that serve both for swimming and for walking on dry land. When in the water, it usually does more walking on the bottom than actual swimming



A scene from a motion picture which faithfully pictured the trials and tribulations of the pioneers of our west. It was with covered wagons that a small group of Forty-Niners attempted to cross Death Valley, and left many of their members behind

Death Valley Can Support Life—

FORTY-NINERS STARVED IN THE MIDST OF PLENTY

By ERNEST E. FAIRBANKS

BETWEEN California's grim Panamints and the ghoulish Funeral Range lies the most unusual valley in the world, long known to the Paiute Indians as Tomesha—"ground afire." By the less than a dozen survivors of 30 Argonauts who entered Tomesha, it was unanimously proclaimed Death Valley. Their covered wagons had been directed toward the California gold fields late in 1849. They had left the main thoroughfare from Salt Lake to California; traveling on it was too slow for impatient fortune seekers. Discussion of a little known short-cut through the mountains caused them to decide to strike out along the new route. This led through what is now the state of Nevada where rough going and lack of game and water confronted the stout-hearted pioneers.

Somehow they managed to get their wagons into Death Valley; into the full fury of a sandy furnace heated by a relentless sun to a peak of 140 degrees. What hardships they had encountered so far were as nothing compared with those awaiting them here. Gold was forgotten; nothing mattered now but food and water. Crossing the valley wastes to the base of the Panamints they spread out, seeking with despairing frenzy for water or an outlet from what had become a torture chamber.

Mechanically they noted trees and shrubs which they were able to describe later in minute detail. Among those described by a survivor was one well-known and justly appreciated by the Indians. The bayonet shaped leaves fell off when old and the stalk looked so much like an overgrown cabbage stump that they named them "cabbage trees" but afterward learned they were a species of Yucca. Here, but unknown to them, they were in the midst of both food and water.

IT is noteworthy that the valley was "ground afire" to the Indians—not a valley of death. Did not 150 or more species of plant life succeed in overcoming the greatest handicaps with which nature can guard its desert solitude? Along with plants were insects, reptiles, and other forms of animal life intimately known to the Paiute. Without the special knowledge of the Paiute, however, the white pioneers were helpless.

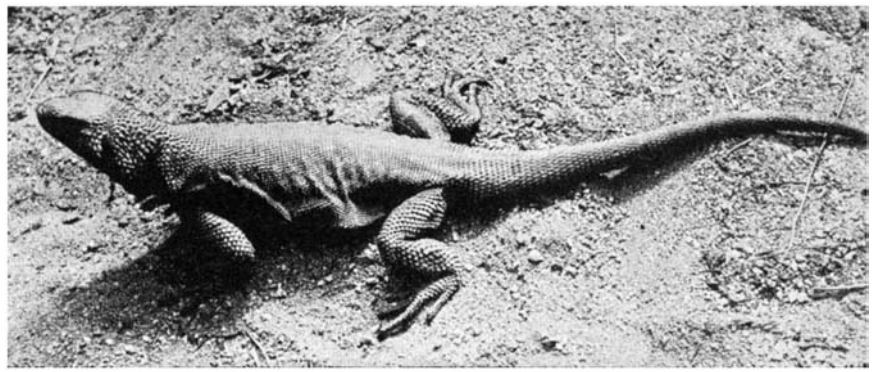
Their oxen, eaten raw or cooked in alkali water, was their only food. Flesh this was, to be sure, but emaciated to a degree that it was unbelievably lacking in fluids. The fiery furnace had proved too much for the oxen; one by one they had dropped in their tracks never to rise again.

There is a tale that Paiutes watched several of the party perish from a vantage point in the higher reaches of the Panamints. Fear prevented their coming to the white invaders' rescue; otherwise they could have offered food in abundance. Everything from soup to nuts is on the Paiute bill of fare. All essential vitamins are present in their food with sunshine vitamin "D" not lacking summer or winter.

Compare a possible modern hotel menu with one consisting entirely of

Paiute substitutes, as set forth on this page. After this feast the Paiute would break no law by becoming mildly inebriated by chewing the seeds of the jimsonweed; Volstead neglected to include reference to that plant. Even this solace remained unknown to the Forty-Niners.

The possibilities of the desert as a provider are by no means exhausted with the menu below. What epicurean adventures await us palefaces in the seeds of the sand grass, devil's pincushion, evening primrose, or joint fire; in the pods of the screw-bean, buds of the joshua tree, berries of the boxthorn or fruit of the prickly-pear! The Forty-Niners brushed most of these aside in their mad rush to find a pass leading out of the valley. Maple sugar is always a welcome change in our otherwise monotonous, one sugar diet. Would we discover sugar from the reed, mesquite, and pine bark equally interesting?



The chuckwalla or edible lizard that ekes out a precarious existence in our western deserts. Many people proclaim their meat to be tasty and tender

MODERN HOTEL MENU WITH DEATH VALLEY SUBSTITUTES

Tomato Juice Cocktail	Cholla Cactus Cocktail
Imported Beluga Caviar	Dried Caterpillars
Pickled Walnuts	Piñon Nuts
Veloute of Celery	Chia Soup
Hearts of Lettuce Salad	Cactus Hearts Salad
Plain Spinach	Salt Plant Greens
Baby Pheasant	Fillet of Chuckwalla
French, Danish, or Vienna Pastry	Imported Nevada Roasted Mescal
Malaga, Seedless, or Tokay Grapes	Yucca Fruit
Bread and Butter	Mesquite Cakes (Baked in Sun)

Many miles from the nearest water hole the Indian does very well with the liquid emanating from the pulpy center of cactus tops. There are several species of cacti which supply a palatable drink but their forbidding exterior did not appear sufficiently inviting to the thirsty gold seekers.

The Paiute hors d'oeuvre of dried caterpillars might not appeal to the more fastidious. According to W. C. Orchard of the Museum of the American Indian, they were sampled by a young lady at the Museum. Apparently she had no complaint to make regarding their taste. Next day, however, when told the full extent of her gastronomic adventure, she became violently ill and was unable to appear at the office.

Dishes from the desert, in Museum of the American Indian. *Left to right, top row:* Yucca fruit; screw-beans; roasted mescal. *Center:* Chia blossoms; cactus buds; piñon nuts. *Lower:* Fan palm berries; dried caterpillars; salt plant green

The next item on the menu requires no introduction; the piñon or Indian nut is now fairly well known throughout the country.

Meal pounded out from the seeds of chia blossoms makes an excellent soup. Most anything edible is thrown in, together with a piece of chuckwalla or rabbit, to make the soup thick and nutritious.

Cactus hearts greet tourists to the southwest in the form of cactus candy.

Salt plant greens or any other non-poisonous young green plant is used as soon as it appears above ground.

Chuckwalla or edible lizard has been sampled by many desert tanned white men prospecting on a "shoestring" in strange out-of-the-way places in our west. One old prospector or "desert rat" encountered in Rawhide, Nevada, ten years after that once flourishing town had been forgotten, assured the writer that its flesh was tender and good eating. Luckily for him the valley just below Rawhide is literally alive with chuckwallas.

DURING the recent lead-silver strike at Leadfield, on the edge of Death Valley, men engaged on the construction of a highway to the railroad at Beatty were fed a tasty stew of tender meat. Two men quit when they discovered that the tasty stew was made from "them damn lizards." All evidence appears to indicate a delectable dish in the form of the lowly chuckwalla. The Forty-Niners disdained these little creatures in their scheme of things.

It is quite another story with roasted mescal or agave, officials of the Indian Museum assure us. Even the most fastidious would concede this to be an exquisitely tasty morsel. Mescal resembles the century plant. It is steamed in pits partly filled with hot stones before it is ready to eat. It can also be roasted. It has a jelly-like appearance and is sweet.

Versed in Indian lore it would have remained for others to name the unique valley. Certainly it was destined to be Death Valley as the many, all too many, bleached bones attest. Death Valley in the midst of life!

MODERN ALCHEMY:

Photographing the Birth of an Atom

By WILLIAM D. HARKINS, Ph. D.
Professor of Physical Chemistry at the University of Chicago

WHAT would be the effect upon business, upon industry, and upon human life if mercury could be cheaply changed into gold; if the energy of 10,000 tons of coal could be purchased for one cent?

Neither of these marvels may come to pass, but scientists of the present day believe they know what material changes would have to occur in order to accomplish them. To understand this modern alchemy it is necessary to know

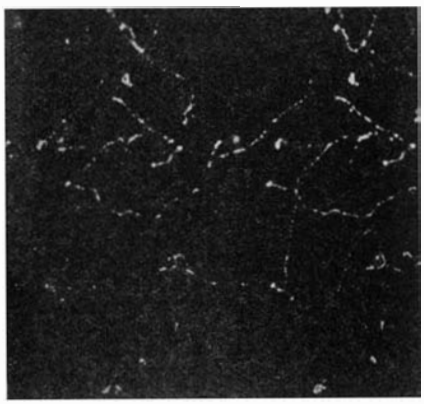


Figure 1: **Tracks of electrons in air, photographed by C. T. R. Wilson**

only a very little concerning the primary and simple facts which are fundamental in relation to the nature of matter.

For thousands of years the problems which have been of most interest to thinking men have been those which concern the nature of the soul and the nature of matter. The 92 elements, of which iron, gold, mercury, and oxygen are examples, constitute the alphabet of the material world and of the materials with which we deal in every-day life, and of the behavior of the sun and stars as well.

The science of chemistry, which largely controls modern industry, owes much of its early development to the art of alchemy, which flourished during the middle ages, the principal object of which was to convert one element into another. In particular the alchemists desired most to transform other elements into gold. However, their ardent endeavors extending over many centuries were entirely unsuccessful with respect to their main object for they were never able at any time to accomplish a transmutation of elements.

We now know what to do to change mercury into gold, but we do not know the mechanical or physical means to employ in doing it. What needs to be done is to add an electron to the central core or nucleus of an atom of mercury, whereupon an atom of gold would be formed. However, this atom of gold might be extremely unstable, and might change almost immediately into some other type of atom.

Now electrons are very abundant and very cheap; they exist everywhere around us, and it is easily possible to capture them or to photograph their tracks. Thus Figure 1 shows the dotted tracks of fast electrons as they pass through air. If a metal plate charged with positive electricity is put near the path of the electron, then the track of the electron is found to be bent toward the plate. If the plate is negative the track bends away from it. From this we know that the electron carries a negative electrical charge.

A MOVING atom, on the other hand, is not ordinarily deflected by an electrical charge, and this shows that it is electrically neutral. Since an atom contains electrons, this indicates that positive charges of electricity must also be present. The track of a positive particle or proton ejected by an atom is shown in Figure 2. While an electron gives a dotted track, a proton gives a continuous or nearly continuous track, which is characterized by its extreme fineness.

It is now known that all atoms are built of protons and electrons and, since the charges of these particles are equal in magnitude and opposite in sign, the number of electrons in any atom is the same as the number of protons. For example, the lightest of known atoms, that of hydrogen, consists of one proton and one electron; the heaviest atom, that of uranium, consists of 238 protons and 238 electrons.

The proton which made the track shown in Figure 2 moved through the air chamber in which it was photographed at an initial velocity 40,000 times that of a rifle bullet. When this proton slowed down to low speed it picked up an electron and became a hydrogen atom. Here we find an important relation: Atoms which move at extremely high speeds through any material are always found to be positively charged. This indicates that if a neutral atom is given a high speed, some of its electrons are brushed off as it passes through a gas or a solid. From this we might gain the idea that electrons constitute the outside of the atom, which seems to be true. This outside is made of negative electrons, which act like clothes to cover the more deeply buried positive part of the atom.

To understand atoms it is necessary to try still another experiment. Shoot an electron and also a proton past a plate charged with positive electricity. Both particles are found to be deflected —the electron very greatly and the proton very little. From this experiment we find, assuming that we already know that the charges of the particles are

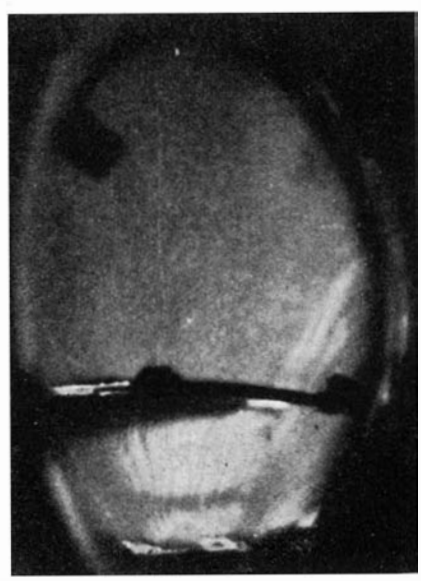


Figure 2: **The track of a proton or nucleus of a hydrogen atom (fine vertical track above the horizontal sheet of aluminum). The many tracks below the sheet of aluminum are due to alpha particles, which are the nuclei of helium atoms. The helium nuclei penetrate the lower edge of the aluminum sheet at velocities of 10,000 miles per second. The proton is formed by the disintegration of the nucleus of an aluminum atom which happens to be hit by a helium nucleus**

equal, that the mass or weight of the proton is much greater than that of the electron, for the greater the mass of a particle the less easy it is to deflect it. More accurate experiments show that it is about 2000 times heavier (more exactly, 1845 times).

We have just found that the outside of the atom is made up of electrons of small mass, while inside the atom are the much heavier protons. Thus the mass of the innermost part of the atom (nucleus) should be much greater than that of its outer layer.

By the use of a very beautiful theory of the viscosity of a gas it has been possible to calculate the diameter of an atom of the gas. It is found that the dimensions are such that it takes about 100,000,000 atoms to make a single line of atoms one inch long. The number of atoms in a cubic inch of gas is well known and is 160 billion billion under ordinary conditions.

The experiment next to be described shows that a very fast atom is not deflected when it meets another atom, but passes directly through it.

An extremely minute amount of a substance, much like radium, called thorium C, is put on the end of a brass screw, set into the wall of a glass chamber which forms the central part of the apparatus (Figure 3) used to make the traeks visible. This material shoots off atoms of helium into the air around it at a velocity 24,000 times that of a rifle bullet, or at 12,000 miles a second. Each helium atom travels about three and one half inches through the air and gives the tracks shown in Figure 4. These tracks are straight lines. Now the number of atoms in the air present in the chamber was so great

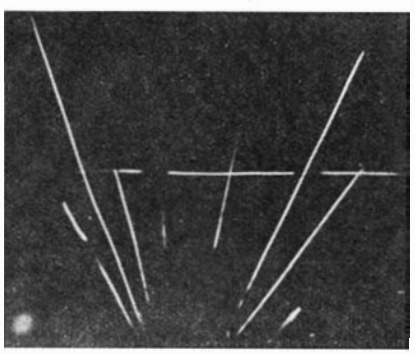


Figure 4: **Tracks of fast helium atoms (in air)—straight lines**

that each helium atom must have passed through more than 100,000 atoms of the air, without being deflected by any of these encounters.

The atoms in the air collide with each other very frequently—about 5,000,000,000 collisions per second for each atom—at speeds of about one fourth mile per second. At such speeds the atoms rebound from each other just as billiard balls do at lower speeds. At 10,000 miles per second, however, as has just been shown, the atoms pass through each other, and are not deflected. So far as the direction of their paths is concerned they go on undisturbed, just as though there had been no meeting.

It must not be assumed that two atoms can thus pass through each other without any mutual disturbance. Electrons are torn out of the atoms as they pass through each other, and it is these electrons and the atomic residues (ions) left behind which make the track of the moving atom visible.

While fast atoms readily pass through each other as if most of each atom were empty space, it is found that for every hundred million atoms of air through which a helium atom shoots, there is, however, a single sharp collision. The question which arises is: What is it that collides? Now it has been shown earlier that the outside of each atom consists of extremely ethereal electrons, while the much more dense protons are inside.

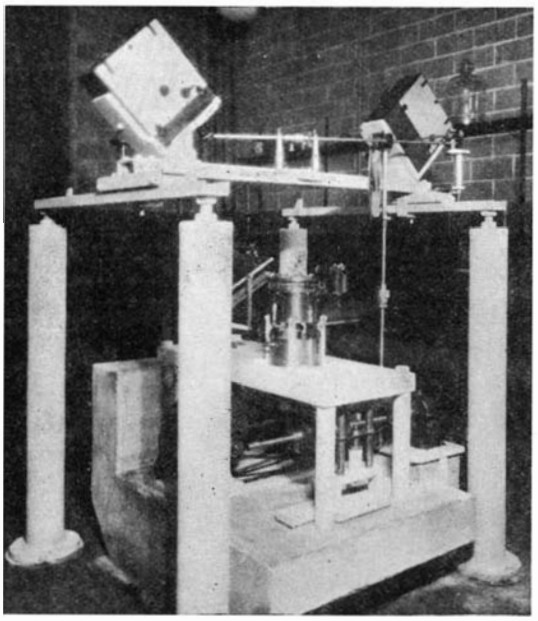


Figure 3: **Apparatus used at Kent Chemical Laboratory, University of Chicago, for the photography of tracks of protons and of the nuclei of atoms of helium, nitrogen, oxygen, argon, and so on, and particularly of groups of tracks which show the synthesis and disintegration of atoms. Cloud chamber in center**

How large is this "inside" or nucleus of the atom? Since slow atoms give collisions at every impact, while fast atoms give collisions only one hundred-millionth as often, it is evident that the diameter of the nucleus of the atom is only one ten-thousandth that of the whole atom.

THE nucleus plays the same part in the atom that the sun plays in the solar system. The nucleus contains all of the mass of the atom—except that a minute part, about one four-thousandth of the mass, is in the outer, or planetary electrons.

Atom nuclei are so small and so dense that all of them in the actual material of all the battleships on earth could be put into a lady's thimble, provided the nuclei could be packed tightly together. The density of such material would be about a million million times greater than the highest density known on earth.

No such high density is known anywhere in the Universe, but astronomers believe that they have found stars with densities as high as 50,000 times that of water. Such densities are supposed to be caused by the partial stripping of the outer electrons off the atoms, which allows them to get closer together.

Collisions of fast atoms (1000 miles a second or more) occur only when their nuclei collide. The first photograph of an atomic collision (Figure 5) was obtained in 1922 by R. W. Ryan and the writer, but Shimizen had photographed a "carrom" (Figure 6) between two nuclei a little earlier.

The collision is between the nuclei of the atoms rather than between atoms and occurs deep inside the atom, at its center. Since both nuclei are positively charged it may be assumed that in a "carrom" the nuclei do not actually meet each other, but are thrown apart by repulsion before they meet.

There is evidence that in some, if not all, of the sharp collisions the nuclei come in contact, since in certain collisions the nuclei are found actually to unite with each other.

The word atom means indivisible. Strangely enough, when we comb our hair or rub glass with silk we are taking electrons out of or adding them to atoms. Even a few of the 110 volts of our lighting circuit are powerful enough to remove electrons from atoms. However when outer electrons are torn off from an atom we do not say that it is disintegrated, or smashed, but say only that it is "ionized," that is, charged with electricity. An atom which has thus lost outer electrons easily picks up other electrons from the space around it, and thus becomes fully recuperated.

This is not so if the nucleus is affected. If something is torn from the nucleus the atom is said to have disintegrated. For example, Figure 7 was obtained as a photograph from air. In this air one atom of an extremely rare gaseous constituent of air, called thoron, happened to be present—one lone atom among all the thousand billion billion other atoms used in the experiment.

This heavy atom suddenly disintegrated, shooting off a single helium atom at a speed of some 1000 miles per second, while the remainder of the atom, a newly born heavy atom of polonium (thorium A) shoots in another direction at about one fifteenth of this velocity. Almost immediately this atom of polonium also explodes, shooting off a newly born heavy atom of lead in one direction and

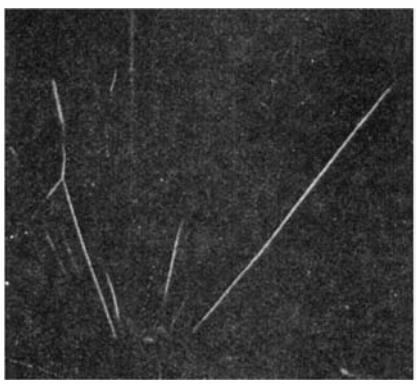


Figure 5: **First atomic collision to be photographed. A helium atom strikes a nitrogen atom, and rebounds downward (left of figure), while nitrogen atom shoots upward**

another newly born atom of helium which goes in the opposite direction. This all occurs in the tenth of a second just before the event is photographed. Thus in this short interval one of the rarest of known atoms has been transmuted into an atom of the ordinary substance, lead, and into two helium atoms.

It is very easy thus to obtain photographs of the disintegration of very heavy atoms whose nuclei are so unstable that they disintegrate spontaneously.

Suppose that instead of putting into the experimental chamber a single atom of thoron (along with other atoms) we had used a single light atom such as that of nitrogen, which is also present in air. During a wait of a billion billion years the photographer would not be able to secure a single photograph such as that of Figure 5, since the nitrogen atom is very stable, and would not be likely to disintegrate within such a period of time.

The great stability of the nucleus of a light atom is shown by the fact that we have obtained a number of photographs in which the atom nucleus was hit by a helium nucleus moving at 20,000 times the velocity of a rifle bullet. Both nuclei rebounded from each other, but neither was broken apart! What other known material would exist unbroken through such a terrific impact?

Such experiments may seem to show that light atom nuclei are atomic in the sense that they cannot be broken apart by terrific impacts. However, a remarkable and extremely simple experiment carried out by Sir Ernest Rutherford in 1920 shows that this is not entirely correct.

Very fast atomic projectiles are easily detected by an extremely simple method due to Sir William Crookes. He showed that if a paper or a piece of metal is coated with a certain zinc salt (zinc sulfide) each single atom which hits the surface of the salt gives a splash of light or scintillation which exists for only a moment but is easily visible in a dark room.

NOW if protons (hydrogen nuclei) are struck by the fastest helium atoms (alpha particles) they may travel through air and give rise to scintillations, even if the screen is a foot from the point where the hydrogen nucleus was struck. At greater distances no scintillations appear, since the hydrogen nuclei have not enough velocity to carry them farther. However, if nitrogen or certain other atoms are bombarded, atomic projectiles are produced which move forward and produce scintillations with the screen as much as three and one half feet away. No nuclei heavier than hydrogen can shoot so far, so we have the remarkable fact that when nitrogen nuclei are bombarded they may give off hydrogen nuclei which shoot several times as far as if hydrogen itself had been bombarded. The obvious inference is that the hydrogen nuclei are produced by the disruption of the nitrogen nucleus, and gain their extremely high velocity from the energy of the explosion.

Furthermore, this idea is confirmed, in that if helium nuclei are shot into hydrogen, no hydrogen atoms come off backward, but if nitrogen or aluminium is bombarded, hydrogen nuclei shoot backward to distances as great as two and one half feet. Thus there is excellent evidence that light weight atoms may be disintegrated by bombardment.

SEVERAL years before this the writer had shown that atoms on whose nuclei the number of positive charges is even, are much more stable than those for which the number is odd. This number is called the atomic number. Thus atoms of atomic number 6, 8, 10, 12, 14, and so on, are much more stable and very much more abundant on earth and in the sun and the stars than elements 7, 9, 11, 13, 15, and so on. In agreement with this, Rutherford found it much easier to disintegrate the odd than the even numbered atoms. Nature greatly prefers even numbers to odd numbers when she builds atoms. Thus gold is rare because its atomic number is odd (79), as well as because it is a heavy element.

It has been shown that the heaviest atoms break up spontaneously, and that light atoms of odd number may either be disintegrated or may remain stable when they are struck at high speeds by other atoms.

Thus atoms can be made lighter. Can atoms be made to grow heavier? Is it possible to synthesize atoms?

In 1915 the writer proposed the theory that the atoms are built up in steps, and that one of these steps is related to the addition of helium atoms. Thus an oxygen atom would be produced if the nucleus of a carbon atom were to be bombarded by the nucleus of a helium atom, provided the two were to unite. It was assumed that hydrogen nuclei (protons) and electrons could also add themselves to an atomic nucleus, but that the highest stability arises when the composition of an atom is that of a whole number of helium atoms. Since the positive charge of the proton is only half that of helium, it is probable that the addition of a proton occurs much more often than that of a helium nucleus.

The nucleus of an atom of iron consists of 56 protons or hydrogen nuclei and of 30 electrons. According to the writer's theory there are a considerable number of steps in the building of an atom of iron. It could be built up if step by step 13 helium nuclei and two electrons, or if 52 protons and 28 electrons, were to add on to what in the beginning is the nucleus of an atom of helium. Presumably such a process would take considerable time—much more than billions of years under the conditions existent on earth. In this theory one relatively simple synthesis was assumed to be that in one or more steps a helium nucleus is formed from four protons and two electrons.

The only radically different theory of

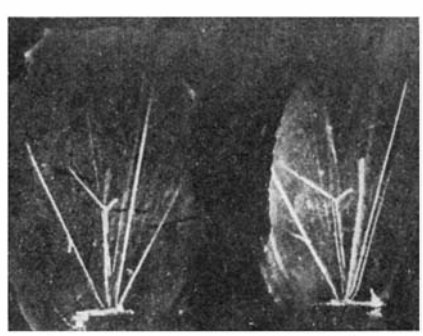


Figure 6: **A carrom between atoms. A fast helium atom strikes an atom of argon. (Actually the two nuclei approach one another only closely)**

atom building is that of Millikan. He rejects the step-by-step idea of atom building, and assumes that the 56 protons and 30 electrons, 86 bodies in all, meet and unite so quickly as to give off a single impulse or quantum of radiation, which would give not more than a millionth of a millionth of a second for all of this to happen. For the birth of a uranium atom 238 protons and 146 elec-

trons must meet and unite in this same small period of time. The extremely great difficulty which this theory has to meet is to explain how 238 protons and 146 electrons can collect before they unite in a volume only a millionth of a millionth of the volume of an atom, which is itself almost inconceivably minute.

In 1921 the writer, with the able assistance of R. W. Ryan, began to photograph the extremely rare collisions of the fastest helium nuclei with the nuclei of nitrogen and other atoms. Upon the publication of the method in 1923 it was adopted in Cambridge, England. Both in Cambridge and in Chicago very remarkable and very rare photographs were obtained.

THESE showed conclusively that in some collisions the helium nucleus and the nitrogen nucleus unite and form a heavier nucleus, that of fluorine. This is, under the conditions, very unstable and almost simultaneously shoots off a fast hydrogen nucleus and is thus converted into oxygen (Figure 8).

Thus a heavier atom is formed from a lighter one. This is the first and only synthesis or building of an atom ever accomplished, and gives entirely direct evidence that atoms may be built in steps.

The process is shown in the accompanying table, Figure 9.

One of the remarkable features of this synthesis is that the oxygen produced is not ordinary oxygen of weight 16 but a heavier atom, formerly unknown, of weight 17. Later spectroscopic investigations have shown that the ordinary oxygen of the air contains one eighthieth of one percent of this previously unsuspected rare variety known as an isotope of oxygen.

Figure 7: **A remarkable photograph of the natural disintegration of atoms, described in the text. The vertical part of what looks like a check mark is a helium atom just shot out of an atom of thorium emanation. Fragment left is an atom of lead and this has a very short track—a tiny stub at the point. Right-hand side of check is track of helium atom. Other check is same event taken at right angles**

The importance of atom building lies not alone in the transformation of the material, but in the enormous energy changes involved. The best example of this is given the well known calculation of Wilson and the writer by the use of the special relativity theory of Einstein. Thus it was shown by us that the union of one pound of hydrogen to give helium or any heavier element would give as much energy as the combustion of 10,000 tons of coal. So, if this reaction could be made a rapid one, coal would become practically worthless as a source of energy, since a pound of hydrogen costs less than a cent.

It is not improbable, however, that this synthesis is extremely slow, and while it is probably an important (possibly the most important) source of heat for the sun and stars, where high temperatures and enormous amounts of material are involved, there is no indication at present that it will ever give a source of energy for industrial purposes under the conditions existent on earth.

Strangely enough, atomic syntheses which have not been accomplished are better known than the single one which has been proved successful. The idea is widely prevalent that mercury has been transformed into gold in a mercury-arc lamp. The nucleus of a mercury atom has a positive charge of 80, which would be reduced to 79 provided a negative electron could be added to the nucleus. Now any atom for which this charge is 79 is an atom of gold. Work in Berlin by Miethe seemed to indicate that in a mercury-arc lamp, in which electrons are plentiful, gold is produced. However, a repetition of the work by Haber in Berlin and by workers in Pasadena, showed that no gold is produced. The electrons which strike the atoms of mercury in an arc lamp are somewhat slow, so Kay and the writer used an X-ray tube in which the energy per electron was about 14,000 times greater. Even with this larger amount of energy applied to the electrons, no gold was produced.

Thus far, in all the work which has been done, in our laboratory only four atoms of oxygen have been synthesized, and to show this it has been necessary to take more than 100,000 photographs.

Instead of following Rutherford's use of the Crooke's scintillation method, we have used the more elegant and laborious cloud track method of C. T. R. Wilson. A fast helium nucleus is shot through nitrogen which is saturated with water vapor. This ionizes (electrifies) the atoms which lie directly in the path of the particle. The gas is then quickly cooled by expansion, and a droplet of water deposits on each (electrified) ion. The track of the nucleus is thus transformed into a line of cloud of the same constitution as a rain cloud. This cloud line is made visible by illumination by a powerful light, and is immediately photographed by a motion picture machine.

According to the theory of the writer, atomic nuclei are built in steps by the addition of particles of low charge, such as protons $(p)^+$, electrons $(e)^-$, alpha particles $(p_4e_2)^{++}$, neutrons (pe), if they exist, and isohydrogen nuclei $(p_2e)^+$.

The dream of the alchemists has been realized in that it has been found possible to transmute one element into another. Thus far, however, the process has been exceedingly slow and laborious, so there is, at present, no certainty that the enormous amounts of energy liberated in the building of atoms can be utilized directly in heating buildings or the production of power.

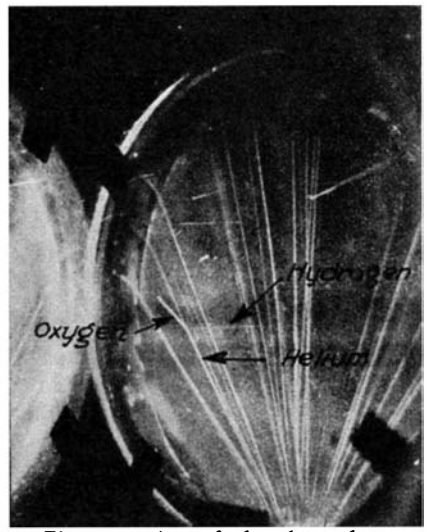


Figure 8: **At a fork, where three tracks meet, a fast moving helium atom strikes the nucleus of a nitrogen atom at velocity of 11,000 miles a second. Nucleus of a hydrogen atom (a proton, shown by faint track) shoots out at 19,000 miles a second, and newly synthesized atom at 2500 miles a second**

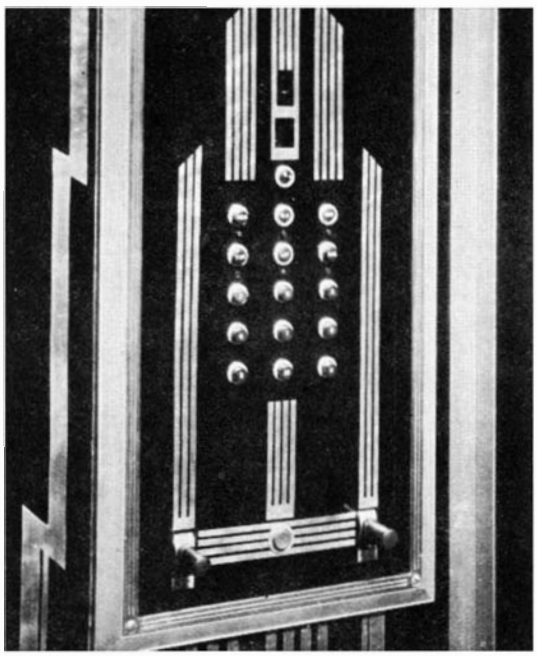
Atom of helium	+	Atom of nitrogen	→	Atom of oxygen	+	Atom of hydrogen
Mass = 4		Mass = 14		Mass = 17		Mass = 1
+ Charge = 2		+ Charge = 7		+ Charge = 8		+ Charge = 1
Velocity = 10,000 miles per second		Low velocity= about ½ mile per second		Velocity = 2500 miles per second		Velocity = 19,000 miles per second

Figure 9: **The synthesis of the building of an atom**

WHAT NEXT IN ELEVATOR ENGINEERING?

By H. D. JAMES
Consulting Engineer, Westinghouse Electric and Manufacturing Company

AS you enter a modern elevator, you call your floor and the operator pushes one of the buttons on a panel beside him. Then the door closes silently and the car starts. Within a very few seconds you are being shot upwards at the rate of from 800 to 1000 feet a minute, but so smooth is the acceleration and so easy the motion that you do not realize the speed at which you are traveling. Another thing you do not realize is that, due to the many safety devices that are guarding you, you are in one of the safest places in the world. When your floor is reached, the car slows down with unaltered smoothness; it stops with its floor exactly level with the floor of the building, and the door opens—all without the slightest effort on the part of the operator.



Close-up of the control station in the upper car of a dual elevator

This represents the best in elevator service now available to the public. What next? What improvements can be made in such service?

The truth of the matter is that we are getting very close to the ultimate—to the final word—in this particular type of vertical transportation. Aside from the fact that speeds will be increased somewhat where legally permissible, only a few further steps in the development of the present-day elevator system are now in sight.

One of these steps consists in the elimination of the operator. The operator's duties on a modern elevator are already very slight. He is no longer needed to make the proper stops, as the passengers can press the "stop" buttons for themselves, so that his chief function at present is to prevent injuries due to the premature closing of the doors as the passengers enter or leave the car. But he is being relieved of even this responsibility.

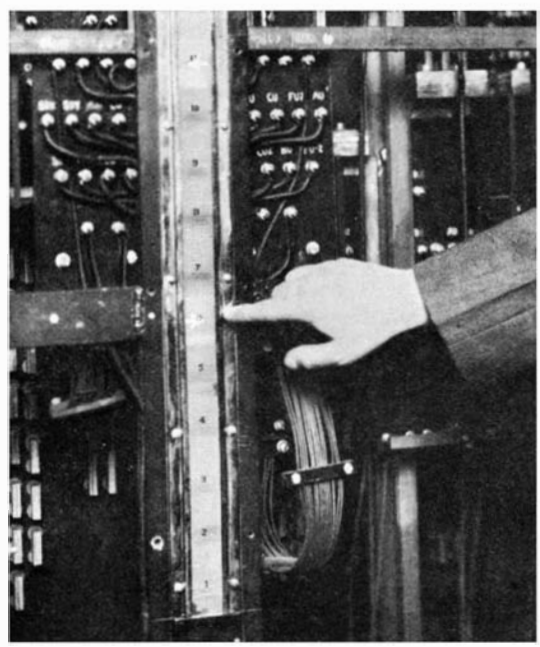
In some recent installations, several rays of light, each focused upon a photo-electric cell, span the doorway of the elevator car. When the car reaches a stopping point, as determined by the pressing of a "stop" button when the passenger entered the car, the doors open automatically and, after a short interval, close again *provided* all of the light rays are shining upon their respective "eyes". But if any of the beams are interrupted, the doors will stay open (or will open again if they have started to close), so that nothing can happen until the doorway is perfectly clear. Since the "electric eye" is more reliable than the human eye, this development brings the operatorless elevator well within the bounds of practicability.

Another step is to use double-decked elevator cars, thus increasing the capacity of each elevator shaft. This improvement has been in view for some time, but little headway has so far been made with it because, apparently, to use double-decked cars the intervals between each two floors served by an elevator had to be exactly the same, which rigidly limits the building's design and involves many architectural difficulties. Recently, however, a method has been worked out whereby the two parts of a double-decked car will automatically adjust themselves to the differences in the intervals between floors, thus making it possible to solve this particular problem.

WITH these two improvements actually in general use it would seem that perfection had about been attained and that no further radical developments were possible. But elevator engineers are not yet at the end of their resources.

"The present system of vertical transportation," they have reasoned, "is based on the idea that there can be only one car in each elevator shaftway. But isn't this a fallacy? Would a railroad insist upon operating only one train on each pair of rails? Why not apply railroad transportation principles to the elevator and operate more than one car in each shaftway?"

With this new conception, an entirely new field of development has been opened up for elevator engineering. Such sudden changes in the direction of progress are quite common in engineering history. A case in point is the electric lamp. The carbon-filament lamp was developed over a space of years until the very limit in illumination appeared to have been reached and further progress seemed out of the question. Then, suddenly, someone thought of using a metal of high melting point instead of carbon, and an entirely new era in electric lighting began.



An elevator control panel in a penthouse. The indicators show location of the elevator cars

What is unusual about the history of the electric elevator is that the name of the same man appears in both the earliest and the latest chapters. It is a high honor for any man to be a pioneer in an important new development, but it is a distinction gained by but few to be both a pioneer and later on a leader in revolutionizing the original conception.

FRANK J. SPRAGUE, who was the first to develop a practical electric street railway system and was also the inventor of the universally used multiple-unit method of electric train control, entered the elevator field in the latter part of the last century. At that time, the hydraulic elevator was supreme in this field, but Sprague developed two different types of electric elevators—the drum-type and the screw-type—which challenged the supremacy of the hydraulic type, and he was also instrumental in the development of the push-button type of elevator control. His elevator business was sold to the Otis Company, but some years later he became one of the foremost to advocate and develop a dual-elevator system, which provided for operation of two elevator cars in a single shaft, the first model being built over four years ago. The engineering problems involved in working out this idea were extremely difficult, but that they have been solved is shown by an installation of a dual elevator at the plant of the Westinghouse Electric and Manufacturing Company, at East Pittsburgh, Pennsylvania.

In the Westinghouse-Sprague dual elevator system, the upper of the two cars is an "express" car, and, in a 40-story building, for example, would serve the upper 20 floors. The lower car is a "local" car, and serves the lower group of floors. In operation, the express car takes on passengers at the street level and starts upwards. When it is well on its way, the local car loads and starts. In the present installation, the two cars are independent of each other, with but two restrictions, and can stop and start as desired; but they cannot run towards each other—that is, the upper car cannot descend while the lower car is ascending—nor, if one car stops, can the other approach it within a predetermined safe distance. Therefore, when the express car reaches the top of the shaft, it is held there automatically until the local car reaches its upper limit and starts to descend; and if either operator should attempt to run too close to the other car, his car is automatically stopped and held until the second car moves onward a safe distance. (See SCIENTIFIC AMERICAN, March, 1931.—*Editor*.)

THE use of the dual elevator system in a modern tower skyscraper makes possible a considerable saving in the space now needed for elevator shafts. In certain existing buildings, this saving represents a gain in rents amounting to as high as 100,000 dollars a year. Such a saving is well worth while, and undoubtedly buildings of the comparatively near future will be planned for dual elevator installations. We can also expect, as a further development, that dual elevators will eventually be operatorless and will have double-decked cars in many cases.

It is also apparently quite possible to operate "triple" elevators; that is, elevators with three cars per shaft; but the use of four cars per shaft seems to involve prohibitive complications. However, the "quadruple" elevator will probably never be needed, since by the time that point is reached in elevator development, a new scheme, which in a vague form is now flitting through the minds of some elevator engineers, may have assumed concrete form.

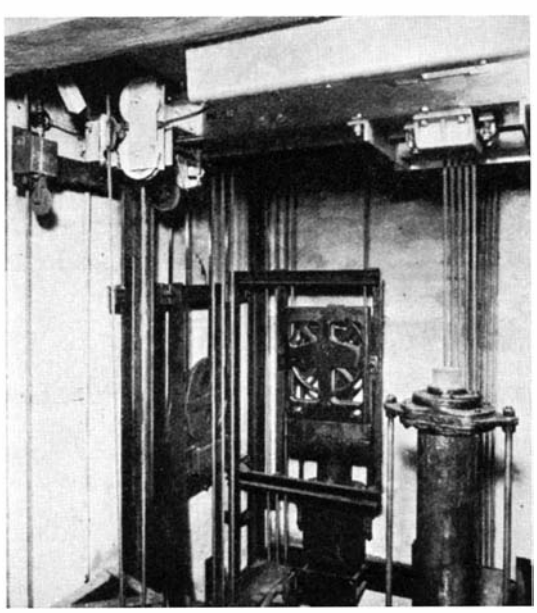
If this latest idea ever becomes a reality, each elevator car will go up in one shaft and down in another one. With this arrangement, a whole series of cars can be operated in the same shaftways, and maximum service with the minimum use of floor space can be provided.

But even the multiple, up-one-side-and-down-the-other elevator does not represent the limits of the thinking of progressive engineers. Much thought is being given to a totally new aspect of the vertical transportation problem.

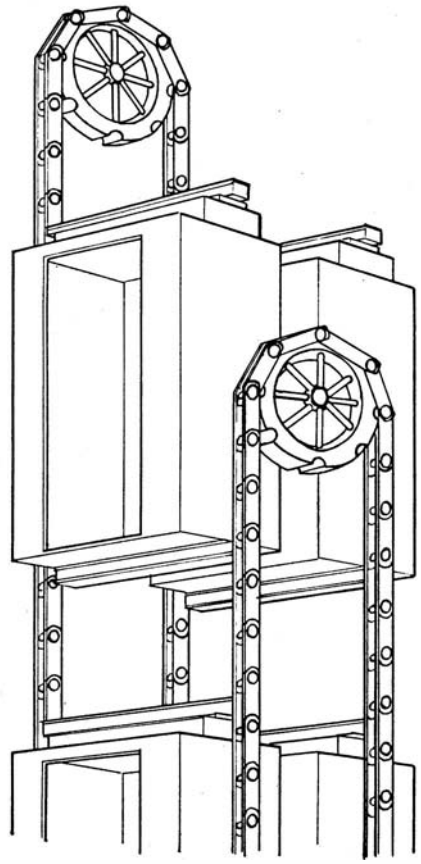
At present, every one who enters a building does so at the street level, so that the entire elevator traffic has to be carried past the lower floors. Obviously, quicker and better service could be obtained if the main passenger entrance to a building were at the "load center", which is about half way up. Each passenger would then be able to reach his destination with minimum travel.

Perhaps the best way to visualize the advantages of this system is to take the common case of an office dweller near the top of one building who wishes to reach an office near the top of a neighboring building. At present, he must go all the way down to the street and then all the way up to his point of call. Obviously, if all adjacent tall buildings were connected together by passageways at, say, the 20th floor level, much time and traveling would be saved.

Of course, the full development of such a plan lies far beyond the province of the elevator engineer, but it is through studies in his special field that its advantages become evident. Or, to put the matter somewhat differently, vertical transportation is becoming so very important in the life of our cities that it may in time cause fundamental changes in our city planning methods and it may even eventually form the basis of our traffic arrangements. At all events, the elevator engineer is looking well into the future and will be able to meet any demands that society may make upon him.



Pit and bottom of the lower car of the dual elevator, showing the safety buffers below



Is this the elevator of the future—a number of cars on endless chains?

INTER-GLACIAL MAN IN ENGLAND

By J. REID MOIR
President of the Prehistoric Society of East Anglia

WHEN it is realized that, since man's first appearance on this earth, four periods of extreme cold and the inexorable advance of great glaciers have overwhelmed his hunting grounds and camping sites in the northern hemisphere, we of the present day cannot but feel proud of our ancient and invincible ancestors. It is perhaps in East Anglia in England that there exists the most impressive evi-

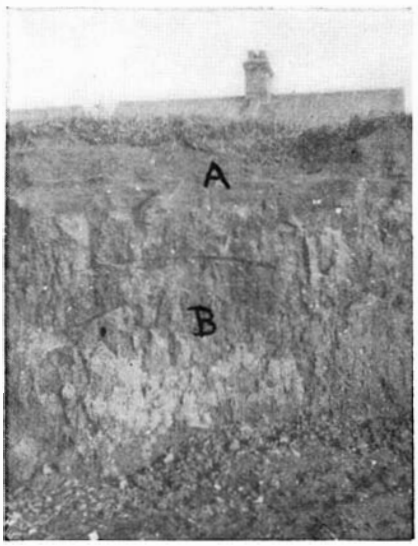


Figure 1: **Boulder clay, *B*, Hunstanton. *A*, Blown sand covering**

dence of man's relationship to the glacial epoch, for in this area have been found remains of the actual land surfaces where human beings lived, and these "floors" as they are called, in many cases, rest upon one deposit laid down by ice and one covered by material accumulated by the same all-powerful agency.

It appears that about 500,000 years ago (my friend Professor Osborn would, perhaps correctly, regard this estimate as much too low) when the remote Pliocene epoch was coming to a close, there set in a gradual sinking of the coast of eastern England. Upon the land surface thus slowly submerged there had lived for an unknown but probably very extended length of time, a race of people making remarkable beak-shaped and other forms of flint implements, and who also shaped bone and other materials for various purposes. Judging from these relics, which show beyond doubt that their makers had long passed the simian stage in their evolution, we may confidently assume that human life, even in those far distant days, though rudimentary, was becoming organized; and that in the warm climate then existing man had started well upon the path of progress which has led him to the advancement of today.

But the days of Pliocene man in England were numbered, for the ice of the first glaciation overwhelmed his long inhabited land surface, striated and broke many of the flint implements he had left behind him when he was compelled to trek south in search of warmth and game, and finally East Anglia went down beneath a refrigerated sea and was buried beneath a great thickness of marine deposits.

After the passage of a no doubt considerable interval of time eastern England was raised again above sea level, a very genial climate once more supervened, and our indomitable ancestors made their next appearance upon the English scene. But after a prolonged occupancy of East Anglia the northern ice once again advanced, and human beings suffered another banishment to southern regions where existence was possible. On two later occasions this great influx and exodus of game and ancient man took place, and it is of the men of the last inter-glacial times that I wish to write in this article.

A GREAT deal is known about these people, because in the caves of France and Spain considerable numbers of their flint implements have been found, together with remarkable examples of their artistic powers in carvings on bone and ivory, and wonderful paintings and engravings upon the walls of their dwelling places in the rocks. From the types of animal bones found with these people of Upper Paleolithic times—that is the latter part of the Old Stone Age—it is known that a very cold climate must have been then present in the south of France. The arctic conditions of the neighborhood are shown by the numerous bones of reindeer and other cold-loving animals discovered in the hearths and dwelling places of the ancient cave dwellers who, of a physical type like ourselves, withstood the rigors of the long winters and hunted and exercised their artistic abilities with outstanding success.

If cold and dreary conditions were present in the south of France about 30,000 years ago, what was happening in the far north in England at this epoch? Of one thing we can be sure and that is, the cold which would cause the reindeer to move so far south had given rise in more northerly regions to glaciers which in their progress over the land would sweep up and incorporate with the ground moraine then being formed, the flint implements and other relics of man lying either on or in the surface soil.

Let us test this hypothesis by taking a journey to a place called Hunstanton in Norfolk, where at certain places along the coast and in pits inland is to be seen a glacial boulder clay which was laid down in Upper Paleolithic times. Hunstanton is situated on the extreme northwest portion of Norfolk, and faces west across the Wash toward the opposite coast of Lincolnshire, where this boulder clay we are to examine also has been found. The deposit is a dark purplish brown and very tenacious clay (B, Figure 1) containing pebbles of chalk and examples of north British rocks, showing that the movement of the ice was from the north.

I have recently been giving a great deal of attention to the brown boulder

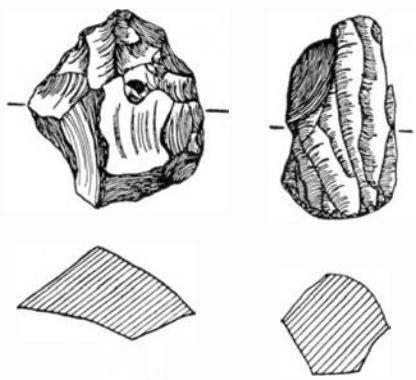


Figure 2: **Two flint artifacts from brown boulder clay at Hunstanton. *Left:* Steep edged scraper. *Right:* A core used as a source of flakes**

clay of Hunstanton and by careful and long continued search have discovered in it a number of flint implements of Upper Paleolithic types, probably referable to the later phase of Aurignacian times. The specimens are usually patinated a dense white or gray color, and many of them exhibit scratches upon their flaked surfaces caused by the pressure of the slowly moving ice.

The types of implements which have been found are shown in Figures 2 and 3 and it will be seen that cores, long flakes, well made scrapers, and burins or graving tools are represented. Sim-

ilar artifacts occur in the Aurignacian levels in the caves of France, but never before have they been discovered in a definite glacial boulder clay such as is present at Hunstanton. This discovery makes it certain that in Upper Paleolithic times in England, an ice sheet advanced as far south as Norfolk and, though much more feeble than its gigantic predecessors, was nevertheless of considerable strength and extent. Thus for the fourth time East Anglia was buried beneath a ponderous ice sheet and cold and desolation were once more supreme.

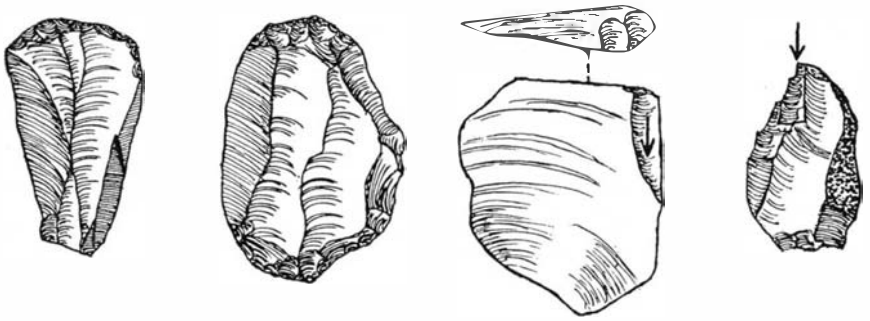


Figure 3: **More flint implements from Hunstanton. From left to right: A blade scraper; a double edged scraper; a burin or engraving tool; another burin**

BUT it is not only flint implements which have been found in the Hunstanton deposits, for in 1897 a much more exciting discovery came to light there. In the year mentioned a geologist, Trueman Tucker, was examining one of the large pits (still in existence) where the beds of the fourth glacial epoch are exposed, when he saw projecting from the side of the section and at a depth of about six feet from the surface, portions of a human skeleton. The finder was quick to notice that the human bones lay beneath a bleached and apparently unbroken layer of gravel (Figure 4) and accordingly left them in place for others to see and corroborate his opinion. The photograph here shown, which, with the human bones, has recently been acquired by the Ipswich Museum, shows the layer of bleached gravel passing over the level at which the skeleton was found. The exact place where the bones occurred is indicated on the photograph by two arrows, and Mr. Tucker and Sir Jonathan Hutchinson both concluded that no burial had taken place from the present land surface.

Now there is no question that the deposits in the pit at Hunstanton where this discovery was made represent beds laid down during the fourth glaciation. Further, I have found a number of Upper Paleolithic flint implements in these accumulations and because of this alone it must be regarded as possible that the human skeleton was buried on an ancient land surface prior to the last advance of the ice into Norfolk. The body had evidently been deposited face downward, and a study of the bones shows them to have belonged to a slender woman of medium height and of clearly *Homo sapiens* type. The bones themselves are of a brownish color and where broken they exhibit a chalk-like appearance. Such a condition is to be seen in bones of very varying ages, and cannot therefore in itself be regarded as a criterion of antiquity. The question is therefore as to whether Mr. Tucker and his colleague were right in their opinion as to the unbroken nature of the strata overlying the Hunstanton woman.

Mr. Tucker published a paper on his find in the *Transactions* of the Leicester Philosophical & Literary Society but this account, though carefully compiled, does not add anything to the facts set out in the present article. It is not possible now to say with certainty that Mr. Tucker's opinion was without question correct. But in view of the discoveries of flint implements which have now been made in the brown boulder clay and associated deposits, together with the evidence afforded by the photograph itself (taken at the time of the find), it may be said to be probable that the human bones are of Upper Paleolithic age and represent one of the great race of people whose sojourn in the south of France has resulted in enabling archeologists to write one of the most fascinating chapters in the past history of man.

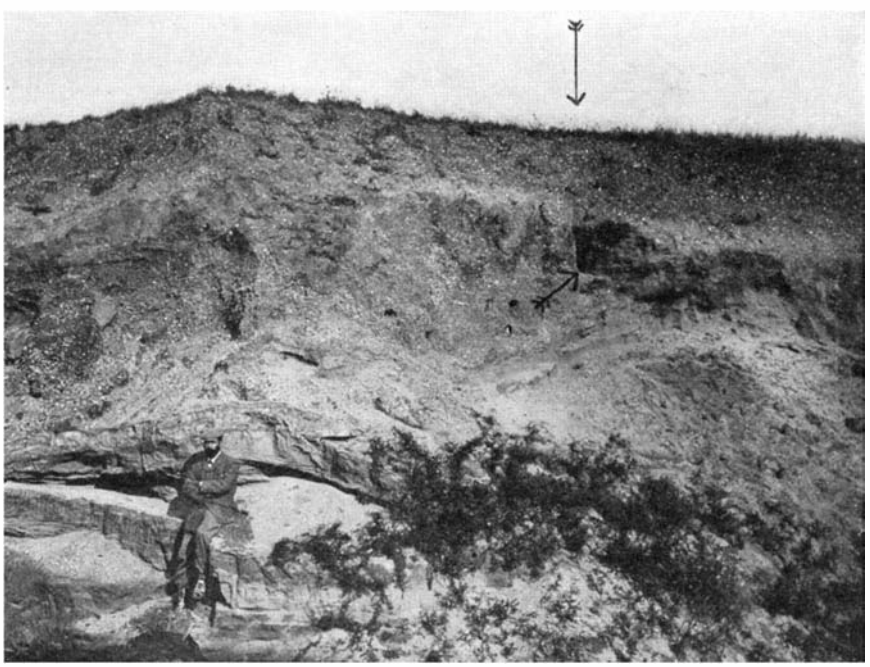
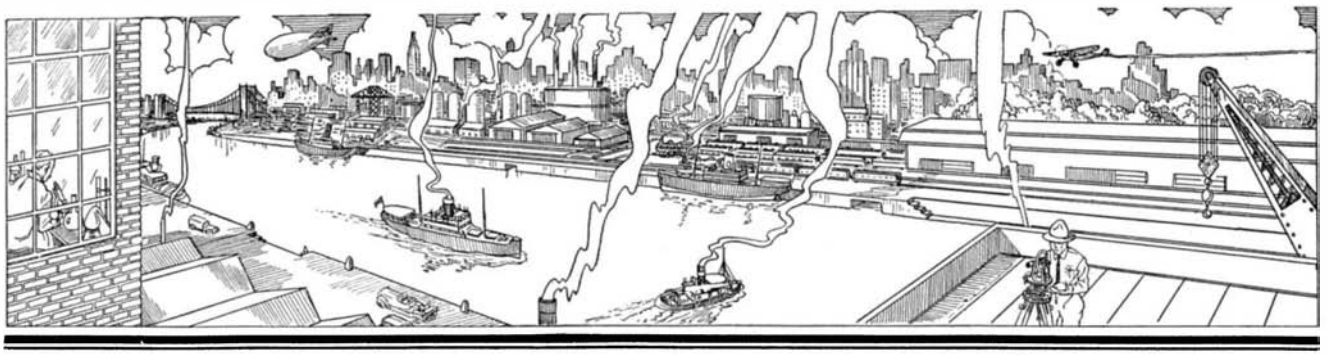


Figure 4: **Section of pit in fourth glacial beds, showing the spot (marked with two arrows) where the human skeleton was found, also bleached gravel band**

FROM the evidence in the French caves and from that collected by Professor Absolon of Brünn, Czecho-Slovakia, we know that in Upper Paleolithic times the dead were buried with care and ceremony. There is, therefore, no reason why the Hunstanton woman should not have been laid in a shallow grave in the land surface then existing. As the cold continued to increase the soil would gradually freeze to a considerable depth, and in such a condition would be able to offer resistance (as we know it did in certain other places) to the erosive effect of moving ice. Such a state of affairs would account for the preservation of a human skeleton beneath a glacial deposit, but admittedly our knowledge of such things is most slender and further discoveries of a similar nature to that at Hunstanton must be made before any final conclusions can be drawn about them.

To those who have dug out skeletons certainly buried within the last 2000 years it has become clear that, while in some cases the shape of the grave can still be traced, in others no such signs are present. But in my experience I have never seen a modern grave cut through a definite layer of bleached gravel, as at Hunstanton, and no evidence of the digging remain observable. In any case, these interesting bones are now in safe keeping in the Ipswich Museum in the east of England.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

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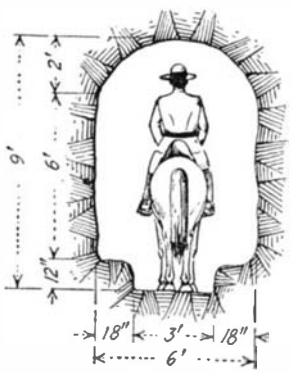
A Tunnel for Saddle Horses

A TUNNEL 183 feet long for saddle horses and hikers is the unique feature that made practicable a new trail to shorten the distance from Many Glacier Hotel to Waterton Lake in Glacier National Park. The improvement project provides an easier and more interesting route for the tourist and shortens the trail time between these two points by approximately



Dimensions of saddle horse tunnel

three hours. In addition, the new trail is 10 miles shorter than the old one. The tunnel is at elevation 7500 and pierces the solid rock ridge known as Ptarmigan Wall. Principal construction difficulties involved the transportation of materials and supplies for eight miles by pack animals.

In cross-section the tunnel is six feet wide and nine feet high and has an arched roof. The floor consists of a three-foot treadway for horses and mules in the center of the floor with an 18-inch rock bench one foot higher on each side. This arrangement of the floor provides against the rubbing of either rider or pack against the rock sides and also permits mounting or dismounting if necessary in the tunnel without difficulty. The bore has a 3.75 percent grade toward the north portal.

Driving was done from both portals, using jackhammers and a compressor. Air was supplied to the north portal, which is located on a precipitous rock face, by a 1½-inch air hose over the top of the ridge, which was about 120 feet above the tunnel grade. The rock is a fine-grained limestone and stands without support.

An interesting speculation during the progress of the work was whether horses could be induced to travel through the tunnel. Many prophesied that this was impossible, but Charles E. Randels, Glacier National Park engineer, rode a saddle horse through the tunnel shortly after completion, and the animal seemed totally indifferent to surroundings. It had also been predicted that the tunnel would prove particularly windy because of the strong winds that are customary along the northern face of the wall, but this has not been the case.

At the north portal there is an almost vertical drop of 1000 feet. The difficulties encountered in the construction of this approach are indicated in one of our illustrations. The eight-foot trail at this point is provided with a masonry guard-rail two feet high, which does not obscure the view but affords a protection for inexperienced riders. From the south portal the trail descends on a 15 percent grade to Ptarmigan Lake about 600 feet below and then flattens out and continues to Many Glacier Hotel. —George W. Reed, in *Engineering News-Record.*

Increase in Spider Bite Poisoning

POISONING from spider bites is increasing, Dr. Emil Bogen of Olive View, California, told members of the American College of Physicians recently. He estimated that there are hundreds and possibly thousands of cases of this condition in the United States every year. Nearly 400 cases of poisoning from the bite of the black widow spider have actually been reported and 20 cases of it were seen at a single Los Angeles hospital in the past year alone, he stated.

"Several death certificates were made out from this cause in California during the past year and several others reported in the newspapers and in personal communications," he said, "so that even though the mortality rate is very low, the possibility of fatal termination cannot be disregarded."

Arachnidism, which is the medical term for spider-bite poisoning, seems almost always to be due to the bite of the black widow, or shoebutton, spider, Dr. Bogen said. This spider may be easily recognized by the bright red patch, shaped roughly like an hour-glass, on its black, globular abdomen. Also it may be known by its web, which consists of straggly, uneven, coarse, sticky threads running in all directions in all three dimensions. It has none of the geometrical exactitude which gives to webs of certain other spiders their esthetic charm, Dr. Bogen said. The black widow spider is found over more than half the United States. People should be taught to recognize it and to destroy the spider, web, and eggs, to protect themselves from its poisonous bite, he urged.—*Science Service.*

Non-Poisonous Illuminating Gas

IN Europe the problem of de-poisoning illuminating gas by the elimination of its carbon monoxide content is receiving more serious consideration than on this side of the Atlantic, says *Industrial and Engineering Chemistry.* Refrigeration methods employed in separating carbon monoxide from nitrogen to be used for ammonia synthesis have been proposed for commercial gas purification, but the latest suggestion comes from Franz Fischer, of Berlin, who

Courtesy *Engineering News-Record*

The north approach trail to the saddle horse tunnel overlooks a 1000-foot drop protected by a rail

has demonstrated the ability of bacteria to convert a carbon monoxide-hydrogen mixture into methane. Whether this will ever become a commercial fact remains to be seen. Certainly it presents interesting possibilities.—*A. E. B.*

Dye Makes Photographic Plate Sensitive to Heat Rays

BEFORE a recent meeting of the optical Society of America, Dr. C. E. Kenneth Mees, of the Eastman Kodak Company, described how it was possible by means of a new dye to make plates sensitive to invisible heat rays. Xenocyanine is the name of the dye. Hitherto dicyanine and more recently neocyanine have been used to sensitize plates which have been especially useful in photographing from an airplane through thin mists. Infra-red and red rays are not scattered by mist as are ultra-violet rays.

With the aid of the new plates Drs. W. F. Meggers, C. C. Kiess, and C. J. Humphreys of the Bureau of Standards have found unsuspected lines in the spectra of 36 chemical elements. It is probable that in the stars elements will be discovered whose existence is not even suspected. There is even the hope that very dark stars that have not yet been detected by telescopic cameras may be photographed.—*A. E. B.*

Best Mosquito Biting Periods Are Revealed

FISHERMEN have long known when fish bite best. Now the periods when mosquitoes bite best, or worst, have been revealed by entomologists of the United States Department of Agriculture.

There are mosquitoes that bite only at night, others that bite only during the day, some that bite best at sunrise, and some best at sundown.

There is one grain of comfort for the mosquito-ridden citizen. Only the female mosquito bites. The male feeds on nectar and similar substances from plants.

Here are some mosquito "schedules":

The "rain barrel" or common mosquito bites only at night and can find her victims no matter how dark it is. When flying it makes that irritating singing noise which is familiar to everyone.

The yellow-fever mosquito usually bites close to the ground or attacks from behind, and often crawls under clothing to bite. It bites only in the daytime and is busiest early in the morning and late in the afternoon. It flies quietly. It will bite indoors all day.

The fresh-water marsh mosquito known under the scientific name *Mansonia*, a severe biter, is busiest just at dusk. It spends the day in the grass and will bite during the day if disturbed.

Malarial mosquitoes will bite all night long and sometimes, too, in the daytime, especially on dark days.

Plastic Surgery for Automobiles

PLASTIC surgery is now practiced on dented and battered automobile bodies. This method of repairing and concealing damage to metal bodies and fenders has been developed by engineers and metallurgists of the Fairmont Tool and Forging Company, of Cleveland.

By this method, it is not necessary to remove the upholstery of the sides or back of a car body, or take out the door-window regulator board and trim pad to repair a dent, as is the case when tools are used to "bump" out a depression in a metal body or door. Instead, dents are repaired from the outside by filling in with so-called body fill metal. The metal, rather than particular skill on the part of the repair man, is said to offer means of revolutionizing phases of automobile body repairing. The metal becomes plastic and remains so at low heat of a torch and can be applied to body parts in a vertical or a curved position without the metal running or dropping, as solder would. Blocks of wood are used to spread the heated metal, in much the same manner as putty is handled. It is pressed in while plastic.

After dents are filled flush to the surface, the metal is smoothed by a grinding wheel or a file and the damaged place is refinished. Repairs by this method take but a little time and cost less than when made by the use of tools.

Deep dent in automobile door being filled with new hot-plastic alloy

Pork Eaters

PORK has made up an increasing proportion of the Nation's meat diet in the last 10 years, says the United States Department of Agriculture. Fifty-two percent of all meat consumed in the United States last year came from hogs. The per capita consumption of pork last year was 69.6 pounds, compared with 69.3 in 1930. A record was established in 1923 and 1924, with 74.7 pounds per capita.

The Utility of Cane Sugar in Mortar

IN a paper presented before the Sugar Division of the American Chemical Society recently, Drs. Gerald J. Cox and John Metschl, of Mellon Institute of Industrial Research, Pittsburgh, discussed their current investigations of the value of cane sugar in strengthening lime-sand mortar. Such an application of sugar is not new, as it is believed that the Romans made use of such materials in mortars that have certainly stood the test of time. Also, in sugar-growing countries, it is known that sugar has been employed to increase the strength of mortar.

Drs. Cox and Metschl found that there is very good reason for the empirical practice of "sweetening" mortar. From their experiments they ascertained that mortar which contains sugar equal to 6 percent of the quick-lime content has a tensile strength 60 percent greater than that of mortar containing no sugar. Further tests are planned of compression strength, setting time, and durability as influenced by cane sugar.

The process of mixing the sugar with the mortar is quite simple. The sugar is dissolved in part of the gaging water and mixed in with the sand and lime. The sugar must not be mixed with the lime before slaking.

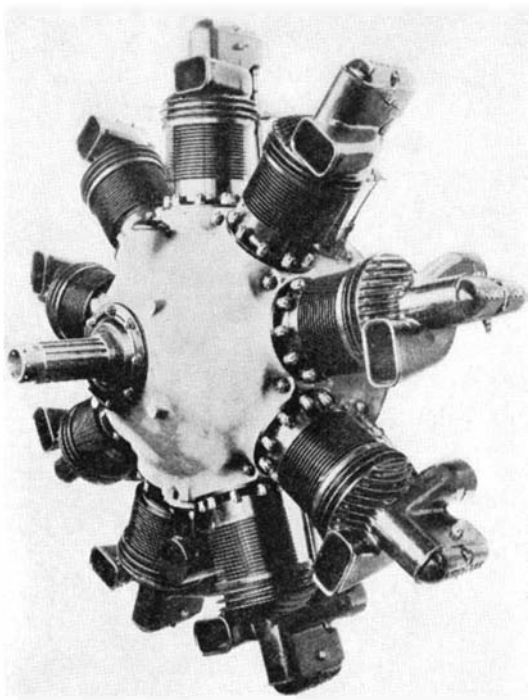
With the present low price of sugar, the five or six pounds of sugar necessary for

The replica of Federal Hall, where Washington was inaugurated President, which is being built in Bryant Park, New York City, as photographed from our offices about April 15. It will have been completed for the official New York celebration of the George Washington Bicentennial on April 30, having been begun on March 14. Sears, Roebuck and Company are the builders; Joseph Freedlander was the architect; and I. W. Doktorczyk was the designer of exterior decorations. Costing about 85,000 dollars, it is mainly of wood, 90 percent of which was factory cut; but it has some supporting steel under the cupola section. The trim is of pre-cast stone and the exterior is imitation stone finish

100 pounds of lime is only a small addition to the cost of laying bricks or plastering a wall.

A New Aircraft Diesel

IN a Diesel engine a heavy, non-inflammable, cheap fuel can be used, and the carbureter and ignition system eliminated. For aircraft use this offers obvious advantages from several standpoints.



Front view of the aircraft Diesel described here. On some of the cylinders, the exhaust manifold can be seen opening toward the rear

Among the difficulties to be met by aircraft engine designers were the reduction of the excessive weight which is generally associated with the Diesel type, and the problem of injecting fuel at the very high speeds of aircraft operation. Fuel control under the varying conditions of flight was also a difficult problem to solve.

Our engineers and designers have met these difficulties, and the future of the aircraft Diesel looks very promising at the moment. One of the most promising of the aircraft Diesels is the Guiberson, which after three years of research and experimentation has been approved by the Department of Commerce.

The Guiberson is a nine-cylinder, air-cooled engine. Rated at 185 horsepower, it weighs a total of 510 pounds, or 2¾ pounds per horsepower. This is not as light as is possible with the gasoline engine, but still very acceptable.

Of course the Guiberson is not novel in basic principle, since Dr. Diesel's original invention is now some 50 or 60 years old. The Diesel differs from the gasoline engine in the following way: In the gasoline engine, fuel and air are mixed together in the carbureter, sucked together into the combustion chamber, compressed, and then ignited by a spark. In the aircraft Diesel the air is drawn into the combustion chamber separately from the fuel and compressed separately. The fuel is then injected directly into the cylinder at the end of the compression stroke, and the injection is continued for a short part of the working stroke.

The pressure in the Diesel remains constant during combustion, while in the gasoline engine, combustion occurs at constant volume. The thermodynamic or constant pressure cycle of the Diesel is more efficient than that of the gasoline engine. Furthermore, in the gasoline engine there are strict limits to the compression pressures. Otherwise there may be pre-ignition and the consequent violent knock with which most motorists are acquainted. In the Diesel, the fuel is injected only on the working stroke. Therefore there is no limit (theoretically) to the pressure to which the air may be raised, and this also makes for higher efficiency in the thermodynamic cycle. Again, because the pressures may be raised to such a high point without danger of pre-ignition, the Diesel type can be made self-igniting. In other words the pressures of the air and of the injected fuel are so high, and the temperatures so high, that the fuel mixture ignites itself and the ignition system, with its attendant troubles, is not needed.

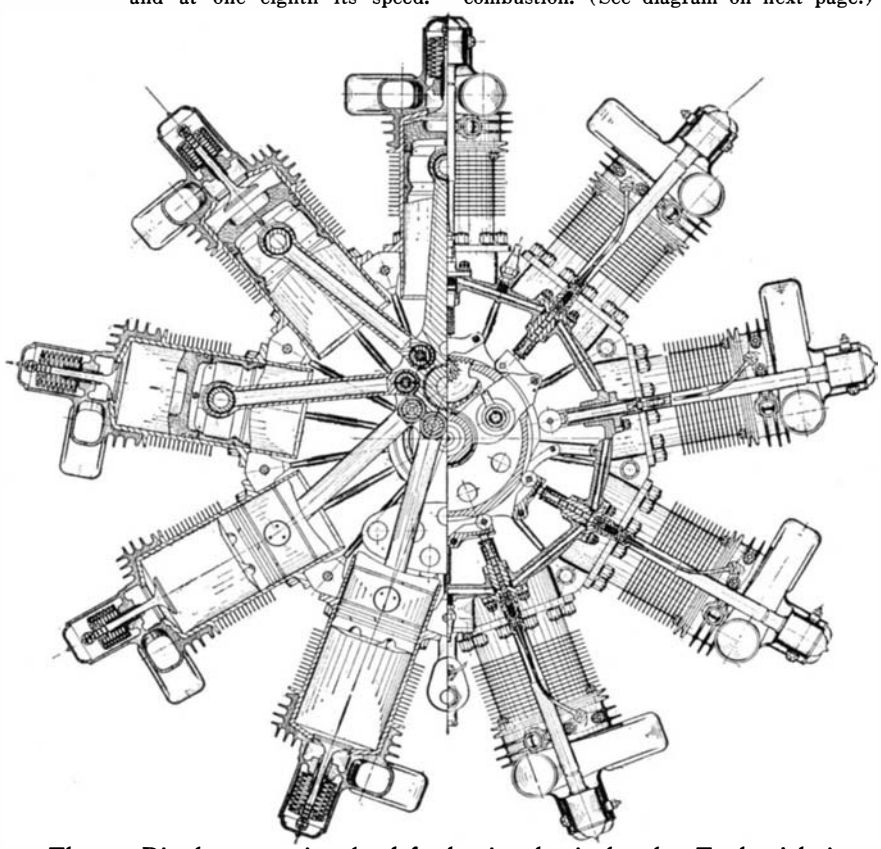
The Guiberson engineers deserve credit for the thoroughly workmanlike manner in which they have solved the problem of fuel injection and control.

The fuel cam is integral with the exhaust valve cam, and is mounted on the crankshaft in the rear. It is driven by an intermediate gear in a direction opposite to that of the crankshaft and at one eighth its speed. This fuel cam has four lobes which are so spaced as to give the proper time of injection. In the path of the fuel cam are nine pump levers, each lever having a roller which rides on the face of the cam. The fuel pumps are mounted in the rear crankcase in line with the pump lever, and the fuel is supplied through drilled ducts. The fuel cam raises the roller, and the roller, in turn, lifts the pump lever. The pump lever, working against the action of a powerful spring, raises the plunger inside the pump cylinder. The pressure within the pump cylinder rises instantaneously to very high values, and the check valve in the upper part of the pump rises against the action of a second spring. The fuel then passes through the check valve, into the pipe which leads to the back of the cylinder. The various pumps are interconnected at the inlet.

One of our diagrams shows the mechanism of the metering pump. To retard the injection and shorten the stroke it is only necessary to move the control plate to the left. Since the fuel cam is turning to the left, it is clear that the lever will then raise the pump later in the course of operations, and also give the pump a shorter stroke.

It will be readily agreed that pump operation and metering control have been made very simple and mechanical indeed.

The fuel nozzle is grooved so as to give the fuel a swirling motion and thus facilitate atomization. A single centrally located valve is used. The inlet manifold is sinuous, as shown, and is designed to cause the air to enter the cylinder in a whirling spiral on the suction stroke. When the fuel is admitted through the nozzle at the side of the cylinder, the combined turbulence produced by the fuel nozzle and by the swirl of the air gives rapid and efficient combustion. (See diagram on next page.)



The new Diesel, cross-sectioned at left, showing the single valve. To the right is a rear view, partially sectioned to show the fuel control system and the pumps

The Guiberson company claims that its engine is "free-wheeling." When the fuel is shut off, and the airplane is gliding, it is desirable that the propeller should rotate slowly as it then offers less drag than when fully stopped. To provide for this "free rotation" of the propeller, a decompression device has been introduced. When the control plate for the fuel valves has been shifted to its maximum displacement to the left, so that the fuel supply is entirely shut off, it also actuates a decompression ring which lifts the valve levers in such fashion that they remain open throughout the working revolution of the crankshaft. With such an arrangement there is complete decompression and the propeller and engine will both turn slowly as long as the airplane is in forward motion. —*A. K.*

Parachutes for Air Travel

RECENTLY the question of parachutes for passenger work has been receiving much attention in aviation circles.

The provision of parachutes for individual passengers does not seem to be very promising. Parachute jumping requires a certain amount of training. Even the experienced aviator requires a considerable amount of instruction before his first jump, and believes his first leap into space to be somewhat of an event. To suppose that the passengers of a cabin plane will have enough coolness and discipline to step one by one to the door of the cabin and jump into space without mishap, without failure to pull the rip cord at the right time, and so on, is rather a strain on the imagination.

The first alternative to the individual 'chute is the design of a single 'chute to support the entire plane. Here many difficulties are involved. If a single man requires a parachute of 18 to 24 feet in diameter, the size required for a transport plane of say 10,000 pounds in weight must become enormous. Therefore it becomes difficult to park the 'chute in the relatively small space available. Also, at the instant of opening the 'chute may experience a shock of three times the weight of the object to which it is attached. Taking up this concentrated pull is quite a problem. Opening a 'chute of this size in quick enough time is also difficult. Multiple 'chutes have been suggested as an alternative.

Then there is the problem of keeping the shroud lines clear of the tail surfaces or other projecting parts of the airplane. If at the time the 'chute is to be used the airplane is spinning or performing some other abnormal maneuver, the complications increase.

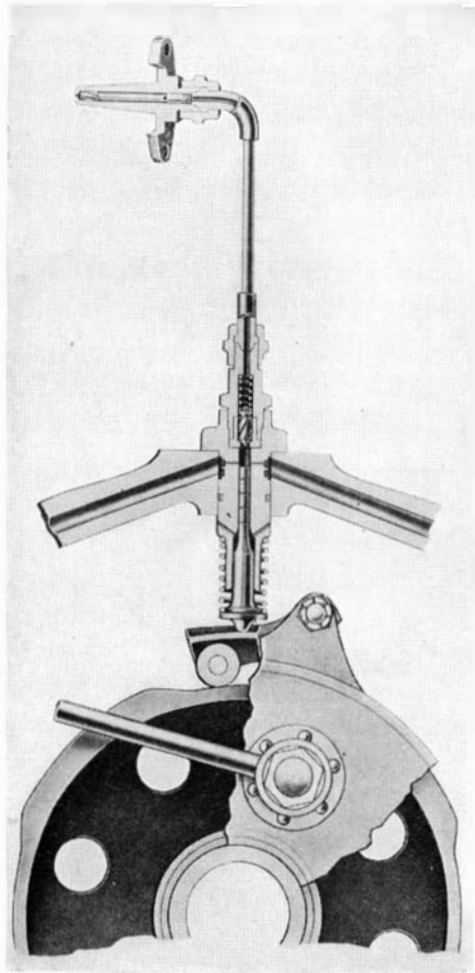
A correspondent, Mr. Albert Jost, sends us a copy of his patent in which he suggests packing the 'chute within the upper center section of a biplane wing. The upper surface of the wing would be rapidly opened by sliding cover plates sideways by the action of springs. At the same time the under side of the wing would be pulled down, also by springs, so that a sort of air funnel would be formed. The air entering this funnel would help to eject and open the 'chute. This suggestion is ingenious and the means for ejecting the 'chute are novel, but it is open to the same criticisms that all ship parachutes have to meet. The question of size, of the amount of assistance that the 'chute would receive from the funnel, and other problems have to be intensively studied before the idea can pass from the patent stage to the stage of practice.

While several descents of airplanes equipped with 'chutes have been made, they have not been highly successful. The parachute engineers of the Army's station at Dayton, Ohio, seem to have come to the conclusion that a parachute for the entire transport plane is too much of a first problem, although they are of the opinion that smaller craft might be so handled with some degree of success.

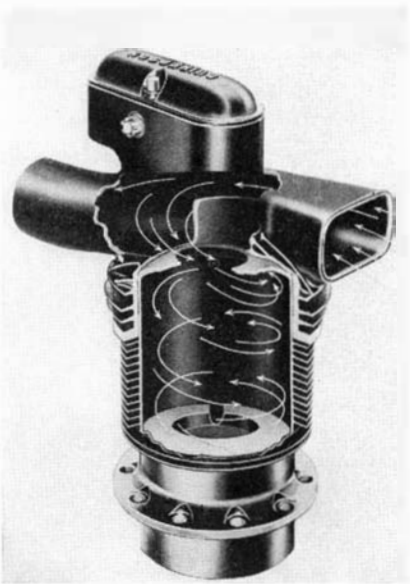
The Army engineers are now concentrating their attention on a parachute for a detachable passenger cabin. The cabin is conceived as being detachable from the main fuselage structure. To make sure that the main 'chute will open when required, a pilot 'chute would be employed, attached to the tail of the plane by a cable. The use of the pilot 'chute also helps to pull the main 'chute away from the airplane and thus minimizes the danger of fouling. The parachute to be used in these experiments is to have a diameter of 85 feet, and has been tested by dropping 2500 pounds of lead from a moving plane. Even in such a cabin 'chute, many difficulties are to be overcome.

Our readers may also recall another attempt to increase the safety of aircraft, in the form of the Herrick Vertoplane, recently described in *Aviation Engineering*. Here the upper wing of the biplane is so constructed that it can be released at will, set in rotation about a vertical shaft in the airplane by a simple, rubber shock-absorber starter, and converted into a rotating airfoil system, analogous to the autogiro. The Herrick Vertoplane has already flown both as a conventional biplane and as a rotor airfoil plane, with the upper wing in free rotation. There remains to be achieved the conversion from stationary to rotating wing in the air.

The aims of the Herrick Vertoplane are to retain all the efficiency characteristics of the airplane, and to have the rotor airfoil to fall back upon when a very slow inclined descent, or an almost vertical descent, is required in an emergency. The aerodynamics of the Vertoplane have been thoroughly worked out, and the continuation of these experiments deserves at least as much interest as the developments in plane and cabin parachutes.—*A. K.*



Diagrammatic view of the Diesel fuel pump and control. The rod that moves the control plate extends to the left. Changing the position of this plate varies the stroke of the pump and consequently the volume of fuel delivered to the cylinder. The nine pumps are interconnected, the fuel lines extending to the sides



The Diesel air intake system, with the valve removed. The arrows indicate swirling of the air, the swirling assisting to atomize the fuel and to promote efficient combustion

George Washington Encouraged Aeronautics

AVIATION people also have something to say about the Washington Bicentennial celebration. Apparently the father of our country encouraged such aeronautical endeavours as were current in his time. The first balloon ascension in the United States, according to *Army Air Corps News*, took place at Philadelphia on January 9, 1793, when Jean Pierre Blanchard made a successful ascent from the prison court in that city.

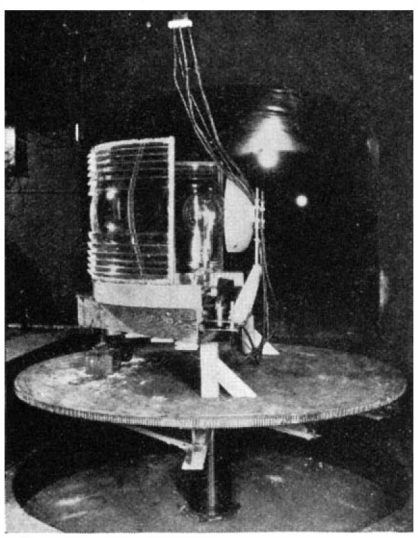
On the morning of his ascension, which was advertised as his 45th aerial flight, Blanchard was presented by the President with a "Passport" which stated among

other things: "These are therefore to recommend to all citizens of the United States and others, that in his passage, descent, return, or journeying elsewhere, they oppose no hindrance or molestation to the said Mr. Blanchard." Washington witnessed the epochal event with many of his cabinet, and a large number of members of both houses of Congress.—*A. K.*

Packard Engines in the Airship "Shenandoah"

FOR years there has been a widespread false idea concerning the make of the engines that were used in the ill-fated United States airship *Shenandoah*.

A short time ago, we published a brief



Courtesy Army Air Corps

An aircraft floodlight with 15,000-watt lamp being tested in the new photometric tunnel at Wright Field

discussion of a foreign car in which we stated that its engine was a small-sized "edition" of those used in a number of airships, including the one mentioned. Our inquiries all pointed to the accuracy of this statement. Lieutenant Commander C. E. Rosendahl, who commanded the *Shenandoah* and who is a survivor of the crack-up of that ship, says, however, that:

"The *Shenandoah* was equipped with six-cylinder, 300-horsepower Packard engines developed by Packard especially for that vessel. This was the original installation and remained on the ship throughout her entire existence."

A Test Tunnel for Aircraft Lights

THE Army Air Corps has constructed a remarkable tunnel at Wright Field, the first of its kind, for testing various types of aircraft lights, including beacons, floodlights, landing lights, airdrome markers, and boundary lights.

The tunnel is 260 feet in length and is painted black inside, so that when all lights are turned off, it is absolutely dark.

At one end of the tunnel is a platform, eight feet in diameter, that can be rotated through any desired angle and can also be raised, lowered, or tilted. Therefore the aircraft light mounted on this platform can be tested at any angle with the line of the tunnel, and it is also possible to bring the light beam in a direct line with the photometer. In this instrument, used for measuring light intensity, is a screen with a translucent spot which is illuminated on one side by the light to be tested, and on the other by a light of known intensity. When the light intensity from the two sides balances, the translucent spot disappears.

The photometer is mounted on a truck which moves on rails and may be brought up as close as four feet to the light to be tested. Black screens, with circular holes cut in their centers, are placed at regular intervals down the length of the tunnel. These screens are for the purpose of shutting away from the photometer the diffused rays of light and focusing the direct beam upon it.

The work of testing aircraft lights has been greatly expedited by this new tunnel. Recently a new type of airplane landing light has been tested by the Army which, consuming but one fifth the energy of the usual two million candle-power beacon, gave one half the light intensity. —*A. K.*

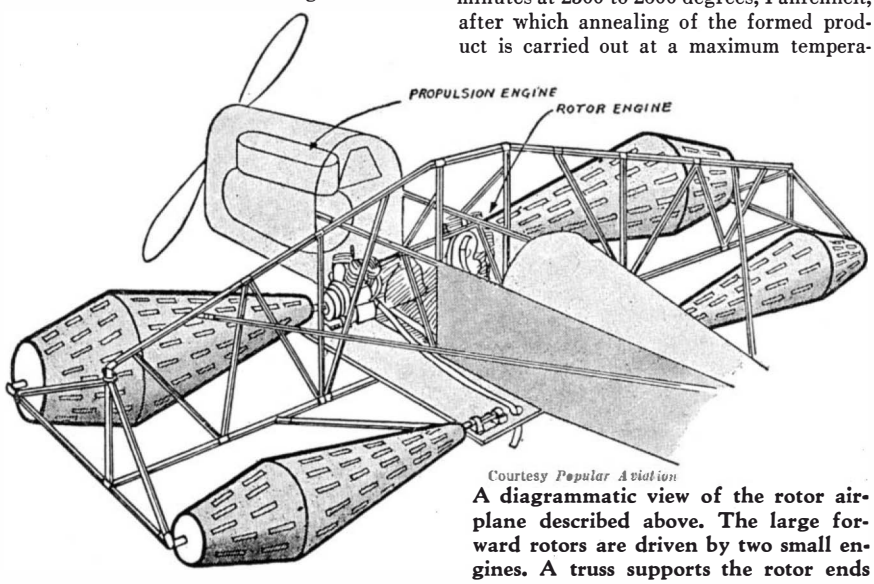
A Rotor Airplane

WE have received a number of letters from correspondents regarding the "spindle rotor" airplane being built by John G. Guest and L. C. Popper in New York City. The diagrammatic sketch of this machine, reproduced by courtesy of *Popular Aviation*, gives a clear understanding of this novel type of aircraft.

The propulsive system is of the conventional type, with a Cirrus engine and an ordinary airplane propeller. Instead of the usual airplane wings, however, two rotor spindles are mounted on each side of the fuselage, driven through suitable gearing by means of two Indian motorcycle engines.

Disregarding the inequality of lift which might occur if one small engine quits and the other continues to function, and disregarding the possibility of both auxiliary engines failing in which case there would be an almost complete loss of lift, the basic objection to the system is the inefficiency of the rotor as a lifting medium. It is perfectly true that a rotor will have a maximum lift eight, nine, or even ten times as much as a wing at the same forward speed and same projected area; but it is also true that the rotor will have at least three times as much drag as a wing at cruising speed.

The principle of the rotor is some 70 or 80 years old; the suggestions for the use of the rotor instead of a wing have been innumerable. It simply is so inefficient that in spite of its lifting capacity it remains an unpromising form of supporting surface. Inventors of the rotor type of aircraft must overcome this basic handicap if they wish to succeed. The airplane wing is a beautiful, streamline body, which lifts with minimum disturbance of air flow. The rotor, whirling around at high speeds, leaves a turbulent eddying mass of air in its wake, and eddies mean expenditures of energy. —*A. K.*



Courtesy *Popular Aviation*

A diagrammatic view of the rotor airplane described above. The large forward rotors are driven by two small engines. A truss supports the rotor ends

Glass from Slag

A GOOD grade of glass can be made from the slag that is normally a worthless product of the iron blast furnace, according to Professor C. A. Basore of Alabama Polytechnic Institute, who reports his experiments in a recent issue of *Chemical and Metallurgical Engineering*.

A method has been worked out in both small and large scale laboratory apparatus, yielding a transparent, light green or almost colorless glass of excellent properties, in many respects superior to ordinary soda-lime glass. It appears to be suitable for bottles and jars, corrosion-resistant kettle linings, structural and decorative purposes, and for X-ray bulbs, goggles, and the like.

Preliminary consideration of the problem of converting slag quantitatively into glass showed that account would have to be taken of the sulfur and iron present as impurities and that the proportions of silica and CaO would have to be altered considerably by the addition of sand. Fortunately it was discovered that glass sand was not needed and that ordinarily pure building sand would serve except where demand for a whiter glass would make the use of glass sand advisable.

The mix that has been used contains 7 parts of granulated slag, 8 parts of sand, 1.76 parts of soda ash to reduce the fusion temperature and improve the working properties of the glass, and 5 parts of hydrated sodium sulfate per 40 parts of the mix added to reduce the formation of scum. Removal of sulfur and oxidation of the iron to the less objectionable ferric condition are accomplished by the addition of about 1 percent of arsenic trioxide which, with the sulfur, forms the volatile arsenic trisulfide or pentasulfide. The melting and reaction require 100 to 180 minutes at 2500 to 2600 degrees, Fahrenheit, after which annealing of the formed product is carried out at a maximum tempera-

ture of 1200 degrees, the glass being allowed to cool slowly in the furnace.

Conservation of much heat is possible when, instead of using granulated slag, slag direct from the blast furnace is poured on top of the other materials contained in a fireclay crucible. Both methods have given satisfactory results.—*A. E. B.*

A Home-built Plane That Can Be Licensed

THE *LNB-4* parasol monoplane, built by the Heath Aircraft Corporation, can be purchased by the home builder in knock-down form, assembled in accordance with factory instructions, inspected by a representative of the Aeronautics Branch of the Department of Commerce before and after covering, and receive the Department of Commerce license.

This bold innovation is due to the fact that the Heath Aircraft Corporation has developed the parasol after many years of experience, and because its "knock-down" system of construction seems to be very practical. It is hoped that a greater number of pilots will now be able to buy the relatively inexpensive parts and engine, and continue their flying at minimum expense.

Our photographs show the neat looking plane both in assembled and in knock-down condition. In the latter photograph the reader will recognize all the main constitutent parts of the airplane. Instruments, cord, glue, nails, cushions, dope, and so on are provided. The manufacturer's specifications of the neat little craft are as follows:

Span, 31 feet 3 inches; length over all, 17 feet 3 inches; total wing area, 135.5 square feet; high speed, 73 miles per hour; landing speed, 32 miles per hour; climb at sea level, 500 feet a minute; cruising range, 330 miles; gas capacity, 10 gallons; weight fully loaded, 700 pounds; horsepower, 25 at 2800 revolutions per minute, Continental A-40.—*A. K.*

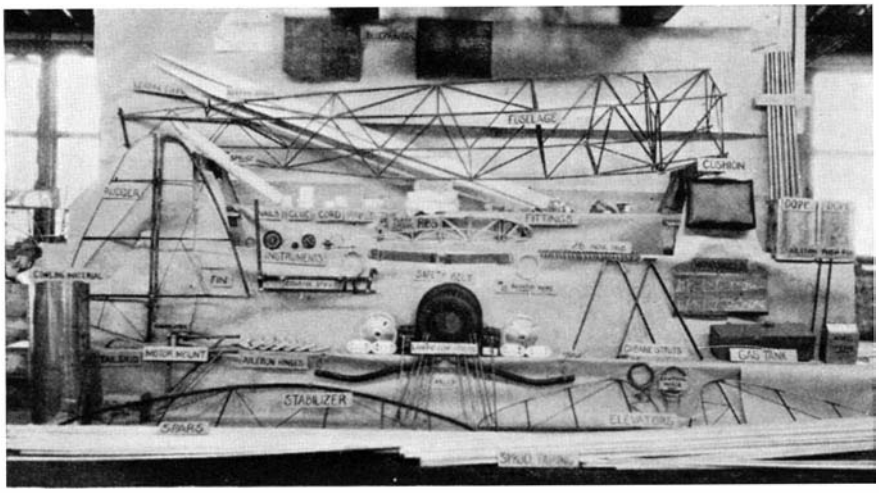
High Blood Pressure

CHEER for persons suffering from high blood pressure was given by Dr. Carl J. Wiggers, professor of physiology of Western Reserve University School of Medicine, in a recent address before the American College of Physicians.

High blood pressure, he said, must be looked upon as a compensatory reaction designed to restore a normal blood supply to the tissues of the body.

"If the physiological conception that hypertension is nature's agent, assuring an adequate blood supply to the tissues, could gain firmer root in the doctor's mind and through him be relayed to his patient, it would do much to remove the feeling of despair and impending doom so common in the layman who learns that his blood pressure is 'high,'" declared Dr. Wiggers.

He urged physicians to keep this conception of the condition in mind in treating it, saying that any agent or remedy that thwarts the natural compensatory process should not be used without due consideration. He said that without doubt the patient with a very high blood pressure is confronted with certain risks, such as rupture of the blood vessels or decompensation of the heart, but he suggested that in attempting to avoid these dangers the physicians should consider whether an even greater risk is not incurred through the use of drugs which lower systemic pressures generally.—*Science Service.*



Model LN knock-down kit for the home-built plane

The Meteor Crater Adventure

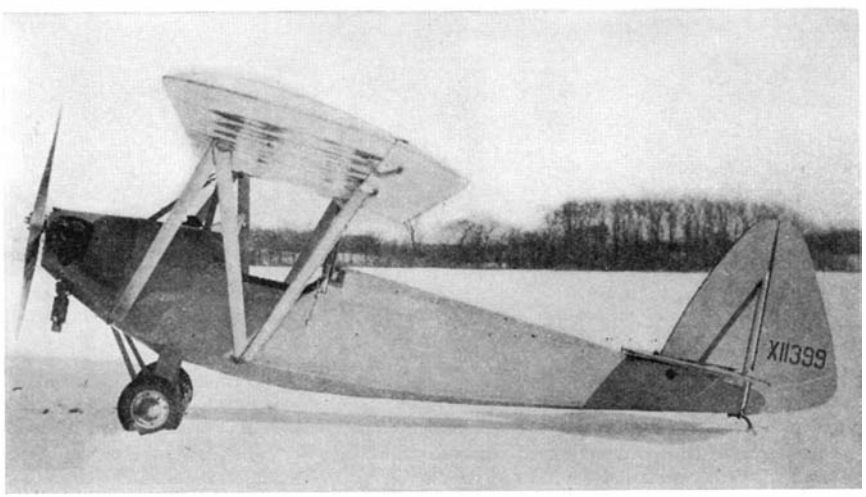
TWO test holes recently drilled at Meteor Crater in Arizona have encountered fragments of iron below a depth of 400 feet, and samples of these fragments contain nickel, which proves definitely that they are meteoric iron. It is believed that contact has now been made with the upper portion of the famous Barringer meteorite, and further developments are anticipated if funds for the exploration can be raised.

Meteor Crater, "the most fascinating spot on earth," is known to most readers of scientific literature. It is a "crater" only in name, for it has no connection with any volcano, but is an immense "shell hole" four fifths of a mile in diameter, caused by the impact of a comet which, the evidence indicates, struck the earth several thousands of years ago. It was thoroughly described in the SCIENTIFIC AMERICAN for July, August and September, 1927 (copies no longer available). The following notes are intended to bring the interested reader up to date with regard to the recent attempts to exploit the minerals believed to be buried at the site.

In 1927, a company, the Meteor Crater Exploration and Mining Company, was organized and limited funds were supplied by a number of capitalists; several men of science also participating in a much smaller way, largely as a kind of scientist's sporting venture, since all scientific men have long been intrigued by Meteor Crater. Early in 1928 roads were built to the Crater, pumping and mining machinery was installed, and a shaft was commenced, not in the crater but at one side where rock conditions were more favorable on the evidence of diamond drill holes. By October of 1928 the shaft had reached a depth of 625 feet. The intention was to sink the shaft to a depth of about 1500 feet and then drive a horizontal "drift" to the meteorite from the bottom of this shaft.

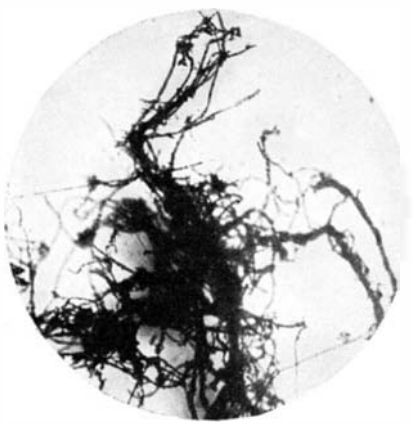
In February, 1929, at 651 feet depth, water was encountered and as sinking progressed the flow increased, soon exceeding the capacity of the pumps. Slow progress was made during the following summer, for the rock was found to be so shattered that water came from all directions to the shaft. It was suspected that this was an accumulation of centuries of rain water which filled the spaces between the cracks in the neighboring rock which had been fragmented by the impact of the giant projectile. The François cementation process (pumping liquid cement into the rock) was tried, but failed to exclude the water, and at 713 feet depth work was brought to an enforced stop.

In the following year, 1930, the whole question of the meteorite was recanvassed by a number of leading astronomers and physicists, and for some time a rather heated controversy "raged" among these men of science, one group agreeing with



A Model LN home-built plane with Continental A-40 engine

the original estimate that several million tons of meteoric iron containing iridium and platinum must lie buried near the crater, while another group reduced the estimate to hundreds of thousands of tons. At about this time the noted astronomer, F. R. Moulton, stated before the American Astronomical Society that meteors weighing 1000 tons or more are completely vaporized by their own impact and this was taken to indicate his belief that the meteorite which made Meteor Crater was not



Shredded leather showing extreme entanglement of fibers in the mass, as shown at 50 times magnification

there but went up in gas immediately on striking the earth.

The next move was a geophysical survey, made in 1930, by the magnetic and electrical methods. This indicated the presence of a large body of meteoric material at a 700-foot depth. In the meantime the company had expended its funds, having spent 293,000 dollars on the whole venture. However, further small sums having been obtained, in 1931 the drill holes mentioned in the opening paragraph were sunk where the geophysical survey indicated the meteorite to lie, and there the matter stands, awaiting the accession of further funds.

To the original stockholders the venture was frankly described as a speculation, and it still is a speculation. Though its proponents have regarded the work in the light of a practical mining project, the chief fascination to those of scientific turn of mind has been the scientific aspect of it—to prove or disprove the scientists' belief that a comet struck the earth in Arizona and made a giant crater. However, even a scientist can find uses for money, popular impressions to the contrary notwithstanding, and so it is hoped that ultimately a fortune in platinum minerals will be found at the end of the Meteor Crater rainbow.

Utilizing Scrap Leather

ALTHOUGH the leather industry is one of the oldest arts known to mankind, no very satisfactory method of utilizing the inevitable scrap leather has been developed, says Chandler D. Ingersoll in a recent issue of *Chemical and Metallurgical Engineering*. It is estimated that the waste scrap leather produced in the United States amounts to several thousand tons annually from sole-cutters, shoe manufacturers, shoe-repair shops, and belting manufacturers. There is practically no market for this scrap at present, its value running from two to five dollars a ton.

There have been certain utilizations of scrap leather which have had more or less of a heyday and are now either relegated to the scrap heap called history or are holding on to existence by the tenuous bonds of habit and tradition. Among these might be mentioned the old "Pot Process" for making prussiate of potash by lixiviating leather scrap, old shoes, wool waste, and other protein refuse with potash in the presence of iron. The yields from this process were small, however, and it slowly gave way to the more efficient chemical syntheses of the present day.

Leather has a well-defined fibrous structure, a fact which gives it resistance to torsional and mechanical strains. Modern efforts to utilize leather scrap are directed toward the plan of untangling these fibers so that they can be worked and relaid into a new sheet which will have, as far as possible, the qualities originally inherent in the leather.

Various attempts to shred leather have been made from time to time, both in the wet and dry state, but due to one reason or another the product obtained was not the fiber structure desired but usually part fiber, part cut fiber lumps, and part powder. Mr. Ingersoll has developed a method of shredding by high-velocity impact of small pieces against an air cushion such as is obtained in a hammer mill. In this way the fibers unravel themselves and a product is obtained which seems in every way suitable for the purpose intended. The illustrations give a good comparison between the new and the old methods of shredding.

The qualities of shredded leather, as far as it has been tested, show its ready adaptation to several uses. It has marked sound-absorbing properties, which, coupled with it moldability, recommend its consideration in this field. In low-temperature insulation it should prove particularly effective in enclosed walls or partitions, because of the high air-volume content of the bulk material. It has been successfully subjected to molding operations, both with and without binding agents, and shows a product of high strength to which the fiber of the leather has given resiliency. Its fibrous nature has naturally suggested its use in wallboard and leather-paper, and thus far work has shown that it will conform well to regular practice in wallboard and paper manufacture. Its use in linoleum also has been suggested.—*A. E. B.*

Keeping Broadcasters on Their Wavelengths

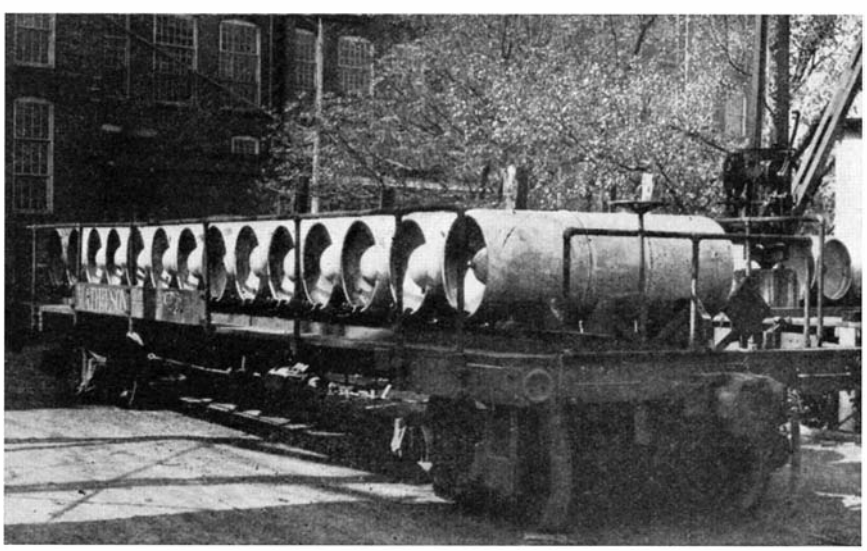
THE Federal Radio Commission's recent order compelling broadcasters to remain within 50 cycles of their assigned wavelengths will go into effect on June 22nd. The order will also require that stations themselves have a method of checking their frequencies. To meet these requirements, a device has been perfected by which stations can maintain a constant check on their frequencies and consequently correct their transmitters the instant it becomes necessary. The device is a "frequency monitoring" unit, designed for the Western Electric Company by Bell Telephone Laboratories.

The monitoring unit can be connected into any stage of the transmitter or used

Shredded leather fibers completely disentangled. Note fine tendrils branching off from the main fiber stems. (Magnification is 50 times)

entirely apart from it by means of an antenna. This flexibility is made possible by the fact that the input may come from either a modulated or unmodulated source without affecting the accuracy of the device.

The impulses from the transmitter are introduced into the monitoring unit, passed



A flat car load of a new type of shipping container for liquefied chlorine. This multiple-unit "tank car" has been developed by the Merrimac Chemical Company. The containers are constructed to withstand both pressure and corrosion

through a stage of amplification and into a detector tube. The unit contains a quartz crystal oscillator which oscillates at the assigned carrier frequency. The output from this oscillator is also passed through a stage of amplification and fed into the same detector. The output of the detector contains the best note or difference frequency. This difference frequency is registered on a visual indicator kept under observation by the station's technician.

A self-restoring button mounted on the front of the panel permits a small temporary displacement of the frequency of the monitoring oscillator. From this the operator sees on the same indicator whether the deviation shown is high or low with respect to that of the monitoring equipment.

In addition to being used directly on the transmitter under test, the monitoring unit may be connected to ordinary radio receiving sets, except those of the superheterodyne type. This makes it possible for a station executive, for example, to keep his transmitter under observation by attaching the unit to a radio receiver in his home or office.

Top of the new "Wire-Kut" can showing the inserted wire opener

Lacquer Solvent from Pentane

A NEW chemical industry, the synthesis of amyl alcohol from natural gas, has sprung up at Belle, West Virginia, in response to the automobile industry's need for a suitable cheap solvent for lacquer manufacture. Chemists of the Sharples Solvents Corporation there have developed a modern, continuous-operation plant which turns out amyl alcohol and amyl acetate by tricks of chemical legerdemain that, a few years ago, were considered only theoretically possible. Lee H. Clark describes the evolution of this unique process in a recent issue of *Chemical and Metallurgical Engineering.*

Pentane, obtained from the natural gas which is plentiful in that section, is first "chlorinated" by mixing it (in gaseous form) with chlorine gas. This produces amyl chloride and hydrochloric acid. The amyl chloride is hydrolized to amyl alcohol by treatment with caustic soda. The next step is the treatment of the amyl alcohol with acetic acid to form amyl acetate.

Modern quick-drying lacquers, so generally used today for automobiles and for general household uses, could not be sold at reasonable prices if American chemists had not been equal to the emergency of producing synthetic amyl acetate.—*A. E. B.*

New Can Opener on Can

THAT a reliable opening device *on* every tin can is the urgent need of the can business, as well as of the American housewife, cannot be doubted. Millions of dollars have been spent by manufacturers in perfecting devices for closing cans and millions more in perfecting the content but the canners have apparently lost sight of the fact that the American housewife needs some consideration and ought to have her daily task of opening canned goods made safer and easier. Thousands upon thousands of lacerated fingers and lacerated tempers attest this need.

This problem has indeed been recognized for a long time. Many futile efforts have been made to provide an easy self-opening can, but not until the new device known as the "Wirekut" can opener here described was perfected has a dependable integral opener been available at sufficiently low cost to permit its use upon every tin food container.

The Wirekut opener is simple. It consists of a steel ripping wire firmly secured in a groove around the under side of the can cover with one end passing to the outside of the cover and formed into a loop. A drop of solder seals the hole through which the loop end passes. To open the can, it is only necessary to hold it upright in one hand (thumb down) between the knees, so that the can will not slip or wobble (just as you would hold a bottle to pull a stopper) then to insert a cross hold such as a nail, skewer, or tine of a fork, through the loop and pull straight up. The cover is thus cut cleanly and completely from the can within 1/32 of an inch of the side wall.

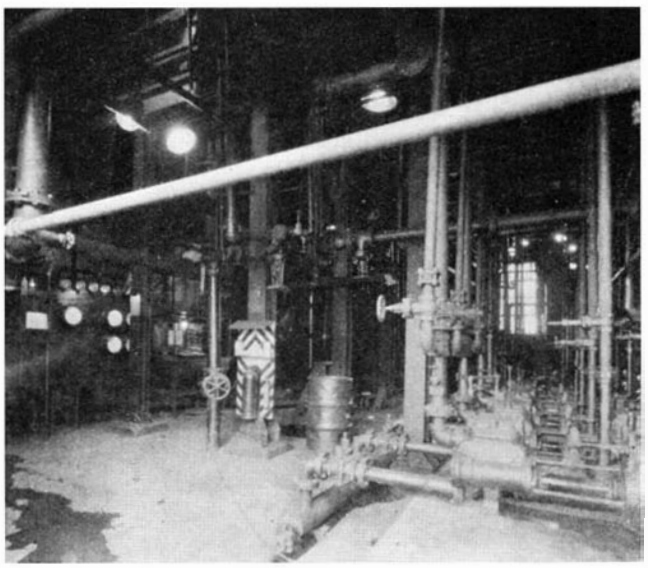
A nail or fork tine in the wire loop, a steady pull, and the can is open

Less Silver in Mirrors

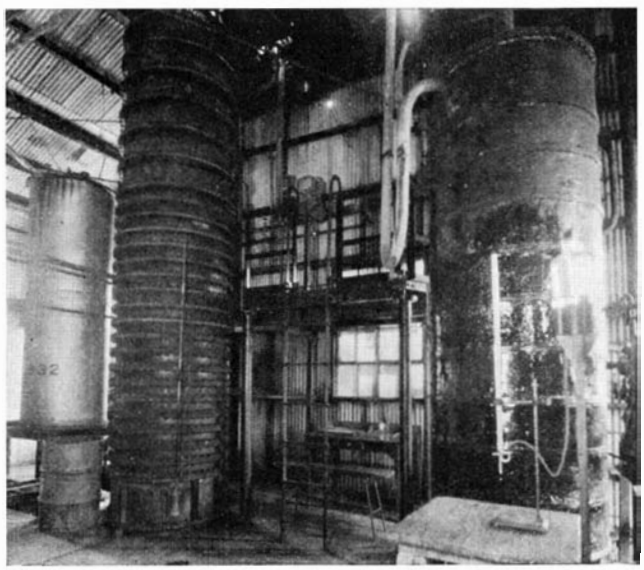
A FRENCH patent has been issued to L. Fernandes covering an improvement in the manufacture of silvered mirrors. According to the method which he has developed, it is possible to use a much thinner deposit of silver on the mirror surface by electro-depositing a coating of nickel, cobalt, zinc, chromium, or an alloy of any of these metals on the silver deposit.

Physician Condemns the Tourniquet

THE tourniquet, bound tightly around the arm or leg to stop bleeding, is no longer considered good practice in first aid, it appears from an editorial note in *The Lancet,* a British medical journal published in London. The danger of too pro-



A complicated maze of piping and other equipment: the pump and control room in the chlorination process where pentane is mixed with chlorine to form amyl chloride



Where amyl alcohol becomes amyl acetate. Tanks for feeding alcohol to reaction kettle and fractionating column; and column for purifying crude product are shown

longed pressure with this instrument was emphasized and the tourniquet itself was referred to as "a disreputable relic of the past whose only habitat should be the museum."

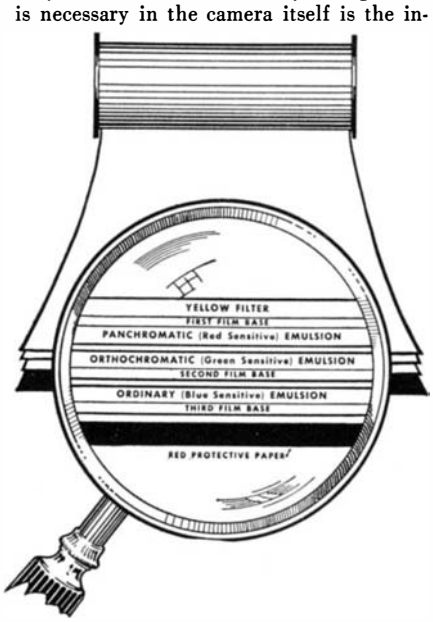
For seven years a Belgian physician, Dr. M. Stassen, has dispensed with the tourniquet in the first-aid equipments for which he has been responsible, *The Lancet* pointed out. During that time several hundred cases of compound fractures of the limbs have been brought to his hospital from points nearly 40 miles away. Not a single death from hemorrhage during transport occurred.

Dr. Stassen thinks the tourniquet is a frequent cause of shock and gas gangrene. By completely stopping the blood circulation in the injured limb, it promotes infection in the crushed and torn tissues. Its removal is followed by absorption of poisons capable of killing a patient already weakened by cold, shock, and loss of blood.

Attention was also called to the fact that at the sixth International Congress of Military Medicine and Pharmacy, various speakers condemned the tourniquet in unequivocal terms.—*Science Service.*

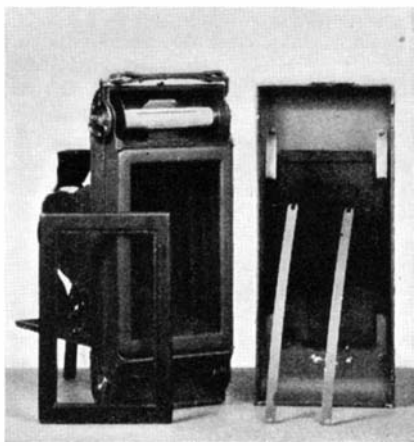
Colored Still Photography for Amateurs

WITH the new tri-pack film recently put on the market by Agfa Ansco Corporation of Binghamton, New York, it is possible for the experienced amateur to take colored still pictures with an ordinary hand camera. The only change that is necessary in the camera itself is the insertion of a pressure plate pad and a glass frame, shown in an accompanying photograph. The camera is loaded in the ordinary manner with the tri-pack roll and the paper leader of the film is threaded between the pad and the glass. This change in the camera is necessary because the three separate films in the roll must be kept flat when the exposure is being made.



A view, exaggerated, of the three emulsions and films, and the single filter in the new color-photo roll

The three films used in the roll are, as shown in one of our drawings, first, panchromatic; second, orthochromatic; and third, ordinary film. On the opposite side of the film base from the panchromatic emulsion is a yellow water-soluble filter. This eliminates enough of the blue from the incoming light to enable the panchromatic and orthochromatic films to register more faithfully the red and green elements, respectively. Of course this filter also reduces the blue which acts upon the third or ordinary emulsion but this fact is compensated for by an increase in the speed of the blue sensitive film.



Camera with pressure pad and glass plate, ready to take color photos

An accompanying chart shows the sensitivity of the three films in terms of microns or hundredths of Angstrom units. The black portion of each chart shows the sensitivity of each film when the filter is used, while the shaded portion shows the sensitivity of the same film to the same range of wavelengths when no filter is used.

In actual practice the photographer exposes the film in the ordinary way but with about three times the ordinary exposure. Extreme high lights and deep shadows must be avoided if full color value is to be obtained. After the six frames on the film are exposed the entire roll must be sent back to the factory for finishing. Here the films are developed and from them is made a set of three intermediate positive transparencies. These are then employed in a mechanical printing process for reproducing the original scene in full color. These transparencies might be thought of as having on them the images in relief. These relief surfaces are then coated with the proper dyes and impressions are made on white paper, the process of making the impressions being similar to the manner of using a rubber stamp. Careful registering of the three successive printing operations produces a single print with the effect of full color.

At the present time it is planned that these films will be supplied only to advanced amateurs upon order through their local dealer. Although the films and processing are relatively inexpensive when results are considered, it is not desirable at this step of the development work to secure wide distribution of the film until the process has been thoroughly tried out by amateurs who really know their cameras and can think beyond the simple process of pushing the button.

Gold of Different Colors

ALL that glitters is not gold. For example, alloys of copper with up to 10 percent aluminum are sometimes used for cheap jewelry because of their close resemblance to 22 carat gold. This type of "artificial gold" must not be confused with "white gold" the legitimate use of which is practically confined to the goldsmith's trade.

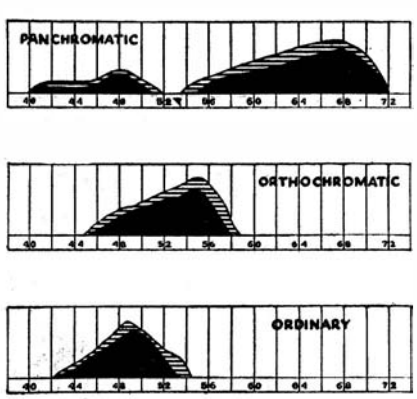
It has long been known among goldsmiths and jewellers that small proportions of other metals profoundly alter the color of gold. Of "white golds" there are many, all being entitled to the hall-mark denoting their proper caratage. Thus there are: an 18-carat white gold, containing 16.5 percent of nickel, 5 percent of zinc, and 3.5 per cent of copper; and a 12-carat alloy containing 20 percent nickel, 20 percent copper, and 10 percent zinc with a minute amount of manganese. In other 18-carat varieties the nickel content is slightly increased at the expense of the copper. A truly noble white gold—21.6-carat—contains 90 percent gold and 10 percent palladium.

Colored golds of various hues are also used in making high-class jewelry, particularly for floral designs. By selecting the proper alloy, a whole range of colors becomes available. The use of iron, platinum, or cadmium as the alloying metal gives various shades of gray. Incidentally, aluminum finds a use here as an artificial gold. Alloyed with gold to make a 22-carat alloy, the resulting metal is of a pale violet color, hard and brittle but quite useful for casting purposes. This alloy is a metallurgical curiosity, since the union of aluminum with gold—both very malleable in the pure state—results in an excessively non-malleable alloy.—*A. E. B.*

Butterfly Farming in England

APROPOS of recent discussion in SCIENTIFIC AMERICAN of butterfly farms, the editor has received a letter from C. F. Graham, of Erith, Kent, England, which we quote in its entirety:

"It may interest your readers to know that for more than 30 years an Englishman has successfully conducted a butterfly farm at Bexley, near London. This is no mere hobby, but a full-time job. Indeed, during the busy months he employs four assistants.



The three graphs showing the color sensitivity of the three films in the tri-pack roll. See reference in text

"Every spring the farmer collects caterpillars of different species in the fields and hedgerows. In this respect it may be said that his 'farm' extends from the north of Scotland to the south coast of England. Thirty years of breeding and collecting have taught him just where to look for the particular species he most requires, even

to the very field or hedge. In this country certain species are confined to small, well-defined localities.

"The caterpillars are brought home and classified. Some are placed in special feeding chambers made of finely perforated tin. Others are placed to feed on the leaves of trees growing on the farm. The trees are then covered with sheets of fine muslin, tied tightly round the bole, so that from a distance they resemble gigantic mushrooms.

"Among the farmer's chief customers are schools, colleges of pestology, and private collectors. Every year he supplies a large number of live specimens for exhibition at the London zoological gardens.

"The farmer told me quite recently that he had a great stroke of luck a few years ago. A cage containing a number of chrysalises of a particular species was accidentally knocked to the floor. The male and female of the butterfly (I forget the name) are of different colors. When the butterflies emerged he was delighted to find a number of specimens which shared the coloring of both male and female. Eight butterflies graduating, half a wing at a time from the perfect male to the perfect female, were selected for mounting, and the collection was bought by a wealthy collector for 100 pounds.

"The farmer makes a specialty of breeding almost black specimens of many kinds of butterflies. These, he told me, command a high price among private collectors."

Sterilizing Milk With Sound Waves

MILK and similar liquids may some day be sterilized by subjection to a "terrific squeak" instead of by heat treatment. This possibility is visioned as a result of experiments by Dr. Leslie A. Chambers and Prof. Newton Gaines of Texas Christian University, at Fort Worth, Texas. The apparatus which they have constructed and used in their laboratories averaged a kill of 80 percent of all bacteria present in various samples of milk, and in a few samples it produced complete sterilization.

The new apparatus was evolved from an earlier form used by Professor Gaines and Professor O. B. Williams of the University of Texas last year. Basically it involves the same device: A nickel tube caused to vibrate intensely and at a high rate by being placed in a rapidly alternating magnetic field controlled by mechanism similar to that used in radio broadcasting. This causes the tube to "sing" with an exceedingly high-pitched audible note. Partially immersed in water or other liquid, its intense sound waves are very destructive to bacteria and other small organisms.

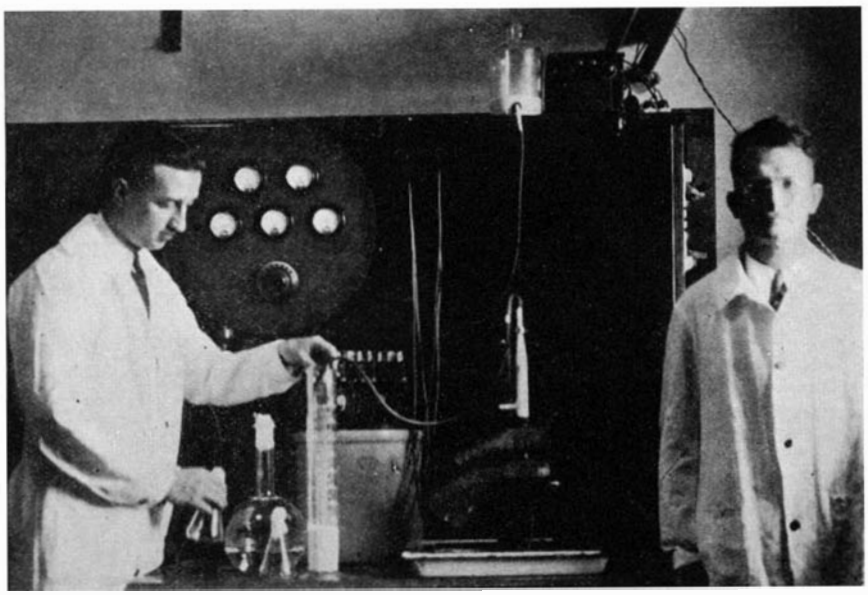
In the apparatus used last year, the experimenters killed bacteria in a flask. This year's endeavor was to develop a means of sterilizing or partially sterilizing liquids as they flowed past and around the tube, making the process continuous instead of intermittent. This was accomplished by inserting the upper half of the nickel tube into a larger tube of glass, making the joint by means of a water-tight rubber collar. The lower end of the tube was given the magnetic impulses, and the upper end drove its high-frequency sound waves into the milk as it flowed through the space between the two tubes, and especially as it flowed through a narrow funnel-shaped outlet.

The laboratory model was of sufficient size to allow continuous treatment of milk at the rate of 100 quarts an hour; but the nature of the apparatus is such that the capacity may be expanded almost without limit, the experimenters state.

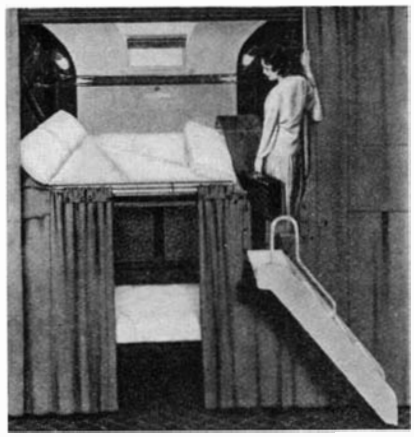
With the co-operation of a local commercial milk concern, the apparatus was tested on a large number of samples of grade A milk, with initial bacterial counts varying from 8000 to 30,000 per cubic centimeter. A few samples of pasteurized milk showing 3000 to 5000 counts were also tested, with results indicating that the vibration treatment destroys germs not affected by pasteurization temperatures. The germ count in all cases showed an average reduction of 80 percent, and in a few samples all germs were killed.

The sound-wave treatment, however, does not destroy bacterial spores; but such spores are also immune to pasteurization. Fortunately for both methods, the real trouble-making germs in milk are not spore-formers.

Other liquids that may eventually be treated by the new method include certain dietary products, commercial alcohol, fruit juices, and delicate sera for use in medicine—in general, products that require a radical reduction in germ count, if possible, without heating.—*Science Service.*



Dr. Chambers, *left,* and Dr. Gaines, with the laboratory apparatus used to sterilize milk with sound waves. The sterilizing chamber is shown near the center



A new type of upper berth for Pullmans, with a folding stairway, a dressing platform, and a dormer window. Easy access, ample room, and proper ventilation are assured

Meat—Man's Normal Diet

VIVID proof that the modern diet of American civilization causes dental decay was presented before scientists gathered at the recent meeting of the American Association of Physical Anthropologists. Two scientists of the National Museum staff told how they have systematically counted teeth having cavities in hundreds of jawbones of prehistoric Eskimos and in the mouths of living Eskimos in Alaska.

The ancient Eskimos were meat eaters living chiefly on walrus, seal, and fish with only a little vegetable food. In 800 jawbones of these prehistoric people, M. S. Goldstein found only 6.5 percent with defective lower molars. He selected these molars to count because they are the first teeth of the jaw to succumb to decay. Most of the diseased spots were no more than pinhead size.

Henry B. Collins, Jr., reported examining the teeth of 296 living Eskimos. He found 26 percent of them with more or less dental decay.

"The significant fact," Mr. Collins explained, "is that in remote, barren regions of Alaska today where the Eskimos are poverty-stricken, they still live in the old-fashioned way as seal hunters and fishermen. And these living Eskimos practically do not know what toothache is like. But Eskimos living in proximity to white settlements show a much higher incidence of dental decay. At Nome, for example, we find more than half the natives with carious teeth.

"In the teeth of those Eskimos who supplement their native sea food diet to a greater or less extent with food that the white men eat, dental decay is prevalent, and is directly proportionate to the extent that the diet has been altered.

"There is evidence that meat-eating races generally have sound teeth, while grain-eating races are much more affected by tooth decay. Indian tribes who lived along the sea coasts of America left great mounds of shells showing how much sea food they

(*Please turn to page* 372)

CURRENT BULLETIN BRIEFS

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

SAFETY IN THE HANDLING AND USE OF EXPLOSIVES (Pamphlet No. 17, January, 1932) is a valuable pamphlet which will aid consumers of explosives in their efforts to conduct their blasting operations with safety. *Institute of Makers of Explosives, 103 Park Ave., New York City, or any Institute Member Company.—Gratis.*

AMERICAN FOREIGN INVESTMENTS IN 1931 (Foreign Policy Reports, Volume VII., No. 24, February 3, 1932), by Dr. Max Winkler, is a scholarly review of the situation, with accurate statistics. *Foreign Policy Association, Inc., 18 East 41st Street, New York City.—25 cents.*

USEFULNESS OF BIRDS ON THE FARM (Farmer's Bulletin No. 1682) is by W. L. McAtee. Birds deserve careful fostering by man because of their decided economic usefulness. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

TEN YEARS WITH WESTINGHOUSE presents numerous facts and figures regarding the Westinghouse Company not heretofore generally known. The brochure is well illustrated. *Carreau and Snedeker, 63 Wall Street, New York City.—Gratis.*

THE IMPORTANCE OF COLLOIDAL GRAPHITE LUBRICANTS IN "RUNNING-IN" OPERATIONS. The surfaces of new bearings are surprisingly rough and irregular, and the preparation known as "Oildag" is very effective in helping to smooth them. *Acheson Oildag Company, Port Huron, Michigan. —Gratis.*

TRAILSIDE FAMILY—THE NATURE TRAILS AND TRAILSIDE MUSEUM AT BEAR MOUNTAIN, NEW YORK (School Service Series Number Seven), by William H. Carr, is an illustrated pamphlet describing the good work and activities at Bear Mountain. *American Museum of Natural History, New York City.—20 cents.*

SOIL CORROSION STUDIES (Research Paper No. 95, U. S. Bureau of Standards) is a review of the studies on which the Bureau of Standards has been engaged since 1922. Final conclusions will not be available before 1935 at the earliest. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

INDUSTRIAL EXPERIENCE OF WOMEN WORKERS AT THE SUMMER SCHOOLS, 1928 TO 1930 (Bulletin of the Women's Bureau No. 89, U. S. Department of Labor), by Gladys L. Palmer, Ph. D., gives an account of the work history and economic status of 609 women whose presence at the summer schools in itself testifies to their having experiences, and perhaps personalities, of more than ordinary interest. *Superintendent of Documents, Washington, D. C.—20 cents (coin or money order).*

YOU CAN MAKE FOR PROFIT (National Committee on Wood Utilization, U. S. Department of Commerce) is a book filled with useful suggestions with 92 illustrations. This is the third volume of a series —each of which can be obtained at the same price. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

CORROSION—AND HEAT-RESISTANT ALLOYS, by Clayton E. Plummer and Richard K. Akin, while only a four page folder gives a key to commercial alloys and where they can be obtained. *Robert W. Hunt Company, Insurance Exchange, Chicago, Ill.—Gratis.*

ARCHITECTURAL ACOUSTICS (Circular of the Bureau of Standards No. 396), by Paul R. Heyl, gives the fundamental principles governing the construction of an acoustically successful auditorium. *Superintendent of Documents, Washington, D. C. —5 cents (coin).*

MORE WATERFOWL BY ASSISTING NATURE gives an outline of a comprehensive, sound, adequate, workable plan for preserving and increasing waterfowl. *More Game Birds in America, Inc., 500 Fifth Avenue, New York City—35 cents, postpaid.*

THE VARIOUS METHODS OF HYDRAULIC DRIVE (*Hydraulik Review*, Volume 2, No. 1) is a splendid German pamphlet giving in the clearest possible manner the principles of purely hydraulic drive, electro-hydraulic, steam-hydraulic, and air-hydraulic operation. For large work hydraulic operation is much esteemed. *Hydraulik G. M. B. H. Duisburg, Germany.—Gratis.*

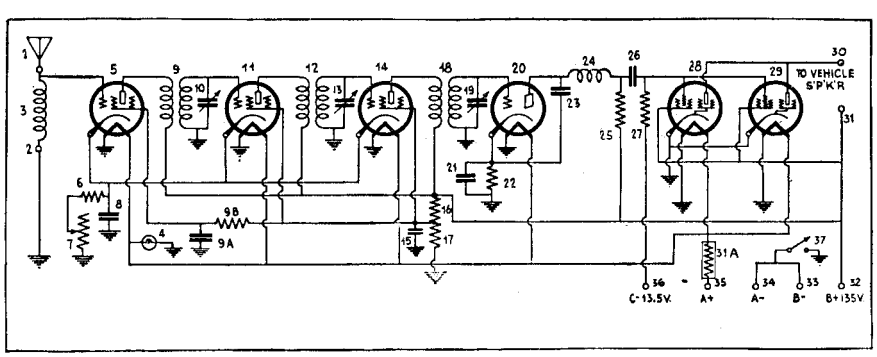
WHERE TO BUY, RENT, AND BORROW 16 MM. FILMS, SILENT AND WITH SOUND is a revised directory of film sources of interest to every one who uses the 16-millimeter film for home use. *Victor Animatograph Corporation, Davenport, Iowa.—Gratis.*

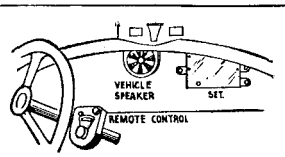
VOLTAGE RELATIONS AND LOSSES IN SMALL UNIVERSAL MOTORS (Engineering Experiment Station Bulletin No. 58) by A. F. Puchstein and Ivor S. Campbell. *Ohio State University, Columbus, Ohio.—50 cents.*

SPIRAL WELDED PIPE describes a type of pipe which is really built to meet the individual needs of the consumer. The pamphlet gives the processes of manufacture and some of the uses are shown. *The American Rolling Mill Company, Middletown, Ohio.—Gratis.*

NICKEL ALLOY STEEL PRODUCTS is a buyers guide listing all kinds of alloys and finished products, all properly classified. Every industry should be able to supply kindred data in the same compass. *The International Nickel Company, Inc., 67 Wall Street, New York City.—Gratis.*

PEAFOWL AND THEIR CARE (Miscellaneous Publication, U. S. Department of Agriculture, No. 127), by W. L. McAtee, is a folder giving information on the common or Indian peafowl and the Javan. Only the former has been domesticated and that not very thoroughly. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*





The auto-radio circuit shown employs the new Arcturus radio tubes, made especially for automotive work. It also incorporates improved receiver components, such as the compact Conoid r. f. coils; a small but powerful new vehicle speaker of true dynamic construction; an effective steering-column remote control; specially designed silencers to eliminate ignition interference; and last but not least, a highly efficient car antenna which fits under the running board. Pentode tubes are used in parallel in the output stage, resulting in unusually excellent performance. An important feature of the design is the fact that this receiver may be assembled for a very modest sum—in fact, for less than the price of factory-assembled automobile radio sets. A complete set of diagrams and additional information about this circuit may be obtained from the Allied Engineering Institute, Suite 541, 98 Park Place, New York, New York—5 cents

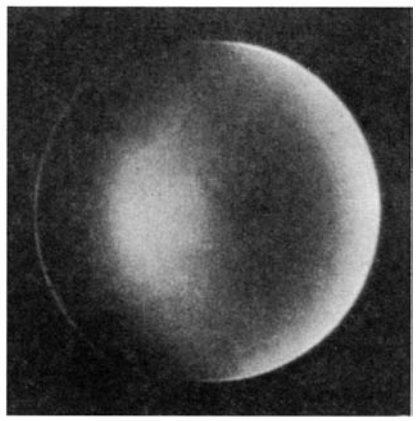
THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

THEY say that "even your best friend won't tell you" about halitosis—or is it "B. O."?—but somebody recently told us we had been publishing "too —— many descriptions of telescopes and not enough sauce." All right then, we shall temporarily sidetrack 32 telescope descriptions now on hand and not yet published and serve sauce. But let's call it hash.

HERE, for one ingredient, are some originally good focograms which show what kind of work amateur telescope makers can do. The first is by Harold A. Lower, 1032 Pennsylvania Street, San Diego, California, whose 12-inch Cassegrainian telescope was described last month in this department. The focogram shown in "Amateur Telescope Making," page 225, is correct as regards the distribution of lights and shadows, but the shadows are too deep. Likewise the present one does decidedly poor justice to the original. Any such reproduction in a magazine or book is just four removes from the original: from the negative to the print, from the print to the engraving on copper, from the engraving to the electrotype, and from the electrotype to the printed page; the end-product is certain to differ somewhat from the original. While it tells much, the worker *must* measure zones and not attempt to judge the curve of his mirror by mere visual comparisons of shadows, except for their distribution. Failure to take such urging seriously has apparently resulted in a large crop of badly overcorrected mirrors—some that have been tested having a whole inch or more of zonal aberration. As Mr. Lower's mirror, a 12-inch, has a focal ratio of f6, the shadows were deeper to begin with than they would be on an f8. When the curve is correct the shadows will be extremely thin and tenuous; in fact a person not familiar with the knife-edge test would probably fail to find them at all. Mr. Lower gave his mirror 95 percent of the full paraboloidal correction, so he writes.

We begged him to send us a few extra prints and copies were sent by us to Professor Ritchey and to Reverend Ellison. Professor Ritchey, who, by the way, tells us he is extremely interested in the amateur telescope makers' movement—he enthused over it, in fact—referred to Lower's focograph as "the most beautiful I have seen," and added, "Please give my compliments to Mr. Lower when you write him." The Reverend Mr. Ellison wrote, "Very many thanks for sending me the very beautiful and interesting focogram of Mr. Lower's 12-inch mirror. It is perfect and typical, and had it reached me a few days sooner I should have had it reproduced and included in the illustrations in the new edition of 'The Amateur's Telescope' now in the press." (By the way, when Ellison's new British edition is ready we shall let our readers know, as many will want to purchase it.)



Lower's focogram

ANOTHER focogram—in fact a series—reaches us from Mr. E. Lloyd McCarthy, 10 Powers Street, Canton, New York. "They show," he writes, "the Foucault shadows seen on my six-inch mirror at four stages of figuring. The second represents the effect of two-inch polishers on the first, but I decided to leave these sub-diameter tools to the skill of Professor Ritchey, as this focogram clearly indicates was advisable! A little difficulty in the matter of contact produced the figure in the third. When I was finally through wrestling with this job I had shortened the focal length two inches." We reproduce this series as a back stiffener for those who are sick and weary, and the moral is, cheer up. The focograms show what *can* be worked out of a horrible mess if one will persist. In fact, if a mirror does not go through a lot of these preliminary monkeyshines it is almost subnormal, like a boy who is just too good for any use.

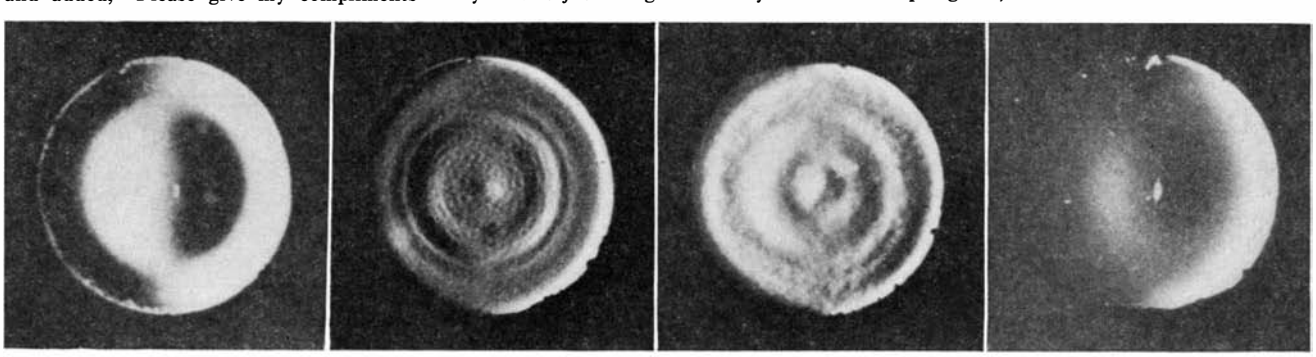
Speaking of Professor Ritchey: We journeyed over to Philadelphia a few weeks ago and saw him and the heavier parts of the mounting for his new 40-inch Ritchey-Chrétien telescope, and an article about this telescope was rashly promised for the present number. It turns out, however, that we have left ourself too little time to write it. Next month or die. This article will not, however, be aimed at the amateur telescope making fraction of our readers, but at all of the readers, hence it doubtless will seem somewhat "written down" to those who already understand telescopes.

THE Amateur Telescope Makers of Springfield, Vermont, have chosen to hold their annual convention of telescope enthusiasts this year on Saturday, August 27. This of course is only four days before the total eclipse, some 150 miles farther east in Maine. On account of the eclipse in Maine, the Pittsburgh amateurs will not hold a convention this summer but will attend the one at Springfield and take in the eclipse later in full force. The amateurs at Springfield hold winter meetings at Stellafane on the mountain top, and the snow is so deep that they must climb Mount Porter on snowshoes and skis. "After a good hot supper, the last one having been an oyster supper," says A. D. Baker, their secretary, "with the fireplace filled with rock maple logs, the flames curling upward and sending out an abundance of heat, we gather for our meeting and discuss those things in which telescope makers are interested. And then, as midnight approaches, we wend our way homeward with a feeling of an evening well spent."

Stellafane is fine in summer but still finer in its mantle of winter snows. And then, too, there are no mosquitoes and no venomous snakes at that time of the year. At last summer's convention an exasperated snake chased a lady twice around Stellafane.

Several have inquired for a list of the organized associations of amateur telescope makers. Here is the list. The Cincinnati group was organized latest—some time last winter. There are also informal groups in Little Rock and Indianapolis. Which community will be the next to organize?

"The Amateur Telescope Makers of Springfield," A. D. Baker, Secretary, Springfield, Vermont.

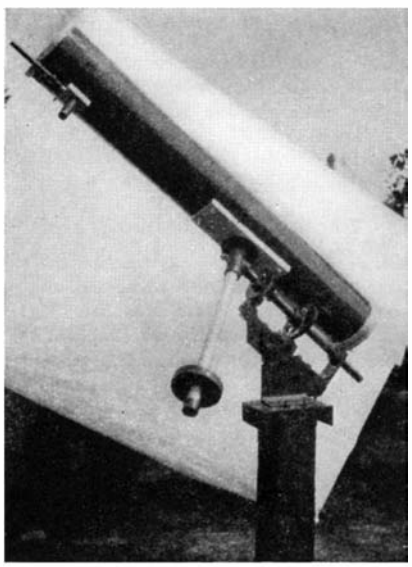


Lloyd McCarthy had his troubles but he "got there just the same"

"The Amateur Telescope Makers and Astronomers of Los Angeles," E. R. McCartney, Secretary, 2940 Mount Curve Avenue, Altadena, California.

"The Amateur Telescope Makers of Chicago," William Callum, Secretary, 1319 West 78 Street, Chicago, Illinois.

The Astronomical Section of the Academy of Science and Art of Pittsburgh, Leo J. Scanlon, Sec.-Treasurer, 1405 East Street, North Side, Pittsburgh, Pennsylvania.



A typical reflecting telescope as made by the amateur worker, from the instructions in the *Scientific American* book "Amateur Telescope Making," a neat six-inch instrument constructed by Charles R. Lewis of Hatboro, Pennsylvania

"The Telescope Makers' Section of the Eastbay Astronomical Association," Franklin B. Wright, Chairman, 155 Bret Harte Road, Berkeley, California.

"The Amateur Telescope Makers and Astronomers of Tacoma," George Croston, Secretary, LaGrande, Washington.

"The Amateur Telescope Makers of Cincinnati," W. Clemmer Mitchell, Sec.-Treasurer, 2390 Wheeler Street, Cincinnati, Ohio.

THOSE ever enterprising enthusiasts, the Astronomical Section of the Academy of Science and Art in Pittsburgh, have just done a good turn for amateurdom. They thought so well of the Hindle monograph on the Cassegrainian and Gregorian that they volunteered to mimeograph for us 125 copies, if we would prepare the illustrations and send the monograph out to advanced amateurs who request it. This advanced monograph would be valueless to a beginner, who should first study the elementary instruction book "Amateur Telescope Making." To others seriously interested it goes for the asking and need not be returned.

Vitreosil is a material made by the Thermal Syndicate, Ltd., 58 Schenectady Avenue, Brooklyn, New York, and we know of no present reason why it should not be regarded as available for mirrors. A six-inch blank appears to cost about 45 dollars. These disks consist of an outer transparent layer of fused quartz on each side, with intermediate layers of translucent fused silica.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page 367*)

ate. These tribes had almost perfect teeth. The buffalo-hunting Indians of the plains had fine teeth.

"On the other hand, the Pueblos of the southwest, both ancient and modern, and other agricultural tribes of the United States as well, have poor teeth. These Indian farmers lived mainly on grain and vegetable foods."—*Science Service.*

Keyhole Finding Key Container

SINCE prohibition went into effect, there have been fewer of the time-worn jokes concerning the man who staggers in at night and spends the rest of the night looking for the keyhole. Our observations have shown, however, that there are just as many keyholes "lost" today as ever before.

An inventor of a new key-holder which contains a tiny flashlight for finding keyholes in the dark probably realized this fact. This key-holder, which has been called "Keylite" by the inventor, Mr. L. A. Priess, takes the familiar form of the fold-over leather container with several swivel-jointed hooks for keys; but rolled tightly and sewed into one edge of the leather folder is a flashlight about three inches long. As this device comes into more general use, we expect the old keyhole-finding joke to go into the discard altogether.

Blowing Bacteria to Bits

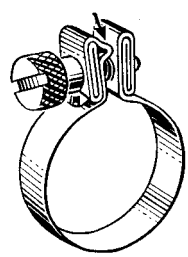
ANNIHILATING bacteria by blowing them to bits is the novel achievement of Prof. David Crowther of Columbia University, a process which holds promise of commercial application in the preparation of pathological vaccines and in the sterilization of certain foodstuffs. When bacteria become saturated with carbon dioxide at a pressure of 800 pounds per square inch and that pressure is suddenly released, the bacteria are destroyed and the protoplasm of the cells is liberated in a colloidal form because of the sudden expansion of the gas within the bacteria. Yeast cells are destroyed with difficulty, but larger organisms, such as weevils and eggs found in flour and cereals are easily destroyed, either by using carbon dioxide, or by a change in air pressure.

The time required for the carbon dioxide to go into solution and to diffuse into the bacteria varies, with the kind of bacteria, from one and a half to two and a half hours. Carbon dioxide is used rather than hydrogen or nitrogen because of its greater solubility at room temperature. The concentration of the bacteria held in suspension in a liquid seems to make no difference. The time required for the saturation of the larger organisms is from one half to one minute at a pressure of 800 pounds per square inch.

The pressure liberates the protoplasm of the bacteria without chemical change, and with certain kinds of bacteria the result is a vaccine superior to that prepared by the old methods involving heat treatment. Where a food product has become contaminated by some organism, complete sterilization is achieved without regard to whether eggs, pupae, or adults are involved. Such a method obviously is applicable where chemicals cannot be used or where they would not readily penetrate. For example, neither heat nor chemicals readily penetrate a package of flour, a bale of cotton, or a bag of seed, but such materials subjected to the pressure of a gas are readily and completely penetrated. In using compressed gas, the volume required is only that which is absorbed by the organism and the space between the material treated, provided the material does not dissolve or absorb the gas.—*A. E. B.*

A Fishing Reel Clamp

FISHERMEN of all kinds will be interested in the new reel clamp recently put on the market by Olson Bros. Saw Mfg. Co., of Brooklyn, New York. It is made in one piece, rolled from heavy nickel-silver wire to a flat strip with rounded edges. The ends of the strip are folded over four times to form the lugs through which



A new clamp for fishing reels. The arrow points to the locking hump

runs the locking screw. On one of the lugs is formed a hump, above the screw hole, which serves, when the clamp is tightened, to force the lower ends of the lugs together and draw the clamp into a perfect circle. The end of the locking screw is rounded and the head is knurled. The head is also provided with a deep, wide slot in which any coin may be inserted to give additional leverage when tightening. There are no sharp edges anywhere on the clamp, so it is impossible to chafe the line or cut the fingers.

16,000 Dollars A Year From Ashes

SAVINGS of approximately 16,000 dollars a year are realized from the salvage of metals from ashes that are produced in the scrap incinerator at the Schenectady plant of the General Electric Company.

The ashes, instead of being loaded into a car and delivered to the dump, are first run through a ball mill, where they are pulverized, the larger pieces of metal passing out of the mill and over a magnetic separator, which separates the magnetic scrap from the non-magnetic material, which consists of copper, brass, aluminum, and other metals.

The finer material which is discharged from the ball mill passes over an inclined, longitudinally grooved "concentrating table," which has a stream of water flowing crosswise of the material.

The metal, being heavier than the ash, slides down the bottoms of the grooves and falls off the lower end of the table, while the ash is washed off the side of the table

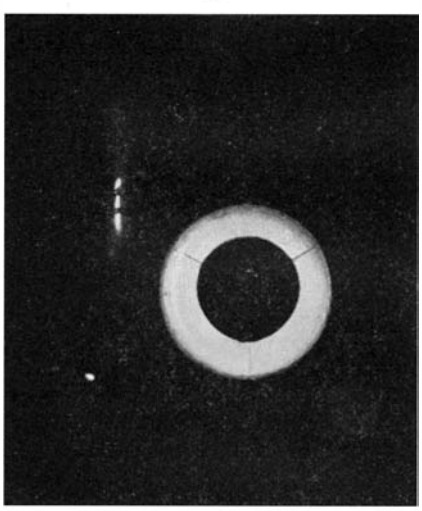
and is then pumped through a "dewatering cone" which discharges the dewatered ash into a dump car. The ash is used for filling in low ground and the metals and concentrates are sent to the smelter or sold as scrap.

By this method approximately 100,000 pounds of ashes are ground and washed and from 20,000 to 25,000 pounds of metals and high grade smelting material are recovered each month.

Non-Skid Rugs

THERE have been so many adaptations of rubber to commonplace products in recent years that we are not often impressed by any new development of this nature. The use of rubber on rugs, however, is one new adaption that, besides being unique, is extremely important from a safety standpoint. The rubber is permanently cemented to the underside of bathroom or boudoir rugs so that all dangerous skidding is eliminated.

A sample rug which we have inspected consists of a very thick pile about one half inch deep, on the underside of which sponge rubber about one quarter inch thick is cemented. The sponge rubber base grips the floor so tightly that there is absolutely no skidding effect. The added beauty of this rug is that it may be put in a tub entirely and washed like any ordinary bath mat.



White spare tire covers for automobiles provide a new measure of safety. This striking night view is ample evidence.—*W. J. Fraser*

Concrete Mulch Tried on Government Plots

BACK-YARD gardens ultimately may be paved instead of plowed.

The United States Department of Agriculture is now experimenting with permanent mulches of concrete, iron, cinders, zinc, aluminum, and other substances, which cover the surface of the ground, except for a small space where the plants grow.

The experiments, an outgrowth of the successful paper-mulch investigations of recent years, are as yet in their infancy, and the department makes no predictions as to their final value. In the tests beans, peas, strawberries, and various other small fruits have grown as well under the permanent mulch as with ordinary cultivation.

Blocks a few inches thick and 9 and 12 inches wide, cover the ground, with rows 1½ inches wide between them. The permanent mulch conserves moisture and controls weeds. In addition it warms the soil earlier in the season and keeps it warm longer in the fall. Rainfall gets into the ground along the rows between the blocks. The cinder blocks are covered with asphalt to make them black and absorb more heat, and other materials are painted black.

Soil covered with the blocks since 1928 has continued productive. Government scientists believe it possible that no ill-effects will be found, because they know that trees grow successfully under city streets and sidewalks, which constitute a "permanent mulch."

The Japanese, in certain parts of their country, grow strawberries by using field stones and cement blocks on the ground between the plants, but these are on mountain sides and are placed on a slant. The chief purpose is to force the plants for the midwinter market, and the system has been in use for several years.

Vitamins in Oil of Halibut Livers

A SOURCE of vitamin A, more than a hundred times as potent as cod-liver oil, the present standard "bottled sunshine," has been found in oil from the liver of the food fish, halibut. Halibut-liver oil also contains an unusually large concentration of vitamin D.

The discoveries came from the joint research of scientists of two pharmaceutical laboratories. The workers are Dr. A. D. Emmett and Dr. O. D. Bird of Detroit and Dr. C. Nielson and Dr. H. J. Cannon of Chicago.

Halibut-liver oil was characterized as "super-concentrated sunshine." It was said to contain not less than 50,000 vitamin A units per gram.

"Under strictly comparable conditions," the report of the four research chemists stated, "the growth produced in experimental animals by halibut-liver oil compares favorably with that produced by doses of cod-liver oil 100 times greater. The halibut oil, as prepared by special methods of extraction, has as a rule from 100 to 110 times the vitamin-A potency of a 500 unit per gram cod-liver oil. The vitamin-D content of halibut-liver oil, which has never been previously investigated, was also found to be unusually high."—*Science Service.*

Paint Serves as a Thermometer

PAINT which will change color with changes in temperature thereby indicating visually the temperature cycle through which the painted surface passes under a given set of conditions is the unique development of W. S. Andrews of the General Electric Company and chemists of John W. Masury and Son, of Brooklyn, New York, reported in a recent issue of *Chemical and Metallurgical Engineering.*

This paint is made by mixing intimately one part by weight of cuprous iodide with two parts of mercuric iodide, either dry or with the addition of a little water. If water is employed, it must be evaporated by the

application of a gentle heat at a temperature below 140 degrees Fahrenheit. When dry, the mixture should be ground to a fine powder, which is then mixed with a thin, light-colored, non-acid oil or spirit varnish. The resulting paint is applied with a brush.

Metals such as tinned iron or brass may be given one or more coats, but the paint should not be applied to aluminum as the resulting chemical action destroys the paint. A surface covered or striped with this paint—for example, a bearing or machine part—will be bright red from room temperature to 130 degrees Fahrenheit, at which temperature perceptible darkening occurs. At 135 degrees, the paint is noticeably darker and at 145 degrees it is maroon. At 155 degrees, it assumes a light chocolate color; and at 160 degrees, it is dark chocolate. When it has reached 190 degrees, it attains the darkest color that can be distinguished; and at 212 degrees, it is almost black.

In cooling, the color cycle is reversed, with the exception that the dark chocolate color appears at 170 degrees instead of 160 degrees, and temperatures between 212 and 170 degrees are not readily determinable. Below 170, the colors re-appear at the temperatures indicated for the ascending scale, and the cycle can be repeated as often as desired. A stripe of the paint on a hot-water tank will show readily the hot-water level.—*A. E. B.*

Cadmium in Wide Use

CADMIUM, which is less popularly known than nickel or chromium, is at present being used extensively in the automotive, airplane, electrical equipment, and radio industries, as well as in various other lines. Cadmium, like zinc, in the hot zincing, sherardizing, or electro-galvanizing processes, is used primarily for rust protection, but in addition, possesses a decorative value not usually associated with rust protective coatings, according to research chemists of The Grasselli Chemical Company, Cleveland.

Some of the products which are protected with cadmium include brakes, carbureters, lubricators, electrical systems, clutches, springs, shackles for automobiles; streamline wires, propeller hubs, landing-gear parts, brakes, and screw machine products for airplanes; while many air-navigation instruments are cadmium plated. This plating is called for in both Army and Navy specifications. Manufacturers of electrical equipment, switchboards, and controllers are using cadmium on a host of products. Nearly all steel parts in radio receivers are cadmium plated to protect them against rust, to improve their appearance, and to provide the desirable electrical properties characteristic of cadmium.

Among the interesting and important uses for cadmium plating was the rust-proofing of miscellaneous steel parts of the dirigible *Akron*. Cadmium plated parts are also being used in the construction of the sister ship of the *Akron*, which is now under construction at the plant of the Goodyear Zeppelin Corporation. Cadmium plated tools, which Admiral Byrd will use on his next expedition to the South Pole, are on exhibition in Jamestown, New York.

Cadmium finds many uses for railroad purposes and in the marine field, since it is particularly resistant to salt air and salt water.

Cadmium is silvery and lustrous in appearance and at one time was considered an undesirable impurity in zinc ores. It was first produced in the United States in 1907 and since that time cadmium has become a valuable by-product of the zinc industry. The development of processes for the recovery of cadmium has made possible the quantity production of cadmium at a sufficiently low cost to permit of its general use. Simultaneously with the increased production of cadmium as a by-product of the zinc industry, new and efficient methods were developed for the electrodeposition of cadmium on iron and steel and the development of such processes for depositing cadmium efficiently and in the most desirable form for protection and appearance is responsible for its widespread commercial use.

It shares with zinc the property of electro-chemical as well as mechanical protection. The ductility of cadmium is such that the rust-protected material can be satisfactorily drawn, bent, or fabricated. It is applied to metals without preliminary plating with any other material.

Viscount Grey and Lord Haldane

(*Continued from page* 341)

more reasonable, if England publicly and irrevocably took her place by the side of Russia and France.

Nicolson asserted that England would eventually be forced to side with France and Russia in the event of war, and a public statement to that effect would deter Germany from risking war, and thus preserve the peace. Grey saw the obvious advantages of such a course but he doubted that Parliament would sanction such a measure, and also he hesitated to place England's decision in the power of Russia or France. He had considerable experience with both Russian and French officials, and he thought he could exercise more restraint on them, especially on the Russian, by not placing the British fleet and expeditionary force at their disposal. He had seen Austria rattle Germany's saber in 1908, and he feared his allies might attempt to brandish the British broadsword.

Although war did not result from the Agadir incident, feeling between England and Germany became very inflamed. Von Tirpitz insisted that the diplomatic defeat of Germany was due to her inferior navy and insisted on a Supplementary Bill to increase the strength of the German High Seas Fleet. Von Tirpitz was supported by the large majority of his countrymen who saw England and France occupying the choicest parts of North Africa and restricting Germany to huge but undesirable parts of equatorial Africa. Chancellor Bethmann-Hollweg, who had replaced von Bülow, denied the diplomatic defeat and endeavored to prevent the adoption of this bill. The Kaiser was confronted by von Tirpitz who demanded a decision.

The Kaiser concluded to retain von Tirpitz's bill for a time but to open negotiations with England in an effort to obtain a German-English alliance or a treaty of mutual neutrality, in which case the German naval program could be reduced; he also desired a statement of England's program and wanted England to relinquish the "two keels to one" standard. Having formulated his plan, the Kaiser invited the British Cabinet to send a member of the Government to Berlin as the proposals were considered too delicate to be handled by the usual diplomatic channels. In response to this invitation the Government naturally sent Haldane because of his cordial relations with the Kaiser and his complete knowledge of the subject, and Haldane canvassed the situation with Bethmann-Hollweg and von Tirpitz.

HALDANE arrived in Germany in February, 1912; he received his usual friendly welcome from the Emperor and the leading officials. Bethmann-Hollweg impressed Haldane as being sincerely desirous of preserving peace. In conference, Haldane made the following points: (1) British naval and military preparations were strictly defensive; (2) British policy was against aggression by any nation; (3) Britain had no secret military treaties, but he stated that if France were attacked and efforts made to occupy her northern shores, the neutrality of England could not be depended upon.

In response to the German points, Haldane would not abandon the "two keels to one" standard, nor promise British neutrality in case of a continental war, and he added that any acceleration in the German fleet would be met by a two to one increase in the British fleet. This made further negotiations impossible, and although there was great friendliness on both sides, when Haldane returned to England with Germany's new program and showed it to the British Cabinet they decided an agreement was impossible and the British naval estimates were doubled in an effort to meet the new German program.

The frank conversations at Berlin did clear somewhat the British-German atmosphere; the officials of both states realized more exactly the difficult situation they confronted. There was less pin-pricking and Edward Grey patiently resumed his task of finding some agreement satisfactory to both sides.

Meanwhile, by 1912 the German Fleet had already attained such strength that the British Admiralty practically had to abandon the Mediterranean in order to maintain a decisive superiority in the North Sea. In spite of her diplomatic insistence on a two to one strength in capital ships, Great Britain, for financial reasons, did not maintain that ratio against Germany. Britain turned over her interests in the Mediterranean to France, and in return agreed to protect French Atlantic coasts. This was the necessary supplement to the previous agreement whereby the British Army would make up a French land deficiency; now the French Fleet was to supplement the deficiencies of the British Fleet.

As fleets move more rapidly than armies, it was necessary to re-group the vessels of the British and French fleets. This was completed in 1912, when the British Fleet took station in almost full strength in the North Sea and English Channel, prepared to contain or defeat the German Fleet and guarantee the passage of a British Expeditionary Force to France, if need be, while the French Fleet, with minor British reinforcements, was stationed in the Mediterranean to contain the Austrian and Italian Fleets and guarantee the passage of the Moroccan divisions to France. To any observant naval mind, the re-grouping of the British and French fleets was as significant as the German strategic railways debouching towards Belgium. To complete the naval arrangements of the Entente, conversations between the British and Russian Admiralties concerning joint action in the Baltic, were undertaken during the year.

The naval agreement between England and France was submitted to both governments, agreed upon and reduced to writing. In a painful effort to conceal from themselves the significance of their deed, the British Cabinet still insisted that they retained perfect freedom of action in the event of European hostilities.

After his return from Berlin in 1912, Haldane was appointed Lord Chancellor and departed from the War Office, but he had established the General Staff and completed the new organization. Colonel Seely, his successor, continued the work until the Curragh incident in the spring of 1914 forced Asquith to take over the War Office in addition to the Premiership. When the crisis with Germany became acute, Haldane was recalled to the War Office where he remained until relieved by Kitchener.

IN 1911, Italy declared war on Turkey and seized Tripoli. In the spring of 1912, Grey learned that Bulgaria, Serbia, Greece, and Montenegro were forming a coalition to take advantage of this situation to attack Turkey. The jealousies of the great powers permitted the formation of this alliance which declared war on Turkey and quickly seized her European provinces, but when the Balkan partners split over the division of the spoils, Grey was able to convene a conference of Ambassadors at London that forced a temporary peace in the Near East in 1913. Grey deserves well of the world for the patience and sagacity he displayed in these intricate negotiations, and it is doubtful if any other statesman in Europe could have restored the peace. Yet it is impossible to believe that Grey did not realize that the Balkan states in seizing Turkish territory were only doing on a small scale and after very severe provocation what the great powers had been doing all over the world for over a quarter of a century.

In the spring of 1914, there was temporary quiet in the European theater and there was an apparent betterment in the relations between Germany and England; underneath the surface the fundamental problems were as insoluble as ever. Then, in the summer of 1914 came the Sarajevo murder, with the succeeding steps, so often told, leading to the invasion of Belgium and to British intervention. During the last days of peace, Grey lived at Haldane's house in Queens Gate. Haldane had returned to the War Office to superintend the mobilization, and these two friends who had worked together to preserve the

peace, now collaborated on Britain's war measures.

Early in September, 1914, Russia, France, and England, then fully engaged on all fronts, made an agreement to prosecute the war to a successful conclusion, and each state pledged itself not to make a separate peace with Germany. In connection with this agreement some secret clauses were added providing for a division of the spoils of the anticipated victory. Theorists may quarrel with these arrangements but these states would have suffered if they lost, and it was only natural they should compensate themselves in the event they were victorious. These terms were modified on the entry of Italy and Roumania in order to provide similar rewards for them.

When the war was fully joined, the rôle of the Foreign Minister was less important than that of the War Minister, for as Grey himself states, "As far as Europe was concerned, diplomacy in the war counted for little." The reason was plain. Europeans from full experience know war thoroughly and they respect its grim realities. Neutral European states could not be coaxed to join an apparently losing side, so diplomacy during the war succeeded or failed not on its merits but on the successes of its military forces. Thus Bulgaria joined the Central Powers, because she thought they were bound to succeed; and Roumania joined the Allies when Brusiloff's drive appeared to be succeeding.

THE outbreak of war unloosed on Haldane such violent criticism because of his German education and his association with prominent Germans that he tendered his resignation as Lord Chancellor, but Asquith disdained to bow to the newspaper mob and refused to accept it. In the spring of 1915, however, the Conservatives made it a condition of their joining the government that Haldane resign, and Asquith was obliged to comply.

After his humiliation in 1915, Haldane might well have retired from public service and amused his declining years with cynical comments on the ingratitude of democracies. Instead, he continued in the House of Lords, and as the senior Ex-Lord Chancellor continued to serve on the Supreme Tribunals. He found time to visit Field Marshal French at St. Omer and saw in action the Army that he had done so much to prepare.

When Ramsay MacDonald formed the first Labor Government in 1923, he reappointed Haldane Lord Chancellor and in this position he led the Labor Party in the House of Lords. But these tasks were not sufficient for this tireless toiler so he became Chairman of the Committee of Imperial Defense, and once again supervised the armed forces of the Empire. The presence of Haldane in the first Labor Government added to its prestige and reassured Liberals and Conservatives that the legal machinery of the country and the defense of the Empire was in his experienced and capable hands. His interest in the progress of education never waned, and one of his last public speeches was an address to a Workers' Educational Association. When he died in 1928, detachments of Regulars and Territorials, headed by the Pipers of the Black Watch, escorted the body of this patriotic and philosophical Scotchman to his grave at Gleneagles.

Critics of Haldane who charged him with being over-friendly to Germany and the Kaiser appear criminal or ludicrous to-day, but he must accept a large share of the responsibility for denying the British people a chance to pass on the question of conscription. He was better acquainted than any of his colleagues with the might of Germany; he knew from Clemenceau's own testimony that from 1908 to 1911, the French Army felt itself unable to withstand a German onslaught. He knew that the Russian Army had not recovered from the Japanese war, and yet he contented himself with preparing an extraordinarily efficient but, compared with continental standards, a ridiculously small army.

Although its field was circumscribed, diplomacy did have a rôle to play during the war, and in the Near East Grey failed to take advantage of the offer of Greece to join the Allies with her veteran army that had triumphed over the Turks in 1913. Grey hesitated to accept the offer of Greece at first because of an ill-founded hope that he could keep Turkey neutral. After Turkey joined Germany he still refused in deference to Russia's susceptibilities. Later on, the Allies recognized their mistake and made futile efforts to gain the adherence of Greece. Grey has to accept responsibility for this error.

On the other hand, he deserves the major credit for preserving good relations with the United States in spite of the interruptions to our commerce by the British Navy. Our people have always resented any interference with their foreign commerce, even those sanctioned by International Law, so Grey's task was not an easy one as the records of our State Department and the British Foreign Office show.

Grey's policies can not be satisfactorily explained to his fellow citizens and enemy citizens at the same time, for if he satisfies his fellow citizens that he safeguarded their interests he is certain to cause his enemies to believe that he plotted their downfall. But Grey can show that he explored fully every peaceful avenue in the crises of 1906, 1908, 1911, and 1913, and succeeded in maintaining the peace without sacrificing the interests of his country, that finally in 1914, he accepted grave military risks for his country and allies before he advised Parliament to declare war. In this procedure he probably represented the bulk of his countrymen, who wished peace and were willing to accept a certain risk to preserve the peace but preferred war to seeing Germany dominate Europe.

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For those who may wish to go deeper into the subjects of the personalities and diplomatic background of the World War discussed in this article, we give the following references:

"Richard Burton Haldane"—An autobiography.

"Before the War"—By R. B. Haldane.

"Twenty-Five Years"—by Grey of Fallodon.

"Portrait of a Diplomatist"—By Harold Nicolson.

"Memoirs of Prince von Bülow," Vols. 1 and 2.

"Reflections on the World War"—By Bethmann von Hollweg.

"King Edward VII"—By Sir Sidney Lee. Two volumes.

Books SELECTED BY THE EDITORS

THE RED MAN IN THE NEW WORLD DRAMA

By Jennings C. Wise, Honorary Chieftain of The Yankton Sioux

FAR more has been written about the Indian from the white man's point of view than from the point of view of the Indian. This is a history of the white man's dealings with the Indians, written by a white man who knows them, but written distinctly from the Indian's point of view. As a lawyer Colonel Wise, the author, has had occasion to defend the Indian in the Supreme Court. His contention, which is probably true, is that the Indian was not a "fiendish savage" before the white man arrived, but that whatever traits he acquired came as a result of being tricked by repeated duplicity. The white man, with a few notable exceptions, in dealing with the Indians, did not consider himself bound by honor to keep his word given in honor; then, when the Indian resented this with increasing feeling, the white man more than resented the resentment and hated him for hitting back. A treaty with the Indian was only a temporary stand-off, and was not meant to be kept after it had become inconvenient. It will do us all good to read this work and get an idea of how it all looked to the Indian. Colonel Wise does not mince words. He says the historians have lacked the moral courage to tell the truth: He tells it.

This long but interesting account—your reviewer expected to be bored but instead found himself "reading toward the dawn"—begins with the pre-Columbian adventures of the Scandinavians in America, and here Colonel Wise is more daring than most historians; he believes the white man was here in far larger numbers and over longer periods long before 1492 than they do. Few will agree with him. The remainder of the large book (611 pages) is a systematic history of every Indian campaign against the white man from the days of the Virginia Colony to our own times. Only today is the Indian getting anything like a square deal. His chief friends in the government have been Franklin, Washington, Grant, Cleveland, Coolidge, and Secretary Wilbur. This book is more than well worth reading, and as a historical reference book it ought to be on the shelves of every library in the land.—$5.25 postpaid.—*A. G. I.*

THE UNIVERSE UNFOLDING

By Robert H. Baker, Prof. Astron. Univ. Ill.

THIS is the second of A Century of Progress Series; the first, "The Queen of the Sciences," was reviewed in our February issue. Within the space of its 140 pages Professor Baker, who is the author of a well-known textbook of astronomy, has compressed a remarkably revealing popular account of that science without taking the reader over any of the rough bumps of the textbook.—$1.15 postpaid—*A. G. I.*

MAN AND MICROBES

By Stanhope Bayne-Jones, M.D., Prof. Bacteriology Univ. Rochester

THE third of A Century of Progress Series. This little 128-page book is a gem. It contains more meaty information about microbes than many a full-grown book can boast, and it was found to make most pleasant reading. It tells in non-technical language just about what the average layman would like to know about microbes.—$1.15 postpaid—*A. G. I.*

RAMBLING THROUGH SCIENCE

By A. L. De Leeuw, M. S., M.E.

A WELL-KNOWN consulting engineer with scientific leanings explains many of the things—experiments with light, relativity experiments, radium, electrons, atoms, sound, time, space, matter, energy, and so on—which every reader having scientific leanings finds fascinating. The author's easy, chatty style of writing renders his book readable and it is not over the head of the average mere mortal. In fact, the book is a kind of modern physics, sugar-coated for taking without a wry face. —$2.65 postpaid—*A. G. I.*

GEMS AND GEM MATERIALS

By E. E. Kraus, Professor Mineralogy and E. F. Holden, Univ. of Mich.

THOSE of our readers who have taken up the new amateur hobby of gem stone polishing described in the March number, as well as others interested in minerals and gems, will find this book a valuable mine of compact scientific information. It covers the many forms of mineral crystals, the physical and optical properties used in identifying gems and other minerals, the composition of gems, the gem cutting and polishing industry (insight into professional methods), artificial gems, and contains a long treatise describing each type of gem mineral.—$3.20 postpaid.

ANTHROPOLOGY AND MODERN LIFE

By Franz Boas, Prof. Anth. Columbia

NOTED as an anthropologist who was recently president of the American Association for the Advancement of Science, Dr. Boas discusses a number of topics concerning races, nationalism, eugenics (which he puts in its proper place), criminology, education, and things in general which touch on much discussed questions such as race superiority and immigration.—$3.15 postpaid —*A. G. I.*

THE WISDOM OF THE BODY

By Walter B. Cannon, Prof. Physiology, Harvard

"I SHALL try to describe the physiological agencies and events in terms which will be clear to anyone who has had a simple training in biology and in general science." This is what the author says in his preface. This book will be regarded as a popular book by scientific men and a semi-scientific book by most laymen. It states clearly the present knowledge of science concerning such things as the constancy of body temperature, natural defenses of the organism, maintenance of oxygen supply, the blood, and so on, but is not intended to amuse the reader. He must be willing to think a little.—$3.65 postpaid—*A. G. I.*

THE GASOLINE AUTOMOBILE

By Ben. G. Elliott, Prof. Mech. Engr. and Earl L. Consoliver, Asst. Prof., both at University of Wisconsin

GASOLINE AUTOMOBILES

By James A. Moyer, Dir. of Univer. Ex., Mass. Dept. of Education

TWO gold mines of information for the motor-car driver, student, service-man, or mechanic! While neither of these books is a complete encyclopedia of all cars made, the information in each is so presented that the reader grasps the fundamental background in

such a way that the knowledge gained can be applied to specific cases. Both books take up the subject in about the same manner, having been prepared as readable, informative text books, but there are features in each that are worthy of special note. In Elliott and Consoliver (a fourth edition completely revised and rewritten) the electrical phases of motor-car work are given special treatment. In the back of the same book is a section on automobile operation and care that will do much to help the reader to a better understanding of his car and the way in which it should be handled.

Moyer (also a fourth edition) devotes a considerable portion of his book to gasoline systems and carbureters, and covers the subject in a manner that would be hard to beat. Photographs of sectioned carbureters, fuel pumps, and so on are liberally supplied, and accurately tied in with the text.

Both books are strictly up to date, including such subjects as free wheeling, floating power and other engine mountings, "silent-second" and constant-mesh transmissions, automatic clutches, fuel pumps, special cylinder heads, streamlining, automobile radios, and so on.—Elliott and Consoliver, $3.20 postpaid. Moyer, $2.95 postpaid.—*A. P. P.*

THE MACHINES WE ARE

By Robert T. Hance, Prof. Zoology, Univ. of Pittsburgh

A SERIES of rather light, breezy, sometimes almost flippant, chapters on the functioning of the human body. While it will not overtax the reader's comprehension, it surely will not put him to sleep. The reader will carry away a knowledge of "the machines we are," gained without conscious effort; this is not a physiology. Far from it, the book is confined to chats about the body instead of lessons to learn.—$3.20 postpaid.—*A. G. I.*

ARABIA FELIX

By Bertram Thomas

THIS is the full text of the outline story which recently appeared in *The New York Times Book-Review Supplement*. It is the tale of almost unbelievable accomplishment in crossing the empty quarter of Arabia—the last great desert expanse remaining for the white man to conquer. Across 600 miles of weird and dangerous wastes from the Indian Ocean to the Persian Gulf, with danger of death from murder, thirst, or starvation, this exciting, adventurous, and important exploration has been acknowledged to be "the greatest feat of land exploration of the present century." One finds here many corroborations of what seemed exaggeration when first read in "Robbins Journal"—the famous book telling of the Arab slave trade in Africa.—$5.20 postpaid.

JOBS FOR THE COLLEGE GRADUATE IN SCIENCE

By E. J. v. K. Menge, Dir. Dept. Zoology, Marquette University

WE are frequently asked by parents and students to give information as to the opportunities which are open to college graduates, so we heartily welcome as a reference this most concise and comprehensive survey of the field of science. It outlines the mathematical, physical, and chemical group, the medical, engineering and biological sciences. Appendices give positions where men and women trained in botany are needed and what we have not seen so completely given before, a list of the most representative endowed research institutions—their field and opportunity. Each division is followed by a selected list of a few of the most significant books appertaining thereto. A valuable work for which there is a distinct need. —$2.15 postpaid.

THE SKYCRAFT BOOK

By L. B. Harney

FROM an active participation in aviation as a licensed flying pilot and through a knowledge of years of teaching in elementary science, the author has anticipated just the questions which arise in the youthful mind and answers them in a running, comprehensive account from the history and romance, through craft lighter and heavier than air to models and model-making. Both for instruction and reader interest, this is much the best book of its grade that we have seen. It is heartily recommended.—$1.20 postpaid.

HOW TO UNDERSTAND CHEMISTRY

By A. F. Collins

FOR the layman who wishes to learn the fundamentals of chemistry, yet is irked by the technical language of a text-book, this handy volume will give the reader an invaluable basic knowledge for understanding the great scientific advances of today. Such matters as acids, metals, bases, and salts; the make-up and handling of formulas; the effects of heat and electricity on chemicals; and so on are explained in clear and concise fashion, readily understandable by anyone.—$2.15 postpaid.

JAPAN SPEAKS

By K. K. Kawakami

THE Sino-Japanese crisis is outlined in detail as seen from the Japanese viewpoint. Whatever we may believe, we owe it to ourselves to understand both sides. It is extremely enlightening and well worth considering as a background for assuming judgment in any case. All the treaties, concessions, political guarantees, and industrial developments are considered in extenso, the last giving a more complete summary than we have seen elsewhere. Japan needs the raw wealth of Manchuria and here acknowledges the fact, though one can but measure the benign attitude of acquiring it, here protested. Individual opinion will in the end assess just how much of this is to be credited. A most timely summary.—$1.65 postpaid.

AS I SEE IT

By Norman Thomas

EVEN his political and sociological opponents concede the honesty of thought and purpose of the author and all join in respect for his fine qualities as a man and thinker. A perusal of this book gives one many points to reflect upon, for though there is bound to be dissension over his conclusions, the facts he brings out and his analysis of sociological situations are thought-provoking and have been most evidently produced by an intelligent interest to better the conditions of his fellow man. We recommend this book to every one interested in the vast political problems of today.—$2.15 postpaid.

THE CHALLENGE OF LOVE

By Warwick Deeping

THE story of a young doctor fired with the zeal of duty to his fellow man, who has been restrained by hide-bound, ancient conceptions of community necessity, finally has to face a choice as to service to that community or to the girl he loves—the challenge. The development of this theme is in characteristic, clean-cut, idealistic lines which lift this author's stories above just well-told tales. There is always an ethical satisfaction in one's mind at the conclusion of all his books.—$2.00 postpaid.

THE COMPETITIVE POSITION OF COAL IN THE UNITED STATES

AN extended study by the National Industrial Conference Board of the position of coal in relation to other sources of world energy in recent years. Owing to a number of factors, the importance of coal declined relatively from 88 percent of the total energy consumption in 1913 to 74 percent in 1929 and 72 percent in 1930. For reference and research this work will be found invaluable for its text, charts, and tables.—$3.20 postpaid.

THE MOON

By Walter Goodacre, Dir. Lunar Sect. British Astron. Assn.

HERE is good news for the amateur astronomer who enjoys studying the endless variety of details on the

moon's surface—and what amateur doesn't! Walter Goodacre, the world's leading lunarian, has just published this new and exhaustive atlas and treatise. Roughly its 364 pages (7¼ by 10 inches) contain the following: A 50-page introduction to the study of lunar features; 25 separate chapters describing all the principal formations on the moon. Each of these chapters contains one section of the author's well-known 60-inch map of the moon, and a dozen pages of detailed descriptive matter about each individual formation. It is true, the same maps in reduced size are to be found in "The Splendour of the Heavens," but the descriptions in the new book are altogether more detailed, and in addition there are in the new book nearly 100 close-up drawings of especially interesting formations. The present treatise supersedes the two previous attempts to give a systematic survey of the markings on the moon, those, respectively, of Neison (1876) and Elger (1897) both being out of print, and is superior to anything of the kind ever published. Every amateur astronomer should add this work to his library before it too goes out of print, as it has been published privately.—$5.25 postpaid, imported.—*A. G. I.*

SEISMOMETRY

By F. W. Sohon, S. J., Georgetown Seismological Observatory

THIS is Part II of a two-volume work entitled "Introduction to Theoretical Seismology," the first part being "Geodynamics" by James B. Macelwane, S. J. Rather oddly the present volume, Part II, is published before Part I, which is in preparation. These two Jesuit priest-scientists are well known authorities on seismology, Rev. Sohon being the successor to the late Rev. Tondorf. The volume under review is not elementary and the reader should understand college physics and calculus, since nine tenths of it is mathematical. It concerns only the instruments and is theoretical and basic.—$2.90 postpaid.—*A. G. I.*

BEHEMOTH, THE STORY OF POWER

By Eric Hodgins and F. Alexander Magoun

THE authors might well have called this volume "The Romance of Power" and perhaps would have, if the word "romance" had not already been worn threadbare as used in this sense. Behemoth is more truly the romance of man's conquest and development of power as exemplified in his myriad of machines, than it is simply a recital of his achievements; his progress in invention and scientific discovery is depicted from the earliest beginnings to the present much publicized "machine age." The authors say that this is an "unlearned" book, but by reason of this fact, its simple style, and the authors' journalistic proficiency—they know the fine value of human interest and sprinkle it liberally on every page—it is a most readable one. It is a "wonder book" of the new age, and to those who wish to have, in addition to the scientific background of man's machines, a lively and entertaining picture of the guiding geniuses that made them possible, Behemoth will prove fascinating. 354 pages, indexed and illustrated.—$3.70 postpaid.—*F. D. McH.*

LEARNING TO SAIL

By H. A. Calahan

WRITTEN from the experience of 33 years teaching landlubbers to sail and seasoned salts how to sail properly, this book answers the questions which are raised by practical operation and makes a fine companion to "Small Boat Building." The latter going more extensively into care and repair. Detailed information on thousands of little points which usually it is assumed one knows anyway—just one of which may be what you are seeking. Generously illustrated with half-tones and diagrams.—$3.20 postpaid.

THE LAWS OF HUMAN NATURE

By R. H. Wheeler, Prof. Psychology Univ. Kansas

THIS book offers the first simplified and condensed general presentation of the *Gestalt* movement, explaining thoroughly the basic principles and concepts which are revolutionizing the interpretation of mind and behavior. It relates this new development in the field of psychology to its sister movements in physical and biological science, and also in social science, including ethics. A clear, balanced, and informative treatment which will be of especial interest to psychologists because it extends the application of *Gestalt* to hitherto neglected branches of the subject.—$2.15 postpaid.

PATHWAYS BACK TO PROSPERITY

By Charles Whiting Baker

CONTRASTED to most of the books on the world's present economic and social plight that have appeared recently, this one stands out as a constructive rather than a destructive criticism. Mr. Baker, an engineer who was for 22 years editor-in-chief of *Engineering News* and is an accomplished economist, shows up many of the social defects of our times and offers methods of mending them that seem eminently practicable. In layman's language and with apt and homely analogies, he carries the reader through discussions of such subjects as unemployment, the cyclical aspects of depressions, the question of our wisdom in mechanizing industry, debts and credits, the gold standard, Capitalism and Communism, wages, charity, the standard of living, and others equally as important in the modern scheme. He sees no broad road back to good times but rather a number of pathways that we must follow if we are to avoid anarchy. He has made a vital contribution to the economic and sociological thought of our times. 351 pages.—$2.65 postpaid.—*F. D. McH.*

MANCHURIA—CRADLE OF CONFLICT

By Owen Lattimore

AN authoritative and complete history of Manchuria by one who has traveled and studied there for years, living the life of the people while conducting research into the voluminous Chinese source material. Many misconceptions about this focal point of world interest are removed and the present crisis is shown in its true light. All the geographical, racial, cultural, economic, and sociological problems that make the current struggle in Manchuria a very complex one, are given detailed consideration. It not only gives a clear explanation of present issues, but imposes these on the historical background an appreciation of which is necessary intelligently to forecast future developments.—$3.20 postpaid.

THUNDER AND DAWN

By Glenn Frank, President Univ. Wisconsin

A KIND of manifesto of a new liberal movement—not a liberalism that the typical professional liberal would ever create or that he is likely to approve, but a liberalism that events are forcing upon intelligent erstwhile conservatives. Its basic analysis and contentions will stand the test of events for the next 25 years, but this is a book singularly fitted to the mood of the moment. "Science, economics, politics, religion, education, are all brought into the picture as they show up as factors in the cause or cure of the current situation"—publishers statement.—$3.70 postpaid.

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

A. C. Radio Set Patent Adjudged Invalid

CLAIMS 3 and 14 of the Lowell and Dunmore patent, No. 1455141, claiming a means for the use of alternating current from the standard residence lighting power in lieu of direct current from batteries in radio receiving sets of the three-section type consisting of radio frequency amplifiers, a detector, and audio frequency amplifiers, have been held invalid in a decision handed down by the United States Circuit Court of Appeals for the Third Circuit.

The court also held invalid claim 9 of the Dunmore patent, No. 1635117, relating to a signal receiving system, including a radio receiving set, adapted for the use of alternating house current. The opinions of the appellate court were announced in the case of Radio Corporation of America v. Dubilier Condenser Corporation et al. The appellate court reversed the ruling of the District Court for the District of Delaware, which had held the claims of the patents involved to be valid and infringed, and directed that the infringement suits brought against the Radio Corporation be dismissed.

Pointing out that the claims for the Lowell and Dunmore patent relate to a combination, the court, in an opinion by Circuit Judge Woolley, takes up each element of the combination. The radio frequency amplifiers, the detector, the audio frequency amplifiers, and finally the alternating electric current, called for by the claims, were all well known, the court finds after discussing the function of these elements in a radio receiving set of this type. The invention particularly claimed, it is pointed out, is directed "to the elimination of hum occurring in the vacuum tubes when they are heated by unrectified alternating current." A separate means connected to each of the three types of vacuum tubes used in a radio receiving set, those performing the functions of radio frequency amplifiers, detectors, and audio frequency amplifiers, for eliminating the hum which would result from the substitution of alternating house current for direct battery current without the use of such means, was claimed to constitute the invention, according to the opinion, and to support the patent.

"This hum eliminating means employed by Lowell and Dunmore in the last element of the claim," it is stated in the opinion of the court "is admittedly old. They simply used it as Heising had taught them by his patent in 1916 in the light of the White patent of the same year. The only thing left and, therefore, the only thing new is merely a part of the element. It is the separate connection (new) of an old hum eliminator with old tubes in each section of an old receiving set of the three-section type."

"The invention of 'separate' connection of hum eliminators, if invention it be, is influenced or is still further reduced in value," the opinion continues, "by the fact that hum eliminators of the kind the patentees employed had long before been connected with the radio frequency amplifier section in the use of alternating current. Therefore, in the final analysis, the claimed invention consists in applying curbed alternating current to the detector section and the audio frequency amplifier section and also to the radio frequency amplifier section in the same way that it had previously been applied to the last-named section."

Considering the question whether this step constituted invention, the appellate court ruled that it did not. The court also noted that at the time of the application for the patent, in 1922, there was no demand for alternating current as an electrical source in radio receiving sets. When the art later employed alternating current, it is stated, "the art employing alternating current—certainly that part which is represented by the defendant—provided hum eliminating means in accordance with the teachings of White and Heising, not for each section of a receiving set but for tubes (in whatever section) according to the different voltage they required to perform their different tasks."

"Being of the opinion," the court concluded, "that in developing the apparatus of the patent in suit the patentees applied in a natural and ordinary way the prior knowledge of the art without making an inventive advance, we are constrained to hold claims 3 and 14 of the patent invalid."

In the opinion on the Dunmore patent, the court also takes up the different elements of the combination claims covering "means for imparting positive potential to the plate and negative potential to the grid electrodes of a vacuum tube by low-frequency alternating current." Referring to the contention that "no one prior to Dunmore had converted alternating current into direct current and used it to energize the plates and negatively bias the grids of audio frequency amplifiers in a receiving system," the court finds that "Dunmore was not the first to convert alternating current into smooth direct current suitable for use in radio sets and not the first to use a transformer, rectifier, condenser, or a resistance in such a system."

The court stated that "we regard the Hull patent No. 1251377, issued in 1917, though alone not dispositive of the case, particularly informing to Dunmore. With this and other tools of the art in his hands, we cannot find that Dunmore made an invention when he applied them to an audio frequency amplifier tube effecting grid bias."

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.

Wiring Plan Patent Sustained

THE Walker patent No. 1592548, covering an underfloor duct system used in electrical wiring of buildings during their construction, has been held valid by the District Court of the United States for the Eastern District of New York, according to *The United States Daily*.

The invention is described in the opinion of District Judge Grover M. Moscowitz as follows:

"Walker provided a wire raceway buried in the floor slab and having pre-formed outlet-passages leading from the raceway to the floor surface, these outlets being supplied in so great a number and so far in excess of the number that would normally be used that, under any conditions that might be presented, there would always be an outlet at the point where an outlet would be wanted."

The possible objection to the considerable excess of outlets over and above those that would normally be used on the ground of expense is said to be met by providing means for making the outlets of so simple and inexpensive a form that the added cost of providing unused outlets is small in comparison with the advantage of flexibility without floor cutting.

The court found that the patent was an advance over the prior art patents cited, in that it eliminated inconvenience, noise, and expense in the installation of the system, and avoided cutting the floor to make connections with the outlets.

The claims of the patent also were held to be infringed. The decision was made in the case of Walker v. Austin & Moore, Inc., the defense of the action having been undertaken by the National Electric Products Corporation, which manufactures and sells the device found to infringe the patent.

Waiver of Patent Rights Clarified

A PERSON who seeks a patent upon a certain structure and discloses, but does not cover by claim, certain novel features therein may be entitled to another patent covering the disclosed but unclaimed features, upon an application filed within two years from the reduction of his invention to practice, even though the second application was made after the patent on the first application had issued, the Circuit Court of Appeals for the Seventh Circuit has just ruled.

The rights of an inventor in this matter depend, it is stated in the court's opinion, upon the fact question of whether the inventor has waived and dedicated to the

public the novel features which he did not cover by claim in his first application.

"Generally speaking," the opinion states, "the filing of an application for a patent, which application discloses novel features without making accompanying claims to all of the novel features disclosed, and the acceptance of a patent thereon, give rise to the legitimate inference that the applicant intended to dedicate to the public the unclaimed novel features of his invention." But it was concluded that such action on the inventor's part does not conclusively establish dedication.

If no other fact appears bearing on the issue of waiver, other than the failure to make the claim in the first application, the inventor may make the claims in a subsequent application filed within the statutory period, it was determined.

The court's ruling was announced in the case of Shipp v. Scott School Township, etc., No. 4597, in which Claim 9 of Patent No. 1711814 was found noninfringed and the remaining claims were held to be invalid.

Acetone and Alcohol Patent Held Valid

WEIZMANN patent, No. 1315585, covering the production of acetone and alcohol by bacteriological processes has been held valid by the District Court of the United States for the District of Delaware in an opinion handed down by District Judge John P. Nields.

The Guaranty Trust Company of New York and the Butacet Corporation are the holders of the legal and equitable title of the patent, the opinion states. The third plaintiff, the Commercial Solvents Corporation, is the exclusive licensee under the patent, and operates a process covered by the patent in the production of butyl alcohol and acetone.

The court also found that Union Solvents Corporation, producing and selling butyl alcohol and acetone in competition with the licensee under the patent, has infringed the patent by the process it uses.

The defense to the infringement suit in which infringement was denied and the validity of the patent attacked on the grounds of lack of utility, lack of operability, indefiniteness, non-patentable subject matter and the prior art, were overruled by the court.

The process of the Weizmann patent, according to the opinion, is carried out by bacteriological fermentation. The principal use of butyl alcohol is said to be in the manufacture of nitrocellulose lacquers of the Duco type, which are used for finishing automobiles, furniture and the like. The principal commercial use of acetone is as a solvent or absorbent in acetylene gas containers, and in the manufacture of photographic films and some types of artificial silk.

First Utilitarian Plant Patent Issued

THE first patent on a utilitarian plant, as distinguished from an ornamental variety, was issued recently covering a thornless dewberry, according to information made available at the Patent Office, Department of Commerce, and reported in *The United States Daily*.

The patent covers a dewberry similar to the Young variety, of which it is a sport, in all respects except that it is thornless. In the patent, the patentees state:

"As is well known, the vine of the Young dewberry as well as all other species of dewberries known to us, are quite thickly covered with sharp thorns, that not only are on the vines but also in varied sizes extend along the fruit and leaf stems, so that it is quite difficult to gather the berries without the pickers injuring their hands. The thorns not only cause painful wounds on the pickers' hands but also tear their clothing and generally impede their labor.

"Knowing how generally beneficial it would be to have a thornless variety of Young dewberry we took special care to propagate this thornless vine and in its cultivation and development endeavored to make permanent its thornless feature, which we have succeeded in doing."

Dewberries are widely grown in the United States, the fruit resembles blackberries, and the plants of all the leading commercial varieties grown at present have thorns, according to a statement by Dr. W. A. Taylor, Chief of the Bureau of Plant Industry, Department of Agriculture. There is listed in a Department publication, however, he pointed out, a thornless variety called the Austin thornless, a sport of the Mayes variety.

The patent, Dr. Taylor said, covers only the specific type of plant described, and not thornless dewberries in general. The Young variety is one which does not stand shipping well, but is an excellent dessert fruit and has a very good flavor. It is grown in several regions, and is now in the stage where its commercial value is being given a thorough test, although it is a comparatively new variety, he said.

Applicants for future patents on thornless dewberries would have to have a plant different from the thornless Young berry as described in Plant Patent No. 4, Dr. Taylor said. However, he added, if some one should discover a sport of the Young dewberry which was indistinguishable from the patented variety, the courts would have to decide whether the later discoverer would have the right to propagate it.

Hosiery Patent Held Valid and Infringed

A DECREE has been entered in the District Court of the United States for the Southern District of New York adjudging valid and infringed both claims of the Regar patent, No. 1719082, covering the process of forming a picot edge on seamless knitted fabrics, particularly hosiery, made by a circular machine.

There are five general features and two special features of the patent, according to an opinion of District Judge Francis G. Caffey, which preceded the entry of the decree. "The general features," it is stated in the opinion, "are these:

"We are concerned with a process. That process relates to the production of seamless fabrics. The purpose of the process is ornamentation. The application of the process is only to the part of the fabric which is known in the trade as the cuff. The particular part of the cuff that is affected is its turn or the line at its turn. The object sought to be attained by the ornamentation at that point is production of a scalloped or picoted edge. That is true as to fabrics generally under the first claim and as to stockings, especially, under the second claim."

The two particular features, it is stated, "are (1) tucked portions and (2) folding. The invention claimed in the specific and the only specific object described in the specifications is, to quote the words employed, 'to provide knitted fabrics with open tucked portions, which, when folded along a transverse line of the open portions, will produce a scalloped or picoted edge'." The method of producing the picoted edge is said to consist "in forming tucks in suitable spaced wales along a transverse line of the fabric, and folding the fabric along said line."

The patent is not anticipated, it was ruled, either by the prior art patents cited nor by prior uses in the manufacture of knitted fabrics. The method covered by the patent to produce the picoted edges was found by the court to constitute invention, it being ruled "that it can not be maintained that this application in the branch of seamless manufacture is analogous to what was employed in the flat machine that produces full-fashioned stockings."

The decision was handed down and the decree entered in the case of H. K. Regar and Sons, Incorporated, versus Scott and Williams, Incorporated.

"Esthetic Idea" Patents Invalid

ALTHOUGH esthetic ideas are "beautiful and charming and add much to the arts," patents protecting them are invalid, the Federal Circuit Court of Appeals ruled in a decision against Mrs. Mary Hallock Greenewalt, a concert pianist, of Philadelphia.

Mrs. Greenewalt sued the Stanley Company of America for infringement on her patented idea for producing "beautiful, harmonious color schemes" coincident with the playing of music by orchestras or organists. The Stanley Company employed the idea in one of its theaters. The decision of the Federal Circuit Court of Appeals upheld a ruling of the lower court.

"Panama" Hats Defined

A CORPORATION selling general merchandise, including hats, and a corporation selling women's apparel, agreed to stop using such words as "Panama" or "Toyo Panama" to describe such hats in advertisements so as to imply that the products are made from the leaves of the jipi-japa or in accordance with the regular process of manufacturing Panama hats, in a stipulation with the Federal Trade Commission. The companies will not use the word "Panama" either independently or in connection with the word "Toyo" or with other words in any way that would deceive buyers into believing the hats to be Panama hats.

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

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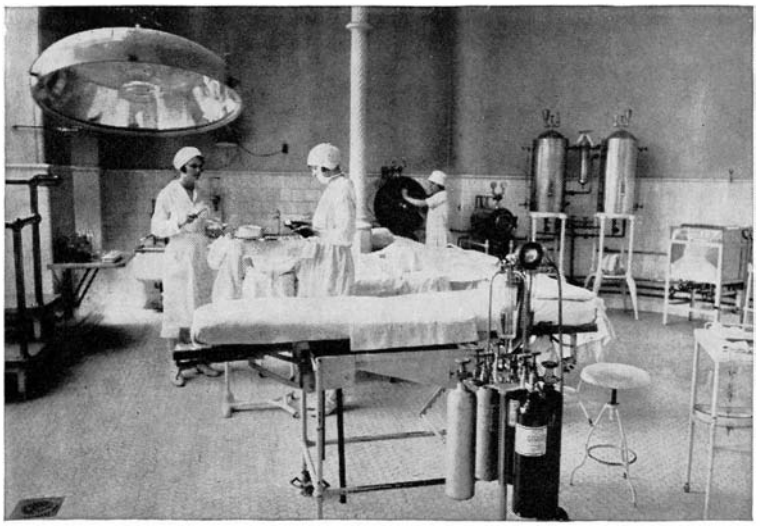

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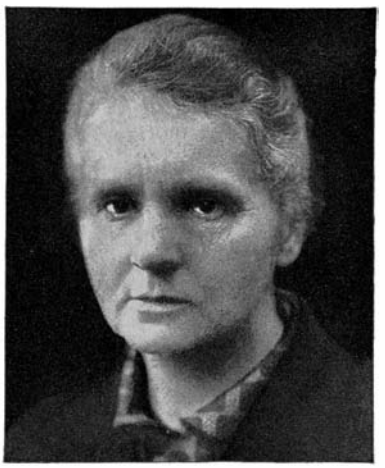

1898—Marie Curie *and her husband discovered radium.*

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1913—American Society *for the Control of Cancer founded.*

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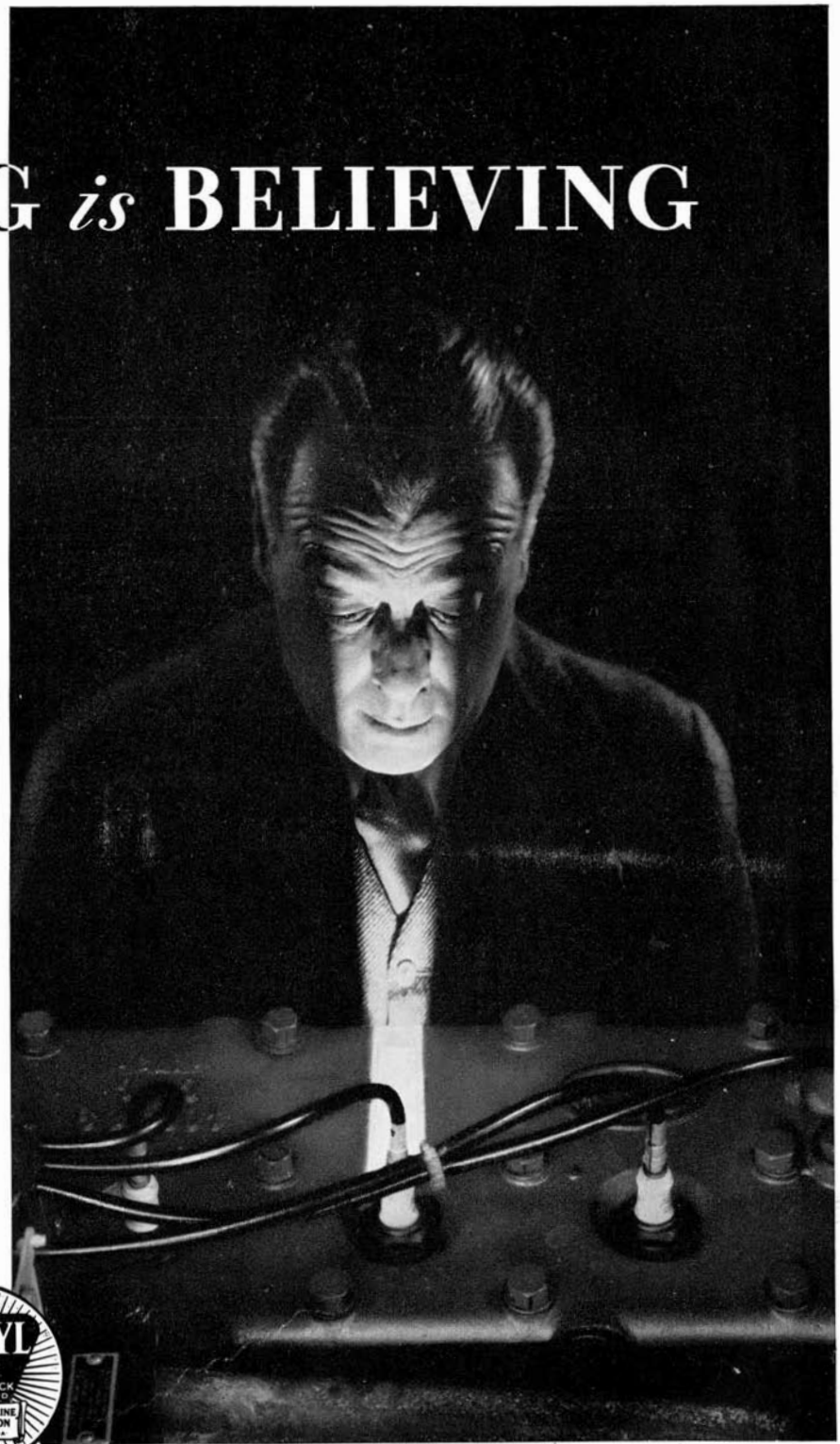

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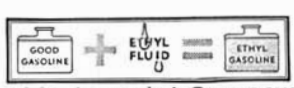

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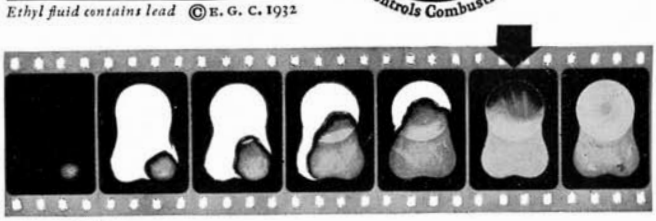

ORDINARY GASOLINE is in the cylinder. You see the spark in the picture at the left. In the next the gasoline vapor starts to burn. More—more—more burns. Then suddenly, in the sixth picture—BANG! The remaining gasoline explodes. That is KNOCK. The last picture shows nothing but afterglow. Knock wasted the gasoline that should be working now.

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