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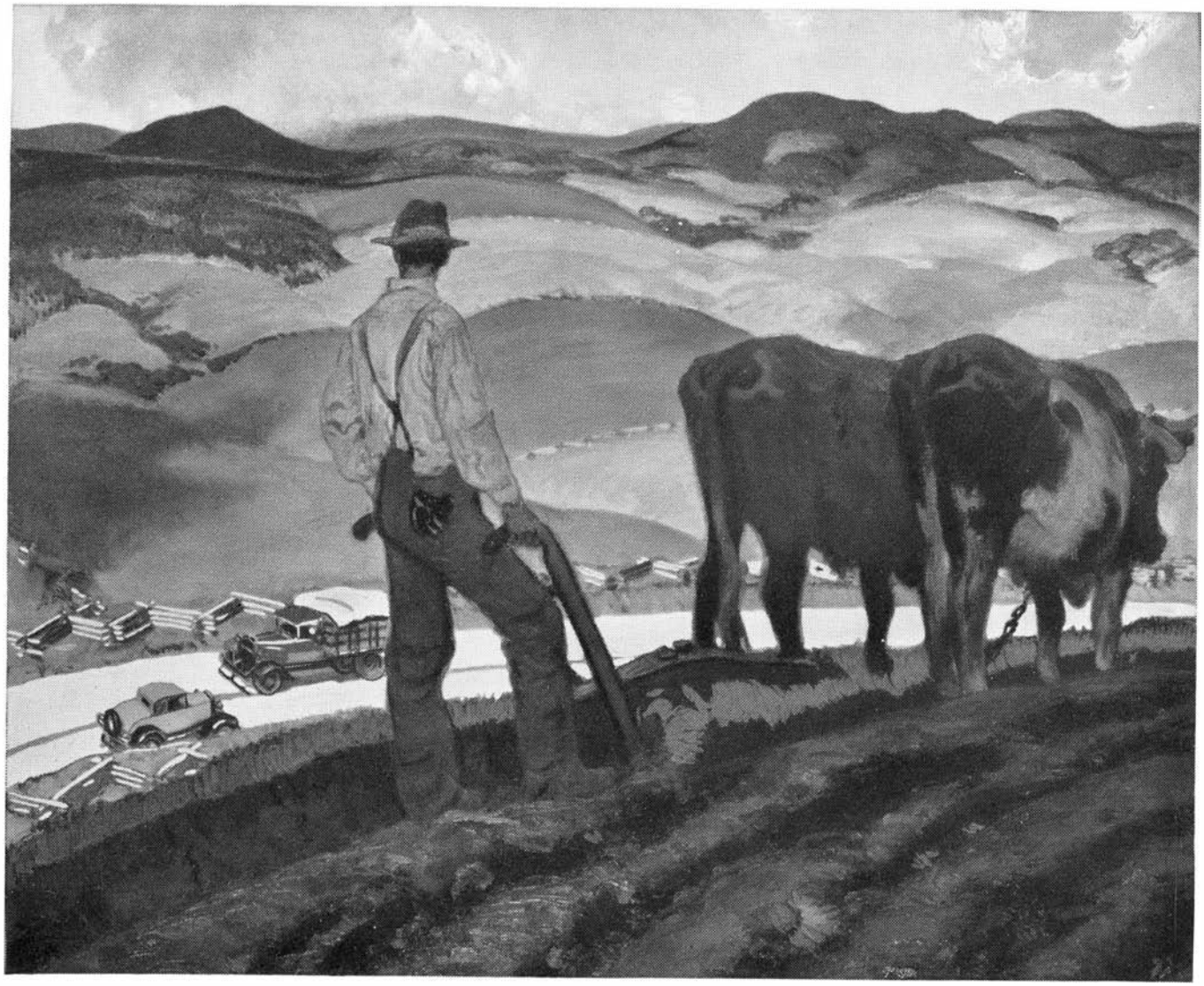

GROUNDWORK

"Mankind passes from the old to the new on a human bridge formed by those who labor in the three principal arts—agriculture—manufacture—transportation"

THESE WORDS are carved above the doorway of the Ford Engineering Laboratory. That they are not idle poetry must be plain to all who have driven over the country roads of America. For everywhere swift, economical transportation is freeing the chained energy of the nation as heat releases imprisoned energy.

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EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

CONTENTS · NOVEMBER · 1931

SCIENTIFIC AMERICAN DIGEST

Of General Interest

Aviation

Chemistry In Industry

Medical Science

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ACROSS THE EDITOR'S DESK

IT is with a sense of personal loss and a feeling of sincere regret that we record the death of Dr. David Starr Jordan, world-renowned educator and man of science. For many years Dr. Jordan was associated with SCIENTIFIC AMERICAN as a contributing editor, and we have always regarded him as one of our most valuable friends. Born at Gainesville, New York, on January 19, 1851, Dr. Jordan died on September 19, 1931 at Stanford University, California, after a prolonged illness.

Dr. Jordan graduated from Cornell University in 1872. In 1891 he became head of the Leland Stanford memorial university, continuing in that capacity for more than 20 years. The post of Chancellor Emeritus was then created for him, in order to allow him more time for his scientific investigations. He held high rank in the field of natural history, and was regarded as one of the leading authorities in ichthyology.

DURING the rush of prosperity which accompanied the World War, industry grew by leaps and bounds. Riding on the crest of the war-raised wave of booming business, new industries grew overnight from old, brought into being by new ideas which lent themselves to immediate application. But along with these applied ideas were conceived others which, at first sight, seemed to be impractical. They were discarded at the insistence of high-pressure production demands, and were forgotten. Then came 1921 and depression. Something had to be done, and in no small way were these discarded ideas responsible for the prosperity that returned and reigned for the greater part of the last decade. They were brought to light, subjected to intensive research, and furnished the bases for new and improved products. Possibly the same process will be the means of breaking the present business dead-lock. In the article "A Chemist Looks at Business Cycles" D. H. Killeffer reviews past performances of business, and gives some refreshing views of future possibilities. The article, founded on unassailable facts, will appear next month.

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Rickets, the bone disease that afflicts more than half of the babies in the north temperate zone, has received a new and effective set-back in the form of milk in which the vitamin-D content has been increased 20 to 30 times that which is normally present. The background of the work which makes this vitamin-content increase possible, and the commercial methods that are now being used to place the treated milk in the hands of the public, forms the subject of an article to be published soon. It will be of vital interest to all parents of small children, and to everyone concerned with the future of the race.

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The history of Poland has been one to arouse sympathy in the hearts of all liberty loving peoples. With the end of the World War and the establishment of a new Polish nation, the Poles responded with vigor to the problem of building up their country to modern standards. One of their greatest accomplishments has been the establishment of a huge seaport at Gdynia, through which products of the nation may pass unhindered to the markets of the world. The engineering aspects of the seaport development have been incorporated in an illustrated article scheduled for publication next month.

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We are all familiar with the phenomenon of ocean tides, but few realize that there are tides in the seemingly solid crust of the earth, and that they also are caused by the gravitational attraction of the moon. Harlan T. Stetson, director of the Perkins Observatory, has prepared an article, soon to appear in these pages, in which he describes the research work that is being directed toward a more complete knowledge of these earth tides. For example, he says: "Investigations now in progress . . . show that the latitude of a given place on the earth's surface varies, not only with the month . . . but depends . . . upon the position of the moon in the sky. . . ."

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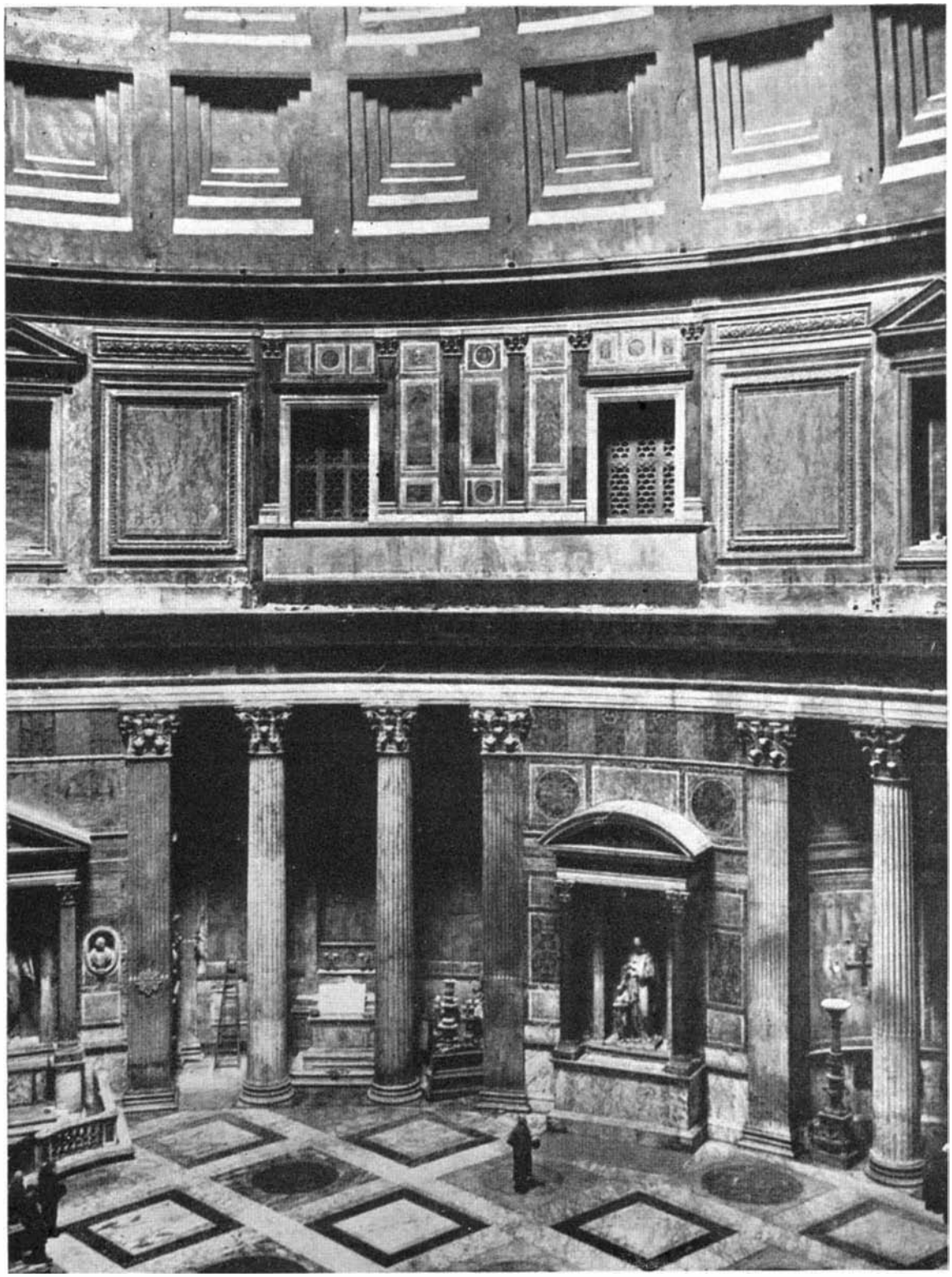
In the early days of the West, mines were the principle source of wealth, but the situation has now changed and the mining industry has declined to a fraction of its former importance. Today the principle resource of the same section is water—water applied by scientific irrigation to render fertile the vast regions of arid land. Just what water means to the West, and what is being done to conserve it and apply it properly, is told in a forthcoming article.

■

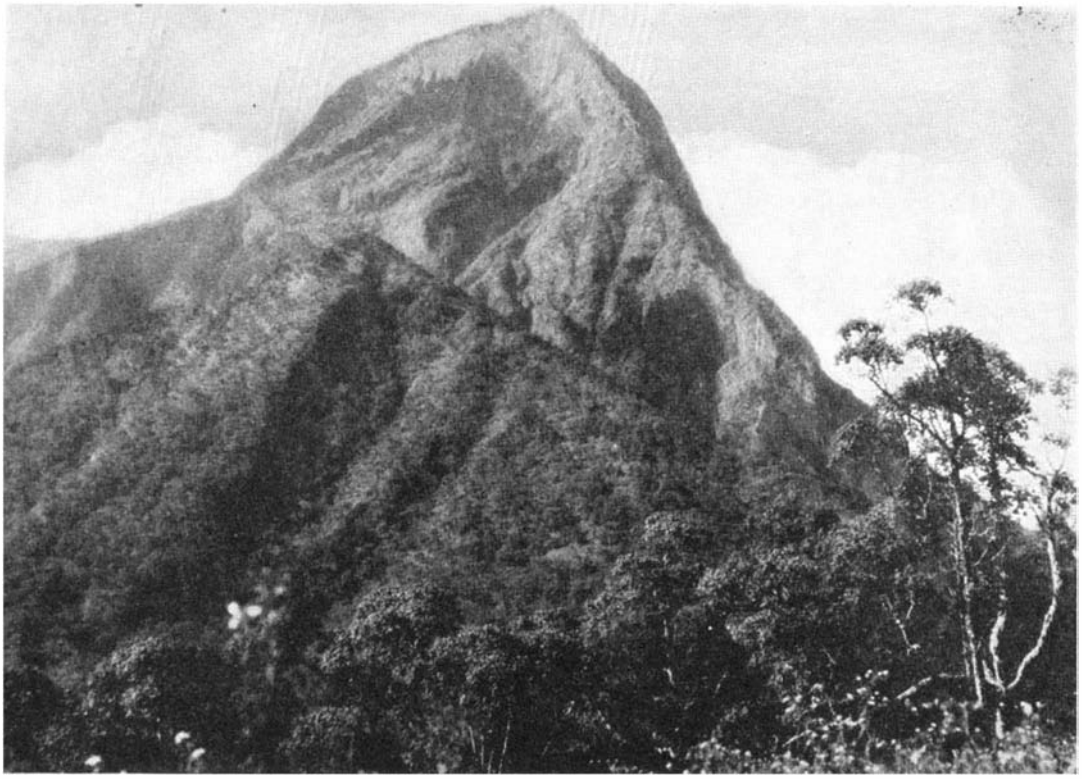
LINUS PAULING

HAILED as a prodigy of American science, Linus Pauling, who at 30 has published nearly 50 papers in original research, and who has won a full professorship in the California Institute of Technology, has been awarded the A. C. Langmuir prize of the American Chemical Society. Prof. Arthur A. Noyes, director of the Gates Chemical Laboratory of the Institute, and described as "a severe critic," characterized Pauling as "the most promising young man with whom I have ever come in contact in my many years of teaching." Dr. A. C. Langmuir, sponsor of the prize of 1000 dollars, called Pauling "a rising star, who may yet win the Nobel Prize." In singling out Pauling, he explained, American chemists, breaking with tradition, are honoring a scientist at the threshold instead of at the sunset of his career. The work of Pauling has had to do with crystal structure, the quantum theory of the dielectric constant of gases, atomic and molecular structure, and determination of the nature of chemical bonds. Prof. Pauling was born in Oregon.



ROME'S SPLENDID PANTHEON RESTORED

THE Pantheon of Rome is the only edifice in the Eternal City with walls and vaulting in a complete state of preservation. It was erected in 27 B.C., struck by lightning in 110 A.D., and rebuilt by the Emperor Hadrian. The dome is 142 feet in diameter. The building contains tombs of several celebrated men including Raphael. Attention has been recently called to it by the removal of the whitewash and plaster of 1746 which overspread the beautiful attic story above the columns, revealing the beautiful slabs of marble, porphyry, and serpentine.



An ancient extinct volcano, Mount Mikeno, is in the gorilla sanctuary of the Parc National Albert, where Carl Akeley rests

AFRICA'S FIRST NATIONAL PARK

By MARY L. JOBE AKELEY

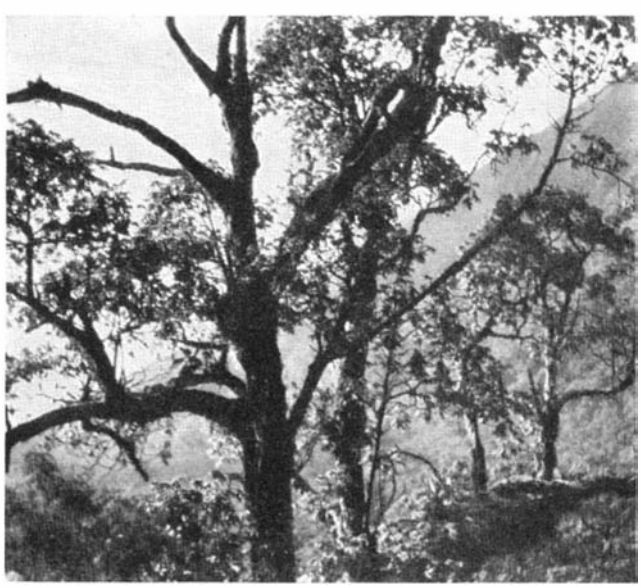
Secretary of the American Committee for Scientific Research in the Parc National Albert, Belgian Congo

IF you travel along the Equator westward from Mombasa, the Indian Ocean port of entry to old British East Africa, now Kenya Colony, or if you journey northward along the Westward Great Rift Valley of Africa, you will reach almost the geographical center of the great continent—a country still wild and unspoiled by man. This region, known as the Kivu District of the Belgian Congo, is west of Victoria Nyanza and north of Lake Tanganyika. When in 1908 King Leopold presented the Congo as a free gift to the Belgian people and it became a colony of Belgium under the name of the Belgian Congo, the Kivu was practically an untouched wilderness, peopled only by savage blacks and by the most primitive of all natives—the pygmies (*Batwa*). Since that day few white men have penetrated its vastnesses. Almost without any outside interference or influence, the black man has dwelt there, has cultivated his tiny *shambas* (gardens) or has hunted the game that roamed at will over a land unchanged throughout many centuries.

Belgian civilization has marched steadily up the Congo River; it has overspread even the valleys of its tributaries. The great Belgian Congo colony has developed enormously since the World War and its riches in copper, gold, diamonds, radium ore, cobalt, tin, and other minerals, as well as its agricultural products make it one of the greatest material assets of the Belgian nation.

In this wild area there is little conflict between economic development and scientific interest. The rolling lands around Lake Kivu are well adapted to agriculture and are rapidly coming under cultivation, but the great volcanoes adjacent to the Lake, as well as the sandy and swampy lands in the north about Lake Edward, are unfit for spade or plow.

Four years after the searchlight of interest had been turned upon the almost unknown volcanic region by Carl Akeley, the Parc National Albert was created by Albert, King of the Belgians, in 1925. This far-sighted act was Carl Akeley's dream come true—that this beautiful spot should become a sanctuary for all wild life. His chief interest was the preservation of the mountain gorilla, most interesting of all anthropoid apes, in the primitive forest of rare and age-old trees—the gorilla's home. His original plea, in 1922, after his return from his gorilla expedition for the American Museum of Natural History, was for a complete sanctuary ten miles square in the uplands of the extinct volcanoes.



A beautiful bit of African scenery showing the paper bark tree and the mossy platforms and profusion of ferns

Warmly sympathetic to this idea was Dr. John C. Merriam, President of the Carnegie Institution, who in turn advocated the cause to Baron de Cartier de Marchienne, then Belgian Ambassador to the United States. Several months before, Mr. Akeley had interested the Belgian Ambassador in the results of the gorilla expedition and his plan of conservation. Accordingly, early in 1924, the Ambassador began active efforts with his home government to the end that not only the small area of the reservation be secured, but that a larger outlying tract of land be set aside as additional protection to the gorilla. Seconding the efforts of Baron de Cartier with unremitting devotion, was the Belgian Consul-General at Baltimore, James Gustavus Whitely.

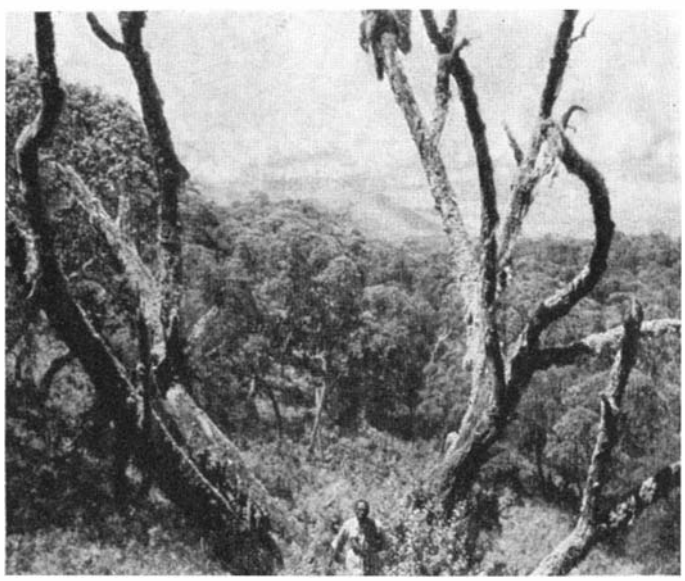
It was on March 2, 1925, that King Albert created by Royal Decree the Parc National Albert, Kivu District, Belgian Congo, as a sanctuary where not only animals, but also plants and natural scenery would be perpetually preserved, and where scientists from all over the world would eventually be permitted to come to study the flora and fauna of Africa under the most primitive conditions.

In the years immediately preceding 1922, with an ever increasing influx of big game hunters and natural scientists into the Belgian Colony, the last refuge of many unusual species, the Belgian Government recognized the necessity of permitting a certain number of such rare animals to be taken for strictly scientific purposes. It has consistently endeavored, however, to preserve these rare species and also to prevent the wanton destruction of other less rare, but harmless animals, the slaughter of which serves no useful purpose.

THE Belgian Colonial Authorities now found it necessary to restrict not only private hunting expeditions, but also certain expeditions contemplated by museums and other scientific bodies. Conceding that among the rare animals most in danger of extinction the mountain gorilla ranked pre-eminent, the 1925 decree, in the interests of humanity as well as science, preserved the remaining gorillas from extermination.

President Henry Fairfield Osborn from the beginning not only had been in warm sympathy with the idea of gorilla protection, but he had also been deeply interested in the possibilities for scientific investigation in this rare spot in the Kivu. Receiving from the Belgian Government an invitation for the American Museum of Natural History to participate in plans for scientific development and research in the gorilla volcanoes, he added to his personal and official interest a unanimous resolution of co-operation expressed by the trustees of the American Museum of Natural History.

During the two years after the conclusion of the 1926-27 Akeley-Eastman-Pomeroy African Expedition, the noted Belgian zoologist and conservationist, Dr. J. M. Derscheid, our companion in the Congo, and the author collaborated in proposals to enlarge the area of the park; to emphasize most strongly the necessity of preserving in the park all wild and natural conditions as they now exist; to save in their ancestral way of living some of the primitive African pygmies, a race now threatened by extinction; to maintain the spirit and essential character of the Royal Decree, as stated in its opening words: "The Parc is created for scientific ends."



Where gorillas roam near Kivu volcano. Carl Akeley used this pretty scene in connection with a gorilla group for exhibition

The project is now well under way. The park area has been increased from 60,000 acres (the original area set aside) to 500,000 acres. In October, 1929, an unprecedented event occurred in Brussels—the establishment and inauguration of an International Commission of 21 scientists for the control of scientific research in the park.

As we were gathered in the *Palais des Academies*, we were deeply impressed by the words of King Albert, who described the widely diversified scientific opportunities of the park—"a region not only of interest to geologists and mineralogists, but remarkable from the point of view of ethnography, since Bantu and Hamitic elements as well as Pygmies are simultaneously present; and, by no means least, remarkable from the point of view of biology, since the wide range of its altitudes allows several life zones to meet and gives rise to flora and fauna infinitely rich and varied."

"No other region of the African continent," said His Majesty, "offers such wide opportunity for scientific study and for the installation of scientific research stations which would be easily accessible in a climate almost ideal for the white race.

"IN our day there is much zeal, and rightly so, for the preservation of the monuments left us by the past. Here, in the Belgian Congo, you have also a primitive monument to conserve—a monument created by Nature during the course of thousands of years. Before you stands a great work to be achieved. In opening up and maintaining this exceptionally interesting region for the benefit of scientific research, Belgium will make a new contribution to the progress and application of science."

On this occasion, Drs. Merriam and Osborn were named as the American members of this International Commission, and the establishment of an American Committee for Scientific Research in the Parc National Albert was determined upon at the same time. His Highness Prince Albert de Ligne, then Belgian Ambassador to the United States, was named president* and the author was made secretary of this committee. The purpose of the American Committee is to bring the Parc and other similar undertakings in Belgian Africa in closer contact with American scientific and conservation organizations, and to secure support for these projects.

At a meeting of the American Committee, held recently at the American Museum of Natural History, New York, Dr. Derscheid, now *Administrateur-General* of the Parc, reported its progress to his colleagues, and told them of plans for the further extension of the park system in Belgian Africa. In addition to the Parc National Albert, there will be created a new park, Parc Leopold, near the northern border of the Congo. It will comprise an area of 1,000,000 acres. Lying north and east of Parc National Albert will be another new park, the Parc Ruwenzori, an area of 500,000 acres in the Ruwenzori Range, adjoining the Belgian Congo-

*Dr. Merriam is now President of the American Committee of the Parc National Albert.

British Uganda boundary. These new regions are of great scientific interest, since this new park extension will protect such rare mammals as the white rhino, the Okapi, and the Giant Derby eland.

Pending the official establishment of these new parks, activity has been concentrated in the Parc National Albert. Patrols of native scouts are on guard to prevent the killing of animals or the destruction of plant life. Meanwhile the Belgian Government has appropriated ample funds for the maintenance of the Park Service, and has advanced a loan of two million francs to begin immediate construction of a Central Station for Scientific Research. Certain limited areas will be closed even to human entrance, except as emergency may require. Entrance into the Parc will be rigidly supervised, since it is desirable that frequenters of the preserve be scientists and students, with a sympathetic and understanding interest in the work to be accomplished.

THE important point of scientific interest in the Parc is the triangle comprising the three ancient volcanoes, Mikeno, Karisimbi, and Bishoke, which rise beyond the palm-fringed equatorial Rutshuru River into the heights of frequent and long-enduring snows. Here in this small area are all the zones of climate of the earth—fervid heat, salutary mildness, biting cold. Clothed in gloriously beautiful vegetation—the bamboo, the mixed forest, the cold forest of giant trees—the old volcanoes afford rich forage for elephant, buffalo, and the strange, man-like mountain gorilla.

Below these extinct volcanoes are wide lava plains, sparsely vegetated and inhabited only by a few families of lion. In one rare spot, a small hill above the lava plains, dwells the chimpanzee.

Bird life is abundant and varied. Birds that live so high on these mountains might well be expected to resemble the birds of the north, and we find here doves, ravens, thrushes, titmice, and woodpeckers.

Two magnificent lakes are outstanding in this Kivu district of the Province Orientale. Lake Kivu is at the southern end of the territory. It is the highest and most spectacular of the central African equatorial lakes. Five thousand feet above the sea, often two thousand feet in depth, its clear and sparkling waters are flanked by rolling hills and rugged headlands. In marked contrast, Lake Edward in the northern part of the district is much lower in elevation. Its shallow turbid waters teem with animal life; its shores and adjoining grassy, sandy plains are hot, affording range lands for large herds of antelope—all the species found in East Africa, and found nowhere else in the Congo; its swamplands and affluent rivers harbor herds of hippo.

More than two miles above the sea level are the active volcanoes of Nyamlagira and Nyiragongo, devoid of animal life. Their eternal fires tinge sky and fleecy cloud by day and flame like giant beacons perpetually throughout the night.

But it is the high reaches of the forest-clad volcanoes of Mikeno, Karisimbi, and Bishoke that compel the greatest interest. You may go from the open spaces of the lower foothills, dotted with occasional trees and shrubs ablaze with scarlet blossoms, into the smoke-like gloom of dense bamboos, through which broad roadways run here and there, where an elephant herd has crossed your ascending route.

Here you have your first view of the gorilla's feeding grounds. Bamboos torn and scattered and twisted show where the hungry ape has fed on the young and tender shoots, sweetly-bitter and pale pink in color. You taste them and find them by no means unpalatable. Above the bamboos you enter the vast cold forest where gigantic trees with ponderous, sprawling branches impress you as nothing you have ever seen before. They are draped in heavy moss, hung with long, swaying ferns, and brightened by gay orchids. The upper reaches above timberline are clothed in giant heaths and senecios and immortelles that almost fringe the dead crater's rim.

Skeleton map of Africa showing the location of the gorilla country and the park

AS you follow the steep upward trail, progress is made possible only by half a dozen natives who go ahead hacking down the dense undergrowth—where sturdy bamboo and brilliant begonia, dainty fern and hostile nettle grow side by side; where vast beds of wild celery crowd into blackberry thickets 12 feet in height; where giant parasite lobelias thrive alike in rotting logs or growing trees; where shining laurels grow among rare flowering plants you have never seen before. It is indeed a veritable fairyland that the natives open up to you with their sharp, hand-wrought axes—a land of almost unearthly beauty which you are so laboriously penetrating.

It is at the 11,000 foot altitude that you see the forest at its best, at the very beginning of *Kanyanamagufa* (Canyon of Death) along which you have listened to the singing stream or glimpsed its shining waterfalls in the depths below. The forest is soaked in mist or rain. It grows increasingly cold. You will need warm clothing for wear by day and warmer still when in your camp at night. But when the sun breaks through the gray and white cumulus clouds or when the winds sweep clear the rugged summits of the volcanoes, then you have a sight worth traveling, as you must have done, half 'round the world to see.

The pygmies are the most curious and primitive of all natives in the still untouched Kivu region, where they hunt game and cultivate their tiny gardens

Everywhere is an untouched, unspoiled Paradise. The glorious living trees adorned with great platforms of golden-green moss stretch their branches not upwards to the sky but almost horizontally like giant arms beckoning you to pause there and learn the unrevealed mysteries of this world. Vivid orchids grow in moss or roughened bark, long fern fronds cling in fluttering draperies to every mossy platform, veils of grey-beard moss adorn massive trunk or lesser branch.

In all the open spaces wild celery grows in great abundance—often its feathery topmost leaves are above your head—its dense-growing, succulent, spicy stalks invariably impede your progress. It remains for the gorilla to do as he likes in the "celery patch"—his favorite feeding ground. There is no mistaking where he feeds. He pulls up the heavy stalks of wild celery, strips off the tough outer husks and gorges on the tender hearts and juicy roots. After one morning's feeding a family of 20 gorillas will make a celery patch 100 yards square look desolate. But their food supply is by no means precarious. A week after they have fed, the spot is covered with long new shoots and soon the wild celery is everywhere growing as luxuriantly as it was before the gorillas visited it.

A view of the Kivu forest in the gorilla country

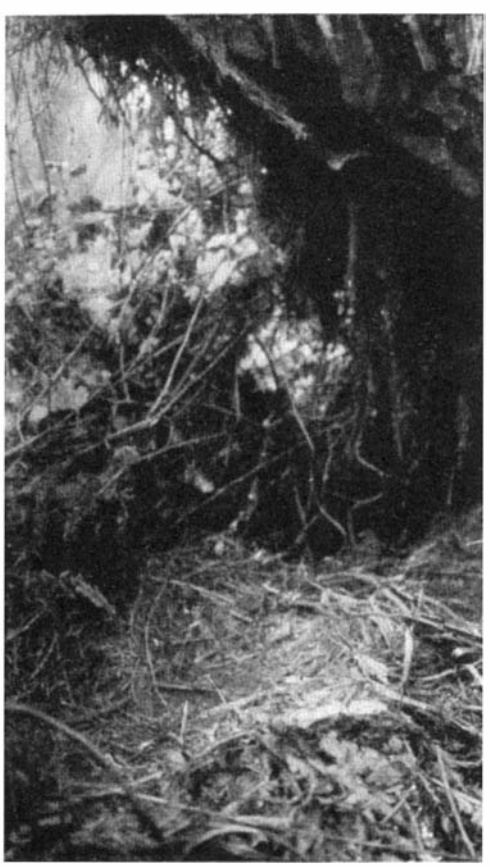
FROM their feeding grounds, their trails—wide and distinct—lead out to other pastures or to semi-open spots among the trees where they build their beds for rest and sleep throughout the long afternoons and nights. These beds are prepared by pulling together dry vines and sticks and moss, and by fashioning them into a comfortable resting place. Sometimes they are quite exposed in the open, sometimes in the dry earth under an overhanging and protecting tree. Mother and babies too old to rest in their mother's arms sleep side by side. Father gorilla's bed is nearby.

Once in a very long while, a half-grown gorilla climbs a few feet up to an overspreading branch and there, close to the family, he builds his bed in the thick foliage. There he is out of harm's way if a hungry leopard invades their camp.

Among the bamboos, throughout the cold forest and up even to the subalpine zone, the buffalo ranges. His trails criss-cross those of the great apes, but there is peace between them because there is no conflict of economic interest. There is plenty of forage for gorilla, elephant, and buffalo.

Here, in this enchantment, is now established Africa's first national park. When Carl Akeley first visited the home of the mountain gorilla in 1921 to collect a group for the American Museum of Natural History, he was not only struck by the beauty of this region but he was also amazed to find apparently so few gorillas inhabiting it. While homeward bound on the Red Sea, his idea of a gorilla sanctuary took definite shape. He wrote to Judge Paul Salkin, Elizabethville, Katanga, Belgian Congo, that he had found the gorilla "a wholly acceptable citizen and not the wicked villain of popular belief;" that he is "a splendid animal in every sense, in no sense aggressive or inclined to look for trouble," and that even the largest male, a magnificent creature weighing 380 pounds, like all the others secured by the expedition, showed only a disposition to get out of danger.

Even in face of the fact that my husband's 1921 investigations were confined to a few weeks, he was, nevertheless, confident that the gorillas were limited in numbers—not the thousands as represented by the professional hunters then interested in gorilla hunting for sport. He found them healthy and not unusually wild. In fact many of the gorillas he met were unconcerned—some even climbing up on an overhanging tree trunk to get a better view of him while he made the first motion pictures ever made of live wild gorillas in their native haunts.



Left: **The gorillas make "nests" or beds by pulling together vines, sticks, and moss.** ***Right:*** **Native removing a specimen of a gorilla nest**

OUR POINT OF VIEW

Whose Fault is It?

"WILL you please send me a picture of an atom, or pictures of several kinds of atoms, with exact dimensions?" Letters expressing substantially this thought are received quite frequently by the editors of all scientific journals, from persons who are sincere in the belief that exact answers can be given.

One inclines at first to smile. But hold—has anyone a right to smile? Who is responsible for leading people to think it possible for a true picture of an atom of matter to be available from scientists? The defendants are two. Neither is really guilty of intent to mislead anyone, but the information in misleading form has nevertheless reached the public. When the physicist describes an atom or draws a sketch of one he is generally speaking to physicists, and he knows they know he refers only to an imaginary concept—one which is only in the process of development and subject to merciless modification. When the popularizer of science picks up such transient concepts and sets them before general readers as if they were established facts he is either guilty or ignorant. Yet, as sundry books and articles reveal, this is being done every day.

Nobody has ever seen an electron. Nobody has ever seen an atom. Nobody has ever seen even a molecule. If our most powerful microscope were about a thousand times stronger than it is, and if there were no other obstacles, some of the molecules—the largest ones—could be brought into our ken provided they would stop their eternal dance and "stay put" long enough to be viewed. We deduce our mental "picture" of these particles from indirect evidence—from the way they act when we put them through various performances. But, just as a blind man could deduce a certain picture of a trained flea by the results of certain experiments on it, yet go wrong time after time, so science deduces a picture of the atom; and like the blind man with the flea, science goes wrong again and again.

The latest "model" of the atom is not a model at all. The closest concept of it is not close at all; it is the Greek letter *psi*. This stands for "electric density" and that is about as near as we can come to picturing it in our minds. As later and later styles in atoms are set, the trend seems to be away from comprehensibility, not toward it, for the average man. Popular writers should be frank about this and not put science in the position of knowing things concerning which it is largely ignorant. With matters going on as they are, the public is gradually becoming cynical, and wonders whether science after all is not largely bunk. Whose fault is it?

Building for Parity

EIGHTEEN months have passed since representatives of Great Britain, Japan, and the United States affixed their signatures to the London naval armament treaty by which the 5-5-3 principle of the Washington Treaty of 1922 on capital ships was extended to cover other categories. And yet, despite our successful fight to be allowed parity with Britain, we have not outlined a program by which we may attain it. It is true that Secretary of the Navy Charles Francis Adams announced early in August the Navy's new policy to put the London Treaty in effect, but at the time this is being written, nothing definite has been done.

Recent figures given out by the Navy Department show that while the building programs of all the signatory nations lag behind the construction permissible for 1930 and 1931, that of the United States lags worst of all. These figures and those given in the SCIENTIFIC AMERICAN Digest of this issue show that we should be building in the calendar years 1930 and 1931 a total of 116,740 tons. Congress, however, provided for laying down *no ships* during these two years and appropriated, on the 1931 program, for only 11 destroyers, with an aggregate tonnage of 16,500, which were authorized in 1916! Great Britain has appropriated for more than four times as much tonnage as has the United States since the London Treaty; France, if we include a program for 1930-1931 approved just before the treaty was signed and another program proposed for 1931-1932, has projected four and one half times as much tonnage; Italy has appropriated for twice as much; and Japan has approved a plan that will bring her to full treaty strength. So far as the United States is concerned, there *is* a naval holiday!

The United States obtained parity with Great Britain—on paper—and now it is up to the nation to achieve it on the high seas. Popular demand should see to that. It is true, of course, that such a demand would place the Administration in an embarrassing position: with a steadily growing Treasury deficit, Mr. Hoover has to consider national economy almost, we might say, ahead of all other things. This desire for economy, however, would be balanced to a large extent by the aid a well-considered naval building program would give to the unemployment situation and to the many industries which would be called upon to supply the materials needed. There is a happy medium somewhere between the two extremes and the nation will look to Mr. Hoover and the Navy to find it.

A False Alarm

TAKE heed! In 10 years, or at least no more than 20, our supplies of natural gas will be exhausted! The conservationist voiced this warning 30 years ago and has been repeating it ever since. Fortunately for the unheeding people who have used this natural wealth extravagantly, his prediction was short-sighted and unnecessarily gloomy.

A short time ago a pipe line to bring natural gas from Texas to Chicago, a distance of over 900 miles, was completed and placed in operation. This is the longest of an ever-growing number of long pipe lines that have been laid to carry the precious fuel; it taps a reservoir which, even though its gaseous product be consumed at the rate of a half billion cubic feet a day, will not be exhausted for 100 years. Looking at other fields, we find that the two which supply San Francisco with 400,000,000 cubic feet daily will last for 75 years; others are being exploited more fully than heretofore; still others are being brought into production.

This does not mean that we may waste our natural gas with impunity, but it does mean that there is enough to supply our industrial and domestic needs for some time to come. And it is not too much to expect that by the time our natural gas supplies have become exhausted, fuel technology will have progressed to the stage where distillations from coal will take their place. As it is at present, artificial, or manufactured, coal-gas is used to dilute the natural gas because the latter is too rich for ordinary use. In the future, coal may furnish all the gas that is needed; and we have enough coal to last several thousands years.

A panoramic view of the hydroelectric development at Rock Island in the Columbia River.

POWER DEVELOPMENT ON

By T. B. PARKER*

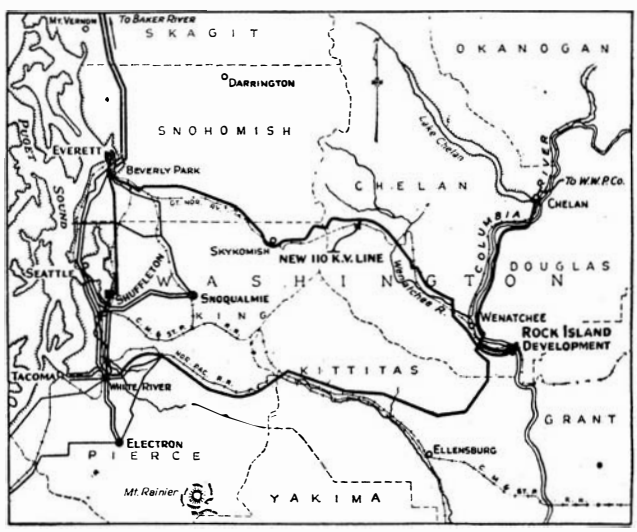
THE Columbia River is one of the most famous streams in North America, and in earlier days formed the gateway to the Northwest. It drains a large portion of the great basin which lies between the Rocky Mountains and the Cascade Range, including parts of Washington, Oregon, Idaho, Montana, Nevada, Wyoming, and British Columbia. The total drainage area is about 259,000 square miles, of which about 89,000 square miles are tributary to the power site at Rock Island where a dam is being built to harness the waters of this river for the first time.

This upper portion of the Columbia watershed includes a large number of lakes, glaciers, and snow-covered mountain ranges, so that the dry season flow is remarkably well sustained. The lowest measured flow at Rock Island was about 21,000 cubic feet per second, which is a very considerable amount of water. Some idea of this quantity may be gained by imagining a stream 210 feet wide and 20 feet deep, flowing with a velocity of five feet per second. The maximum flood on record since 1858 occurred in 1894, and was estimated at 740,000 cubic feet per second. The discharge of the Columbia River shows a remarkable regularity in its seasonal variations. The larger floods occur in June or July, while from October 1 to April 1 the flow rarely exceeds 100,000 cubic feet per second.

The Rock Island Hydroelectric Development, now under construction, is located on the Columbia River about 12 miles downstream from the city of Wenatchee, Washington, and thus is adjacent to the famous Wenatchee fruit-growing district. It is being built for the Puget Sound Power & Light Company, which is the principal distributor of power in western Washington. This development will have several novel features, and will be the first large low head development in the Northwest.

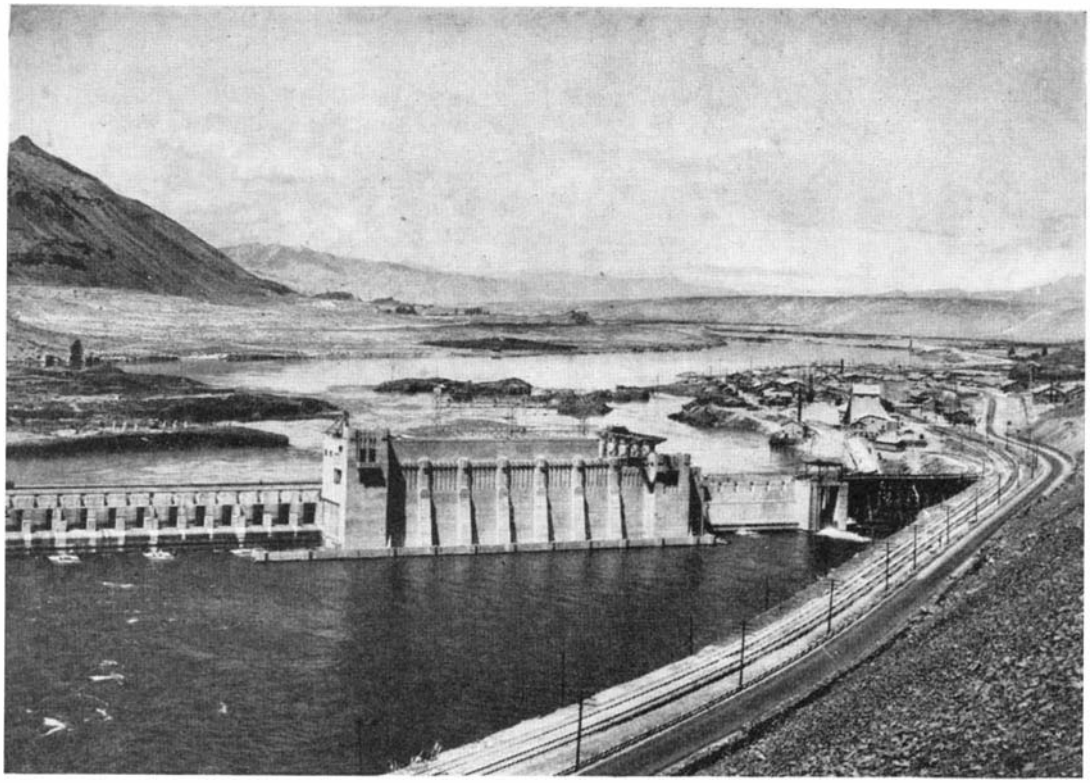
At the island which gives the project its name, the river divides into two nearly equal branches, and flows with considerable turbulence through a rocky gorge about half a mile long. At low water, the total drop is about 15 feet; at high water about 7 feet. When the dam is completed to its ultimate height, a maximum head of nearly 51 feet will be available at low water. It is not planned, however, to develop this full head until necessary to meet load requirements.

For larger flows in the river, the head is greatly diminished, and it is the production of the necessary power under a reduced head which is one of the most interesting features of this development. During a flood equal to the highest flow recorded since 1894, the minimum head will be about 20 feet.



Map showing location of Rock Island development

*Project Engineer, Stone & Webster Engineering Corporation, Boston.



This photograph, taken from downstream, shows the work as completed at the time of writing

THE COLUMBIA RIVER

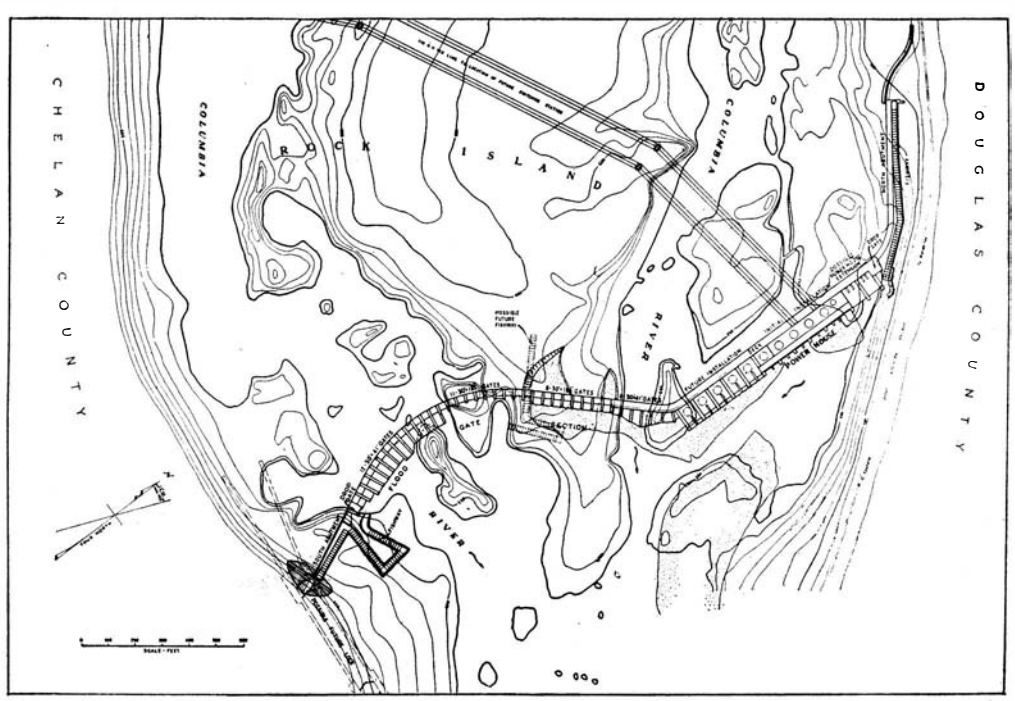
Fortunately the maximum reduction in head will always take place during June or July. Since the capacity of other water power plants on the same system is at a maximum in the summer, it follows that during the period when the generating capacity at Rock Island is reduced by high water, the demands for output from this plant will also be less.

The development has been planned on the basis of an ultimate capacity of ten 15,000-kilowatt generating units, with provision for the possible later addition of two more 15,000-kilowatt units should this prove desirable. The initial installation will be four units, or 60,000 kilowatts.

The power house is located in the east channel at an angle with the direction of flow. It is connected to the east bank by means of a gravity bulkhead section, and with the island by a gate controlled spillway. A similar spillway is being constructed across the west channel.

The power house has a number of unusual features. Owing to the necessity of providing for possible extreme high water, all windows and exterior openings have been omitted from the building up to the main deck, which is about on a level with the roof of the generator room. This condition has made it necessary to provide extensive drainage, ventilating, and lighting systems.

The water wheels have been designed with a view to producing as much power as possible under a reduced head without sacrificing too much efficiency under normal conditions. Although designed to operate efficiently under a head of 50 feet, these wheels will develop 21,000 horsepower, equivalent to normal generator capacity, when the head is reduced to 32 feet. For a head of 20 feet,



Plan of Rock Island development, showing fishways, power lines, and so on

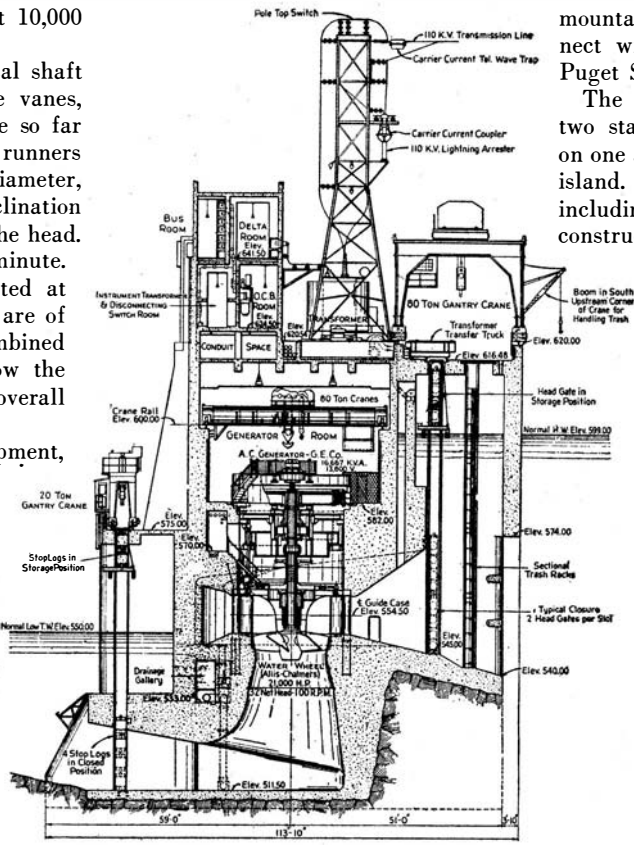
each wheel will produce about 10,000 horsepower.

The wheels are of the vertical shaft propeller type with adjustable vanes, and are the largest of this type so far installed in this country. The runners are about 18 feet 7 inches in diameter, and have six vanes each, the inclination of which can be varied to suit the head. The speed is 100 revolutions per minute.

The generators are each rated at 16,667 kva., 13,800 volts. They are of the umbrella type with combined thrust and guide bearing below the rotor. Each stator has an overall diameter of 28 feet 8 inches.

The 13,800-volt switching equipment, the main and station service control equipment, and two banks of three 13,800 to 110,000 volt, single phase transformers for the two outgoing high tension circuits are located on the roof of the generator room.

The topography at Rock Island is very favorable in that a dam with the required crest elevation has a comparatively low average height. On the other hand it is necessary to offer very little obstruction to the flow of the river during extreme floods, in order to avoid raising the water level upstream. The result is a spillway consisting mainly of a massive concrete sill upon which are constructed concrete gate piers seven feet thick and 30 feet apart in the clear. The piers support a reinforced concrete deck from which the flood gates will be operated.

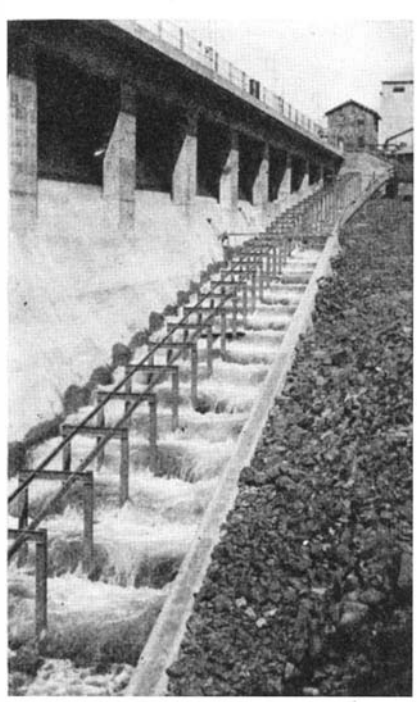


A cross-section of the main unit of the power station in the Rock Island development showing all the details

ALMOST as well known as the Columbia River itself is the Columbia River salmon. Every spring and summer enormous numbers of these fish return to the river to breed. Finding their way by some remarkable instinct from the ocean to the place of their birth, they pass up the main stream, over rapids, and through all obstructions, finally arriving in the shallow waters of the tributaries where they spawn and die. The fisheries industry is one of the largest in the northwest, and it is essential to the continuance of this industry that there be no serious interference with fish migrations on the principal rivers.

In the case of the Rock Island development the government required the immediate construction of two fish ladders, which when completed will probably be the largest of their kind. These fish ladders have proved to be one of the major problems of the entire development, because of their large size. Each ladder will be of rock and concrete, 500 feet long and 20 feet wide with a slope up and downstream of 1 to 10. One is located on the east and one on the west bank of the river, each along the downstream side of a concrete abutment section, with openings through the abutment at various levels to allow a flow of water into the fishway and to permit the upstream passage of fish into the reservoir.

Power from the Rock Island development will be transmitted at 110,000 volts over lines which will cross the mountains at favorable points and connect with existing substations of the Puget Sound Power & Light Company.



Looking up one of the completed fishways built by government order

The project is being constructed in two stages by diverting the river first on one and then on the other side of the island. The east channel structures, including the power house, are being constructed first. The low water period, during which it is possible to divert the river, usually extends from September to April, inclusive, so that it has been necessary to do most of the work during this part of the year. Cofferdams in the east channel were started in February 1930, in order to get as much of this preliminary work as possible out of the way before the following construction season. Both upstream and downstream cofferdams were completed to within 10 feet of their ultimate heights before the spring floods.

DURING the late spring and summer, water continued to pass over the cofferdams, reaching a maximum depth of 11 feet over the upper cribs, but causing very little damage. During this period active work on the job was confined to the assembling of construction plant and equipment. Very low water conditions returned in the late summer and by the last of August the space between the cofferdams was completely pumped out. Work was immediately pushed as rapidly as possible on the excavation and concrete work in order to avoid pouring concrete during cold weather.

Cofferdams in the west channel were started in February, 1931. The downstream barrier was completed to its full height, and the upstream coffer to within 10 feet of its ultimate height before being topped by high water.

During the 1931 high water season the station superstructure has been built and much of the equipment installed. As soon as the floods recede water will be diverted from the west channel through gate openings in the east channel structures and the west channel spillway will be constructed. It is expected to have the plant entirely completed and all units ready for commercial operation by August 1, 1932.

Stone & Webster Engineering Corporation have the contract for the design and construction of the entire development. All construction is under the general direction of W. D. Shannon, general superintendent, and H. F. Anthony, project manager. R. E. McGrew is superintendent at the Rock Island Station, and T. H. Campbell, superintendent on the line construction.

UNITED STATES PLANT PATENT NO. 1

By ORSON D. MUNN
Member of the New York Bar

THE first United States plant patent has been issued. Henry F. Bosenberg of New Brunswick, New Jersey, has the honor of being recognized as the first person, under the amendments to our patent statutes, to invent or discover and asexually* reproduce, a "distinct and new variety" of climbing or trailing rose. This rose was "not known or used by others in this country, before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, or more than two years prior to his application (for patent), and not in public use or on sale in this country for more than two years prior to his application," and not abandoned. Therefore, on Mr. Bosenberg's application, which was filed on August 6, 1930, Plant Patent No. 1 was granted to his assignee, Louis C. Schubert, of New Brunswick, New Jersey, on August 18, 1931, who thus becomes the first person in the United States to whom a patent for a plant has ever been granted.

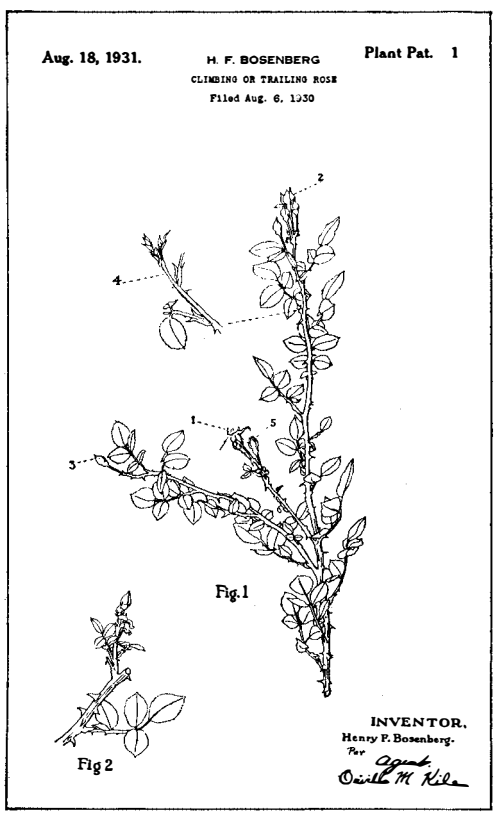
SUCH patents are granted under Sec. 4886 of the Revised Statutes, as amended by the Act of Congress approved May 23, 1930. "Tuber-propagated plants" are excluded from the benefits of the law.

An inspection of this patent and the drawing which constitutes a part of it, shows that it is for a "climbing or trailing rose," and that apparently the only identifying characteristic which serves to distinguish it from other climbing and trailing roses is its so-called "everblooming habit."

The claim of the patent is as follows: "A climbing rose as herein shown and described, characterized by its everblooming habit."

This claim must be read in connection with a disclaiming clause found in the patent, which reads: "No claim is made as to novelty in color or other physical characteristics of the individual blossoms, nor as to the foliage or growing habits of this rose other than as described above."

The patentee has this to say as to the "everblooming habit": "When grown in the latitude of New Brunswick, New Jersey, my new climbing rose, named 'The New Dawn' and illustrated herewith in exact drawings from photographs, provides a succession of blossoms on a single plant from about the end of May to the middle of November, or until stopped by frost."



Reproduction of drawings accompanying specifications for Plant Patent No. 1

Patents for plants, like patents for other inventions, secure to the owner of the patent the right to exclude all others from exercising the invention, or from "infringing," as it is technically known. The interpretation of this patent and the scope of the rights secured to the patentee, if it shall ever be used as a basis of a suit for infringement, will raise some nice questions, not only of law, but in the science of botany.

Congress recognized that the granting of such patents might require of the Commissioner of Patents a knowledge of botany which he may not possess, and it therefore provided that "The President, by executive order, may direct the Secretary of Agriculture to furnish the Commissioner of Patents such available information of the Department of Agriculture, or to conduct through the appropriate bureau or division of the department such research upon special problems (submitted by the Commissioner of Patents), or to detail to the Commissioner of Patents such officers or employes of the department, as the Commissioner may request for the purposes of carrying this Act into effect."

HOW shall these plant patents be interpreted? What are the rights secured? What do they cover? All these questions must be asked by one who desires to respect such patents and not be charged with infringement, as well as by the courts who may be called upon to enforce such patents against infringers. How are we to identify infringements? For example, "Plant Patent No. 1" claims as the peculiar characteristic the "everblooming habit" of the climbing or trailing rose. This characteristic, "a succession of blossoms on a single plant from about the end of May to the middle of November," is apparently the distinguishing characteristic of such a rose plant "when grown in the latitude of New Brunswick, New Jersey." Would this characteristic be the same if such rose plants were grown in Charleston, South Carolina, or in Portland, Oregon, a city famed for its roses, or in any other part of the country?

Sec. 4884, as amended by the Act of Congress referred to, provides that such a plant patent grants to the patentee, his heirs or assigns, for a limited period (17 years from its date), "the exclusive right to reproduce asexually the plant."

It would seem that the exclusive right granted by this provision can be of little commercial value to the patentee. However, the true value of a plant patent can be determined only after a legal battle has been fought and ultimately decided by the Supreme Court. Such a decision will have a definite bearing on the future success of all plant patents granted.

*"Asexual Reproduction.—Fission.—The simplest form of asexual reproduction is called fission. It is restricted to unicellular organisms and is the sole method of reproduction employed by the most primitive plants. It consists merely in the division of a single-celled individual into two protoplasts of equal size. These two new individuals, produced by fission, together contain all the materials of the single parent cell."
"Textbook of General Botany," Holman and Robbins. Published by John Wiley & Sons, Inc., New York.

In the previous two numbers photographs taken at Mount Wilson Observatory by Dr. Ferdinand Ellerman of the Observatory staff were shown. At left and at right are two more of this series. The first one is a view looking east from the Observatory, showing the mountains in typical autumn condition. The one at the right

THE HOTTEST PLACE IN THE UNIVERSE

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

THE question "What keeps the stars shining?" is far from being fully answered, but the answer has been one of the most fertile sources of new ideas in astrophysics. We told last month of the possibility that the internal supply of heat may be maintained by the building up of atoms—hydrogen being, so to speak, the fuel and the heavier atoms the ashes—and touched only casually upon the alternative possibility that a still greater source of heat may be found in the destruction of atoms—the disappearance of the electrical charges of which they are composed and the liberation of the enormous corresponding amount of energy. Such a process would be more than a hundred times more powerful as a source of heat than atom building. May we believe that it really happens within the stars?

"Doctors disagree" very decidedly about the answer, but so much of interest is involved in their very disagreement that the unfinished tale is worth telling.

The trouble is that our present knowledge of atoms indicates that, while the transformation of matter into energy is theoretically possible, it should happen only at exceedingly high temperatures. Atom building, according to Professor Atkinson, may happen inside the stars at temperatures of about 20,000,000 degrees. But, according to the recent work of Professor Milne of Oxford, the disappearance of atoms with the heat would begin to occur only at a temperature thousands of times greater. So, before we can say very much more about this problem, we must find out if we can how hot the stars are inside.

We could do this if only we knew what the density and the pressure of the gas were at a given point inside the star, say at the center. To be sure, we would have to know also something about the nature of this gas—the average weight of the particles of which it is composed. But inside a star we know that the atoms are thoroughly broken apart into loose electrons and heavy nuclei, and the heavier the nucleus the more free electrons there are to bring down the average, which comes out much the same for all kinds of atoms. The simple assumption that the average weight is that of an ordinary hydrogen atom will lead us to about the right temperature. If the gas is really composed of metallic vapors our first estimate must be approximately doubled. If it is all hydrogen it must be halved (because each hydrogen atom is split into two parts). But we will very rarely be wrong by more than a factor of two.

SUPPOSE now that we had a mass of gas as big and heavy as the sun and that it was of uniform density throughout. Very simple calculations then show that the temperature at the center, on our standard assumption, would be 11,000,000 degrees, Centigrade. For different materials it would vary from 5½ to about 25 million. Of course there is no reason to suppose that the sun or any other star is of uniform density. There is no doubt that the surface is far less dense and the center much denser than the average. If we knew how much greater the density was at the center and how it diminished toward the surface, to calculate the pressure would be a perfectly definite problem. The greater the central density the greater the pressure there. But the two rise together, so that the temperature, which depends on the ratio of the two, does not change so much. It can be shown indeed that, even if the central density were a hundred times the average for the whole star, the central atom would at most be only a little more than four times the value already calculated. Unless the central condensation is greater than this, the temperature at the sun's center must be between 5 and 100 million degrees—which is not hot enough to permit the annihilation of atoms, though adequate to set off the atom building processes.

For stars of different masses and sizes (but built alike as regards the increase of density toward the center) the temperature should be proportional to the mass divided by the radius. Applying this rule to the numerous stars whose masses and diameters we know or can estimate, we find that the central temperature should be a good deal the same as in the sun for all the stars of the "main sequence," which includes Sirius, Procyon, the sun, and the faint and red dwarf stars. The very white and massive stars, like those of Orion, may be two or three times as hot inside. For the cooler giant stars such as Capella, Arcturus, and Antares the internal temperatures come out much lower. The only stars which can be much hotter inside than the sun (provided always that they are built in-

shows fog on the same mountains, a summer condition. Feature-by-feature comparison of the two photographs will reveal that the fog-surrounded "hill" of the one is the mountaintop of the other. A fog cascade is seen to be pouring out of the more distant valley across the shoulder of the nearby ridge, very much as if it were water

ternally in more or less the same fashion) are the white dwarfs, like the Companion of Sirius, which are of very small size and high density. The central temperature of such a star may be 20 or 30 times as great as the sun's, and may reach a billion degrees or perhaps more.

If stars of other kinds (that is, the vast majority of those visible with our telescopes) derive their energy from the annihilation of atoms inside them, it appears that they must possess an enormous concentration of mass toward the center. It will not suffice if the central density is 100 or even a 1000 times the average; there must be a small central core in which the density is something like 1,000,000 times that of a star as a whole.

THERE is nothing physically absurd about the existence of such a dense core. The "stripped atoms" inside a star are of exceedingly small size, as are also the free electrons, and under sufficiently great pressure they might be crowded together far more closely than is possible for atoms of ordinary matter in which the outer "orbits" of the electrons are of much greater dimensions. Eddington pointed out some years ago that this remarkable condition of matter occurs in the interior of the white dwarfs. But it is only recently that the possibility of a similar dense region inside ordinary stars has been seriously considered at Milne's suggestion.

We can calculate most of the properties of the gaseous matter inside a star fairly well, including the opacity or the resistance which it offers to the escape of heat toward the surface. If we could only calculate also from theoretical considerations the rate at which heat is produced in each part of the gas it would be possible by a rather complicated calculation to find just what internal distribution of density would give an exact balance between the heat produced inside each part of the star and that which escapes to the surface, and so find out just how the star was built. Unfortunately, nobody yet knows definitely how the heat is produced nor at what rate, so that the best anyone can do is to make some reasonable guess about it and work out the consequences. Several investigators have tried this, among them Milne. Starting with simple assumptions which had already led Eddington to his well-known model with the central density 54 times the average, he found that other solutions were also mathematically possible in which the central density was enormously greater. These had one disadvantage: at the very center the density came out infinite!

This seemed absurd at first glance, but it depends on the assumption that the simple "gas laws" which were used in the calculations hold good, no matter how greatly the gas may be compressed. There is good reason to believe that this is not true, and that even under the highest pressures a gas could not be compressed beyond a certain limiting density. If this fact should be taken into account mathematically the solutions would doubtless lead, not to an infinite density but to a small region at the center where the material compressed by the weight of the overlying layers reached almost the highest possible density—that is, just the small dense core which we have seen is the *sine qua non* for a very high central temperature.

The first stages of the diminished compressibility can be worked out from the quantum theory, and it is found that in the interior of a smallish star, say of half the mass of the sun, the density would reach several hundred times that of water, but get no further. A mass of gas with its center in this condition, and of course with layers of ordinary compressed gas of lower density in its outer regions, would be very strikingly similar in size and density to the actual white dwarfs, and it appears that these once problematical bodies are beautifully explained by Milne's calculations.

Inside more massive stars, where the pressures are still greater, it appears that the density may be still greater. No one has yet dared to set a limit, but it may be very high indeed.

IT is possible, then, that many or indeed all of the stars have at their very centers small, enormously dense, and exceedingly hot regions within which the annihilation of atoms may actually be taking place. If this is true these minute cores may be the sources of practically all the stars' heat supply, the outer regions acting only as a blanket to keep it from escaping too fast.

Whether this picturesque state of things actually occurs, and if so where among the stars, must remain uncertain until theoretical physics is in a position to predict more about the heat generating process. But the recognition of its possibility is a step forward.

A few years ago Eddington, writing upon this problem at a time when it appeared reasonable to believe that the internal temperatures of ordinary stars were at most of the order of 50,000,000 degrees, referred to the difficulty that such a temperature seemed theoretically "inadequate to account for any appreciable annihilation or transmutation of matter," but concluded: "We do not argue with the critic who tells us that the stars are not hot enough for this process; we tell him to go and find *a hotter place.*"

Sir Arthur's jest was much appreciated by his colleagues, but for some years his challenge went unanswered. Now Prof. Milne has met it seriously and it may be that the "hotter" place really exists.—*Lowell Observatory.*

FORD, THE PRACTICAL

By EDWIN P. NORWOOD

MANY titles have attached themselves to Henry Ford. He is variously referred to as the automobile king, the world's richest man, Ford the educator, Ford the philosopher, and Ford the farmer. Aside from his automotive plants that extend around the globe, he personally maintains a huge private hospital, an even larger educational institution—the Edison Institute of Technology—and operates Trade Schools for boys. A recent compilation reveals that his activities embrace fully 35 major occupations, trades, and manufacturing lines, to say nothing of minor ones. And yet first, last, and all the time, he is, more than anything else "Ford, The Practical."

Looking back over three score years to his childhood, he recently remarked, "My toys were all tools. They still are."

The sole difference between that day and this is that the kit has grown greatly in size.

Picture, if you will, a motor truck chassis raised upon jacks. Seated underneath, on chance-may-offer boxes, are several men in animated discussion—one gray haired and wiry of build.

Again, visualize a pleasure car standing on the floor of an experimental laboratory and once more the gray haired man in earnest discussion with another. Suddenly you see the older man motion to the other. You see them hitch themselves under the car, roll on their backs, and continue their debate.

FOCUS such scenes in the mind's eye and you will have a mental picture of Henry Ford in action. You will have an idea of that forthrightness of movement characteristic of him when getting at some mooted point relative to one of those cars or trucks, more than 20 million of which have borne or still bear his name.

There is an old saying that forthright men "take off their coats." Ford doesn't waste that much time. He is too quick in thought, in action, and in speech for that.

And yet nothing in which he has a hand is ever done in a hurry. The atmosphere around Henry Ford is one of calm. He does not surround himself with fussy or what we are pleased to call "peppy" men. He has never been a believer in the modern "pep" philosophy. He surprises men with the amount of time he has. He has time for everything except watching the clock. Instead of confining his activities to a certain number of "office hours," and then racing through them, he utilizes all or any part of each 24 hours. Though sponsor of the eight-hour day and five-day week he would be the last man in the world to apply any such rule to himself. He reduces hurry, not by crowding time but by making use of all that is at his disposal.

OF the many articles that have been written about Ford and Ford methods, some have been commendatory while others have been censorious. Only too often these articles express personal opinions and may or may not be accurate in detail. The writer of the accompanying article, however, bases his discussion on the evidence of his own eyes, having had the opportunity to observe Mr. Ford almost daily—and at all times during the day's work—for many months. He thus is able to picture a side of Ford that is little known, a side which, whatever may be one's personal opinion of the man, provides for all an object lesson in perseverance and attention to details. There is no doubt that industry has learned something from his methods. May it not also learn something from the man himself and particularly from a consideration of his way of getting things done?—*The Editor*.

It cannot be said that Henry Ford is irregular in his habits of work; yet he has no routine. It is never certain where he will be at a given time. He starts out in the morning and goes where his "hunches" lead him. But he is always somewhere, doing something. It is not at all surprising to find him in the Dearborn shops at 6:30 A.M. On these visits it is said of him that he sees more in 10 minutes than most eyes take in during as many hours.

Several years ago he noted a man using emery paper on a motor block. Two hours later an order had gone out to dispense with this article in connection with all operations where flecks from such paper might become embedded in bearing surfaces. That one glance and that quick decision started a months' long quest for an abrasive that would do the work yet not endanger the life of car parts so vital as crankshafts and cylinder blocks.

Evening often finds him in the research laboratory that he has erected in Greenfield Village for his Trade School graduates. He works at the bench with them, as they seek new uses for the earth's products.

"What do you call yourselves?" the writer recently asked one of these youthful chemists.

"Students," was the response. "That is what Mr. Ford says he is, you know."

At two in the morning this same man may be working in his own laboratory which is built into his home at Dearborn. Waking in the night, he gets an idea. And with Henry Ford, an idea is a worthless thing unless steps are taken to project it in practice. Of him, Edison has said, "I take off my hat to Ford for his knack of finding the best and simplest way to do things mechanical that baffle experts."

NIGHT work is no new experience to him. It is but a repetition of what he did 40 years ago when he labored with his first gas buggy on Bagley street, in Detroit. At 68 he is still finding better ways of doing things.

He is a good sleeper, but he finds a total of six or, perhaps, seven hours sufficient for him. He has an office but is seldom in it. His appointments are usually kept in some one of a dozen offices other than his own. If yours is with him you will find him essentially "easy to meet." A laden office boy drops a paper and Henry Ford picks it up for him. He speaks to everyone who passes him or whom he passes. Nine times out of ten he stops to shake hands.

He is modest but this is the result of innate philosophy rather than meekness. Recently a caller congratulated him upon his "inventions connected with the first automobile."

"I never invented anything," he answered. "Everything is here. We just put old things to new uses."

In other words, as he sees it, all the laws of mechanics have always existed. Thinkers have merely ferreted them out and put them to practical use. Thus it follows that he believes anything can be done. Nothing is impossible.

"The newest, latest thing in existence is a person; the finest thing in the world is mind. The coarsest thing is the earth. Bring mind and matter together and

almost anything is likely to happen."

He refuses to give up. He has no use for a quitter, much less a loafer. If a man says to Henry Ford, "I can't do that," Henry Ford usually takes him at his word, unless his keen eyes inform him that the man can do it. Many have found they can do the impossible for him. He often quotes, "My friend is he who makes me do what I can." When a young man bristled somewhat at Ford's correction, Ford simply said,

"Look here, I don't waste time trying to fix anything that's not worth fixing."

The left handed compliment induced the young fellow to go after his problem again.

The manner in which the man works is illustrated by a story of a certain part now used in the Model A engine. Mr. Ford had himself conceived the idea of a simplified assembly. To reduce the part to the desired simplicity required machinery which would fashion two split guide bushings and hold their outside diameter, when paired around the stem, to within three ten-thousandths of an inch. All else was ready for production. Then weeks and even months passed while men worked to produce the needed part. Finally some of the staunchest men in the plant began to doubt. One of them decided to have it out with "the boss." He reported the lack of progress.

"How many have we made?" Ford asked.

"There they are—probably a hundred of them."

"And how many of them are right?"

"Not more than two or three."

"Two or three!" Ford shot back. "Then we've got it! Just go ahead and make them all like those two or three."

TRANSLATE the foregoing paragraphs into higher wage scales for men, shorter hours and shorter weeks for labor, quantity production by means of conveyor lines—any number of things—and they will tersely tell exactly the same story.

"To see a thing clearly in the mind is to make it take form," Henry Ford will tell you. "Concentrate on a job and you will attract all the things necessary to accomplish it. You attract the things to which you give a lot of thought. I have had to quit many jobs and wait—because I hadn't spent enough thought on them."

Henry Ford has always had sufficient means to carry on even his earliest engineering experiments. This statement will probably come as a surprise to many readers, for popular notion runs to the contrary. People are incorrigibly romantic where public men are concerned. If a man reaches the White House, they like to think he came from a log cabin. If a man attains wealth they prefer to believe he rose from extreme poverty. Many stories have been told of Henry Ford's early poverty. There is the mythical turkey that he could not afford on Thanksgiving; and the legendary milk he could not provide for a sick baby. The fact is, the Fords were well-to-do for their times. Ford's father was a warden of the Episcopal church, a justice of the peace, the owner of a first class farm, and the possessor of a home which even in this day would be rated comfortable. Henry Ford himself has always been able to support himself on a well-to-do scale. When he worked in a saw mill he owned the mill. While it is true that his highest wages prior to entering motor manufacturing were 100 dollars a month, it is to be remembered that such an amount 30 years ago was considered a top-notch salary. The truth is, there has been no poverty interlude in Henry Ford's life. He has always found something to do. Indeed, his experience with work lies at the basis of his personal philosophy: that if a man starts to work at anything useful, whether he is hired to do it or not, he has set in operation forces which will link him with necessary support. He is convinced that every man has a self starter which will always work, given the proper incentive.

What of his present wealth? Again the approach is that of the engineer:

"Wealth is only a tool to do things with. It is like the fuel that runs the furnace or the power that turns a wheel —only a means to an end. And the end is a better sort of life for the last family."

HENRY FORD

ARE THERE CREATURES LIKE

By EDWIN LINCOLN MOSELEY

Professor of Biology,
Ohio State College

AS Alexander of old yearned for more worlds to conquer, so modern man, having conquered land and sea, and at last the air, would like to extend his activities to other realms. What is the evidence that he could exist on other worlds or that some of the heavenly bodies are already peopled with man-like creatures?

New interest in this absorbing question has been aroused by recent determinations of the temperatures of some of the planets. We do not expect to find life where water could not exist except in the form of ice or steam. If we consider the vast distances that separate us from even the nearest of the heavenly bodies, it seems almost inconceivable that we could ever ascertain the temperature of any of them. This feat has been accomplished, however, not with thermometers but by using very sensitive galvanometers connected with miniature thermo-couples in vacuum cells. By directing a very large telescope toward one of the nearer planets and concentrating the rays upon a thermo-couple it has been possible to find out approximately the planet's temperature. This differs on different parts of the planet, just as it does on the earth. Likewise the temperature at one place changes as the planet turns on its axis and exposes the place to more or less of the sun's rays. In this way it has been found that the temperature of the equatorial region of Mars rises, when the sun gets high in the heavens, to some 50° Fahrenheit or higher.

THERE is evidence that oxygen exists in Mars' atmosphere, as well as a little water vapor, although probably less than in the air above the deserts on the earth. The atmosphere of Mars appears to be less dense than that at the top of Mount Everest, which no human being has yet been able to reach because of insufficient oxygen in such a rarefied atmosphere.

Inasmuch as the temperature of the equatorial region of Mars rises well above the freezing point in the middle of the day and both water and oxygen are probably present, it may be stated that as yet we know nothing that would absolutely preclude the continued existence of life upon that planet, although conditions there seem less favorable for life than on the most desolate parts of the earth. On the other hand, there is no evidence which appeals to the majority of astronomers that life of any kind actually exists on Mars. The dark areas, which were formerly interpreted as due to vegetation, have been found to have a higher temperature than the other parts of Mars' surface, whereas if they were covered with trees or other plants they should be cooler. They are probably lower and more moist than the surrounding regions.

"If there were a building on Mars 100 times as large as the Capitol of the United States, it could not be seen with the best telescopes on the earth. . . . ."

If there were a building on Mars 100 times as large as the Capitol of the United States, it could not be seen with the best telescopes on the earth, although with these telescopes it is possible at times to observe the tiny satellites that revolve around the planet. This is equivalent to seeing a baseball at a distance of some 200 miles. No living thing, even if 10,000 times the size of an elephant, could be detected at the distance of Mars or of any other planet.

With the exception of the moon and sun no other heavenly body is so well known as Mars. Venus, as she follows her path around the sun, comes nearer to us than Mars ever does. But when nearest, Venus is between us and the sun, so that in looking at her we must face the sun or the brilliantly illuminated sky near it and—what is more important—look at the side of Venus which is dark because it is turned away from the sun and so is not illuminated. Moreover, this planet seems to be completely enveloped in clouds all of the time, so that even with the best telescopes no permanent markings are visible. But spectroscopic examinations of the light from Venus indicate that the quantity of oxygen in her atmosphere is quite too small to sustain life.

As to other planets in the solar system and their satellites, their great distance or the circumstance that they are continually enveloped in clouds has prevented our learning much about their fitness for life. Mercury, the nearest planet to the sun, probably keeps the same side continually facing the sun, just as the moon continually presents the same side to the earth. The side of Mercury which is receiving heat from the sun is too hot and the other side too cold for any life. In a narrow region along the border of the hot and cold parts it is conceivable that living things could exist.

The planets more remote from the sun than Mars have such a low density as to indicate that there is nothing solid in them, unless it be in the central part. Moreover, it is probable that all of them are too cold to sustain life.

So far we have been considering the possibility of human life on planets which in the remote past formed parts of the sun and still continue to accompany the sun in its journey through space. As the earth is also one of the children of the sun, it never wanders so far from the others that light requires more than a few minutes to traverse the space that intervenes. Let us now leave the solar system and turn our attention to other parts of the universe.

ALTHOUGH the stars do not appear to be more remote than the planets, yet all are so distant that the light which enables us to see them has been years, instead of minutes, in reaching us. Only a few thousands of stars can be distinctly seen with the unaided eye but many millions are visible with telescopes, and still other millions have been photographed with long exposures of plates in cameras attached to large telescopes that are moved by accurate clocks to prevent the earth's rotation from shifting the image on the plate. Because of their great distance these telescopic stars are so faint that the combined light from a million of them would not be perceived by the retina of the human eye. Yet among all these millions of heavenly bodies not one could in its present condition support life of any kind. All are too hot. If they were not so hot as to emit a strong light, they would be invisible from the earth. We call them stars but if they were no farther from us than the sun most of them would appear to be fully as large and brilliant as the sun, if indeed their heat did not destroy us.

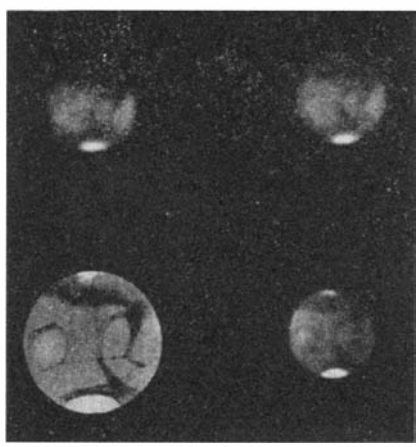
The only *visible* heavenly bodies which are cool enough to support life are members of the solar system—bodies which revolve about the same sun around which the earth revolves.

OURSELVES IN OTHER WORLDS?

One of these, Jupiter, is some 1300 times the size of the earth. If it were removed from the solar system and placed in the neighborhood of the nearest star it would not be visible with the best telescope on earth, unless it were to give out many times as much light as it or any other planet gives out now.

While it is probable that no life of any sort exists on a single one among the many millions of bodies which have been seen in the heavens, the case may be different if we consider those that have not been seen. We are inclined to underestimate the importance of many of those things which we are not able to behold with our eyes. We know from the motions of certain stars, together with the fact that at regular intervals they become dimmer and after a short time regain their brightness, that they are accompanied by dark companions which at such times shut off part of their light. It may be that many visible stars are associated with others which we cannot see and which in their revolutions do not come between us and their bright companions. Moreover, it was at one time thought that most of the stars resemble the one we call the sun in having a retinue of planets. Their distance from the earth is so great that if this were true we should not be able to see these planets. Of late years, however, many astronomers have believed that the sun is nearly exceptional in having planets about it. Our sun is believed to have given birth to the bodies that revolve around it, as the result of some great star passing so near as to cause a prodigious tide and disruption which tore them away from it. Only once in the billions of years of solar history has such a thing happened to the sun. To most of the stars it may never have happened. They are so far from other stars that approaches close enough to evoke any tidal disruption would not by chance occur in many billions of years.[1]

RECENTLY this idea has been modified by the following consideration: The part of the universe which we call the Milky Way or galaxy, and which contains virtually all the stars which can be seen individually even with the aid of the largest telescopes, has long been expanding. The stars of which it is composed are probably kept from wandering beyond the region of the galaxy by the attraction of the whole mass. In recent years we have learned that radiation from a hot body causes a gradual reduction of its mass. For trillions of years the stars of the galaxy have been radiating vast quantities of energy and so their mass has been decreasing. Accordingly their power to attract one another has been decreasing and so they have become more widely separated than they were formerly.



By E. C. Slipher, Lowell Observatory (Sanger)

Mars. The pair at top are direct photographs, the larger one below is a drawing, and the remaining one is a photograph of the same drawing made at a distance through same telescope as were the top pair

This means that trillions of years ago the stars of the galaxy were not nearly so far apart as now and so the chance of near approach to other stars in the galaxy was much greater than now, affording more frequent occasions for disruption. Consequently, many stars may, like the sun, be accompanied by a retinue of planets and satellites.

If, however, of all the stars known to the astronomers—that is, all the stars in the entire universe—only one in a thousand has any planets revolving around it, and if in turn only one in a thousand of these planets possesses enough water and such an atmosphere and temperature as would make life possible, still the number of such planets capable of supporting life would amount to millions.

In view of what precedes we may say that in the present state of our knowledge of the universe we have reason to *infer* that the earth is only one of many orbs that are fit for the abode of living things. However, worlds that are suitable for life would never become inhabited unless at some time living creatures had been carried to them or else had originated upon them. We know nothing of the origin of life upon the earth. So far as our observation goes every individual has come from some individual that existed before. This is true of both plants and animals. We know of no instance of even the lowliest form of living things springing into existence without a parent or parents. That they have done so sometime, somewhere upon the earth, seems less improbable than that the first life was brought to the earth from some other place.

IF, however, life has originated once upon the earth, then why may it not have arisen more than once? If within our own time life had originated again and again in the ocean, our failure to observe it would not be remarkable, when we consider how ignorant we still are of many of the higher and larger forms of marine life, to say nothing of those of microscopic size. Outside the ocean it seems improbable that life ever has originated upon the earth. All freshwater creatures and all terrestrial forms of life have probably been derived in the course of ages from those that lived in the sea. For this reason it is probable that on those celestial orbs which, like Mars, are without seas, life has never started.

Every organism seems to be well adapted by its structure and habits to live successfully in the region where it is found. That those regions from which it is absent are unsuited to its existence is a natural inference, but is far from expressing the whole truth. No one ever saw a starling in Cleveland, Ohio, until recently. Now thousands may be seen at one time in the air over Cleveland's public square. The ocean was an insuperable barrier to European starlings, English sparrows, and ring-necked pheasants. Yet, when brought to America by man, they thrived as well or better than in their native land. The same is true of rabbits taken to Australia and New Zealand. The former absence of those creatures from certain continents was due to their inability to cross barriers and not to unsuitable climate or other environmental factors of the unoccupied territory.

In view of these facts it is clear that we are not warranted in assuming that every form of life which could main-

[1] Sir James Jeans estimated in 1928 that a given star's chance of forming a planetary system by this method would be one in 500,000,000,000,000,000 years. Taking our own galaxy, with 100,000,000 stars, he calculates that one star in each 100,000 would have a "solar" system; that is, theoretically, there would be 1000 such systems in the galaxy. Of course, as Sir James would be the first to admit, such calculations are not exact because direct data on which to base them are lacking. But they do at least give some idea.—*Editor.*

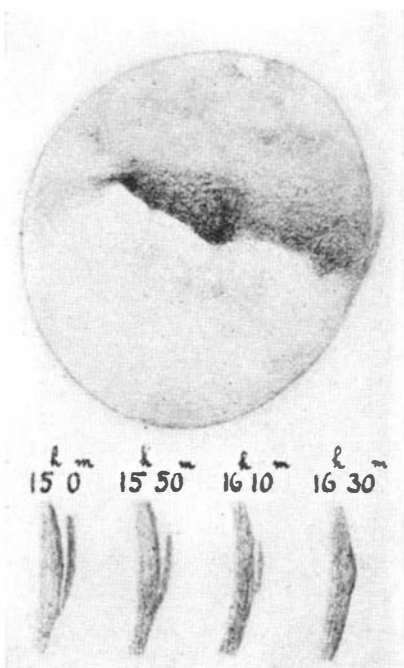
tain itself in any continent is to be found there. Those which are actually there are but a fraction of the myriads for which climatic and other conditions would make life possible. It would be even more unreasonable to suppose that every celestial orb, where temperature, atmosphere, and moisture resemble those on the earth, is inhabited by creatures closely resembling those that live on the earth. If there are very many bodies in the heavens whose exterior closely resembles the earth's exterior, it is quite possible that on some of them a somewhat similar flora and fauna has developed.

That a person would ever be able to fly across the ocean seemed a foolish speculation a few years ago. Now the younger generation is ready to believe that human ingenuity will sometime make it possible for a person to be carried by a rocket or some other device to another planet. They will at least admit that colonization of other orbs by people from our own has not yet taken place.

WE are so much concerned with the life of man that to think of a world teeming with living things, but without any people, requires quite a stretch of the imagination. Yet our own world for hundreds of millions of years supported plants and animals of a great number and variety without any that resemble man more than a fish or frog. The time that has elapsed since the first human beings appeared may be a million years, but it is only a very small fraction of the time since life first started on the earth. If several of the planets, or the satellites which accompany them in their revolutions around the sun, were able to support life, it seems improbable that in the course of their slow development they would arrive at the stage where human beings would come into existence at approximately the same time as on the earth.

The fallacy of assuming that human life must exist in all those places where such life is possible may be shown in other ways. Before the ancestors of the Indians and Eskimos came to America from the Old World, there was no creature on this side of the earth more like man than are the prehensile-tailed monkeys of South America. Yet man had been living in Eurasia for hundreds of thousands of years. Were it not for his migrations, America would be without human inhabitants now and probably for all time. If men have never originated in the Western Hemisphere, where conditions for human life are so favorable, how much likelihood is there of their evolving on a planet whose physical conditions probably differ from those of the earth to a much greater extent than the Western differs from the Eastern Hemisphere?

Man does not bear a strong resemblance to anything in the animal kingdom except the mammals. It is inconceivable that he could have developed from any other class. It is probable that all the mammals now existing on the earth had a common origin; in other words, that their ancestors did not spring up independently in different places and in different geological periods. If no creature bearing so close a resemblance to a man as does a squirrel or a horse has ever originated anywhere in the world except by descent from the common ancestors of the mammalian class, it seems improbable that creatures moulded in our own form have arisen otherwise on other orbs.



Drawn by G. Van Biesbroeck, Yerkes Observatory

Drawing of Mars, through the 40-inch telescope. Extension at terminator is a cloud. The other sketches show the apparent effect of the planet's rotation on it

It is possible that in more than one place on the earth Nature has repeatedly produced the beginnings of mammalian life and that these beginnings have been unable to survive because of competition with mammals that had progressed farther and became more highly developed. In that case there seems to be no reason why creatures having many of the characteristics common to mammals on earth may not have evolved elsewhere.

If there are mammals, or animals much like them, living on many distant celestial spheres, the chance of manlike creatures having evolved on some of those spheres seems quite possible. That any of them closely resemble us seems less likely. The aborigines of Australia are descended from ancestors who in an early period of human development were separated from other people and have been isolated from the inhabitants of other continents until recent times. They differ from us in many ways. They have no domestic animals and do not cultivate the soil, but subsist on fish, lizards, snakes, insects, and such other animals as they can kill. They have no fixed abode, but when the weather is inclement they make a rude shelter of bark or brush. They wear little or no clothing. They never acquired the arts of weaving, pottery-making or smelting of ores. They have no bows and arrows, to say nothing of more formidable weapons, no written language, and according to some observers, no religion. Their women are slaves and are frightfully maltreated. Yet we call these Australians human. Like ourselves they are able to walk erect after attaining a certain age. Their hands are serviceable for more purposes than are the hands of apes, and they have greater intelligence than apes. Their features are on the whole rather more like ours than those of any of the apes, although many people of our race would hesitate to call them human.

NO instance is known of any of the types of animal life which had flourished in past ages and which had become wholly extinct ever having been evolved again in the course of the world's history. So many forms are possible that, if their development is largely a matter of chance, a particular one, such as that of man, would not often come into being. If, on the other hand, the course of evolution is determined by the surroundings of the organism, does it seem probable that in other worlds the physical and biological environment would resemble more closely what we have on our terrestrial continents than the environment on one of these continents resembles that on another? It is then very doubtful whether anywhere in other worlds there are beings which resemble us as closely as do the Black Fellows of Australia.

Among animals that have acquired the ability to walk erect, so that the fore limbs are free for other uses, increase of intelligence or learning conveys an advantage. Man has become the master of all the other large animals on the land and of many in the sea. His struggle with the insect world is still undecided. More education may enable him to conquer the insects. If intelligence gives an advantage in this world, why not in others? In some of them the evolution of superior beings has probably been going on longer than on the earth and under more favorable conditions. We may well believe that whether those beings look like us or not, they may have surpassed us in many ways. What would we not give really to know something about them?

THE BIRTH, LIFE, AND DEATH OF A RAILROAD TICKET

By FRANCIS X. MILHOLLAND
Assistant to the Senior Vice-President, Baltimore and Ohio Railroad

"ALL tickets, please."

Every railroad traveler has heard this trite, courteous, and important request as the conductor enters the car and starts to check-up his passengers, but the ordinary person gives little thought to the origin of his ticket and what happens after the conductor has collected it. Yet the railroads have developed a science of ticketing their passengers that never fails to account for the revenue that each ticket represents to the carriers.

Long before the passenger ever thought of his trip the ticket that he buys has been prepared for him. For the purpose of having tickets readily available, there is a ticket supply department in the general offices of every railroad, with an adequate staff to prepare in advance the thousands of tickets of many different kinds. Not only must there be plenty of tickets always on hand, but the thousands of agents in the stations all along the line must be supplied with sufficient to take care of demands.

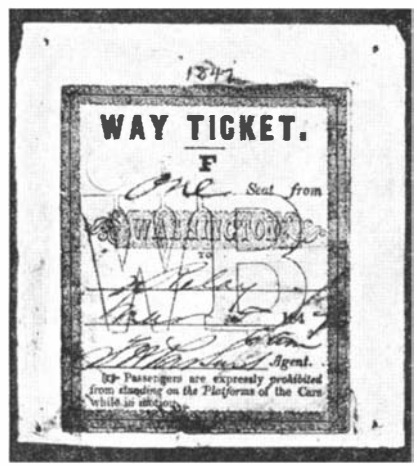
Beyond supplying, selling, and collecting of tickets is their accounting. To take care of this, there is the auditor of passenger receipts, with a large force to assemble, sort, classify, record, and indicate both the mileage and the revenue involved in each and every ticket. A ticket is handled, on the average, 15 times.

THE accounting is not as easy as it looks. If a passenger buys a ticket, from Washington to New York, or from Baltimore to Chicago, for example, over the Baltimore and Ohio, it is a simple proposition. There are only to be considered the point of origin and the destination. However, should a passenger intend to go, for example, from Baltimore to San Francisco, or to Los Angeles, Portland, or Seattle, his part of purchasing the ticket and handing it over to the conductor still is simple, but the work of the railroad necessarily becomes complex. The line in question ends in the west at St. Louis, Springfield, and Chicago and beyond these points the ticket becomes a joint one with whatever railroads the passenger uses in continuing his journey.

Complications in ticketing grew as the railroads developed. When railroads were new there were no tickets. For example, when the first train ran to Frederick, Maryland, from Baltimore, the method of collecting fares was as crude as the cars upon which passengers traveled. People who traveled on the railroad then were content to sit and tell the conductor where they were going, give their names, and produce from wallet or purse the fare to their destinations, while the conductor gravely and carefully wrote on a manifest their names, destinations, mileage to be covered, and the amount collected for the trip. Then as passengers to principal local points increased, card tickets with point of origin and destination printed thereon were inaugurated and furnished to ticket offices, chiefly to save time in issuing.

The ticket agent does more than sell tickets; he keeps books and banks the conductor's cash fares and supervises the whole office

Railroads were constantly increasing in number, with the trend ever westward, so the next question that arose regarding ticketing was to provide interline forms from St. Louis, Chicago, and other gateways to all points on connecting railroads. To take care of this, a separate form for each line operating beyond such gateways was deemed necessary. To simplify the process and handle the inter-line business economically there was eventually adopted what is known as a "multi-form" ticket, which in many instances resulted in the discarding of as many as ten or more of the old individual forms, thereby bringing about a very substantial reduction in the number of tickets which agents were required to carry.



An early one-way ticket, Washington-Relay, Md. March 5, 1847

AS the railroad ticket developed, so did its various kinds. The simplest is the local ticket, but its progeny are many, including the one-way, the round-trip, the excursion, the commutation, the printed destination, the clergy, the conductor's cash fare receipt, the interline one-way and round-trip, the skeleton form for facility in routing, and the interchangeable scrip coupon book.

The life of a railroad ticket begins in the office of the ticket supply clerk, where a copy of the prescribed form is prepared and sent to the printer for setting up in type. Proofs are checked by the rate department to insure accuracy as to junction and transfer points of connecting lines. Reference is made to various circulars and maps lest errors appear as to exchange points. After this the printer receives the order to run off the tickets in whatever quantity is desired. Upon receipt in office of the ticket supply clerk they are

filed in cases awaiting requisitions from the agents along the line. When printed, all tickets are consecutively numbered so as to be readily identified in the records.

This might be called the infantile period of the ticket's existence, for the ticket has not yet begun to move, but it does begin to move when the agents' requisitions come in. Then it steps into passive life, being taken from the ticket supply case where it has reposed and sent to the agent, who stores it in his selling case subject to call. This move is kept on record in the ticket supply office, in the agent's office, and in the auditor's office.

Now the ticket has "gone to school" and the big experiences of its life are before it. It is ready to be sold to the first customer. Suppose it be an interline ticket. The prospective passenger steps up to the window of the little station at Nappanee, Indiana and expresses a desire to go to Boston, Massachusetts. The agent takes the ticket from the case where it has been resting, stamps the date on the back, receives the proper amount and the ticket changes hands. It leaves home—for a while. Although the issuing line may not reach Boston, the interline ticket will take care of the passenger to that point, and the passenger will have no worry about procuring other tickets.

Upper: **Conductor is "making up his run." Extreme accuracy is essential as not all tickets are lifted.** *Below:* **Operation is being reversed; clerk is "working" the run and checking up**

NEXT the ticket begins its active life. Under its new owner (who really seems to think a lot of it for he carefully puts it safely away) it is brought out and shown to the gateman, who punches it to show that the passenger has received endorsement and is privileged to enter the train.

After the train is in motion, the ticket is shown to the train conductor as well as to the Pullman conductor, and the passenger announces his intention of stopping over in Washington, D. C. The train conductor then punches the Nappanee to New York coupon of the ticket, indicating that he has honored it to the end of his run, and writes on the back of the coupon, "Off at Wash., D. C."

Distinctive ticket punches are furnished to the division superintendents by the ticket supply clerk and the division superintendents give them to the conductors on their respective divisions. Each punch, different from any other, tells an interesting story to the initiated.

If the destination shown on a ticket be a point on the parent line, the last conductor examining the ticket and honoring it to destination would retain it and send it along with other collected tickets and his reports to the auditor of passenger receipts.

Conductors distinguish passengers in the coaches who have already turned in their tickets from those just boarding the train by issuing small train checks which are of different colors to signify various destinations, or travel zones. After selecting and punching one to suit the case before him, the conductor places it in a small metal holder on the seat. These train checks are sometimes called "hat checks" because the former custom was to stick the check in the hat-band of the passenger, but this practice is no longer in vogue as seat clips are provided.

Reverting to the inter-line ticket to Boston, the various conductors *en route*, after examining the ticket, report to the auditor of passenger receipts that they "have honored, but not lifted" it, this report being made on a special form. On the last lap of the passenger's journey the train conductor takes up the Nappanee to New York coupon of the ticket, sending it to the auditor of passenger receipts, while the passenger retains the larger portion of the ticket that is good on the foreign line for the remainder of his trip to Boston. This part of the ticket is taken up by the conductor on the last foreign line and forwarded to his auditor for final disposition.

AFTER the receipt of the Nappanee-New York coupon of the ticket by the auditor, it is checked against the report of the agent who issued the ticket at Nappanee. Then, along with others, the coupon is placed in a metal box for lodgment with the custodian of records. About two months usually elapse from the time the ticket is lifted until it is permanently filed away.

Under the regulations of the Interstate Commerce Commission, used tickets may be destroyed at the option of the carrier after completion of the audit, with some exceptions. The used local tickets, however, are held by the Baltimore and Ohio for a period of six months after the audit, and home interline and foreign interline tickets are held for a period of three years after the audit, as the tickets are needed for reference purposes. As to the exceptions to the rulings of the Interstate Commerce Commission, used caretakers' tickets must be kept for five years and redeemed tickets for three years. A macerating machine puts an end to the useful life of the railroad ticket. It is again to become pulp, whence it came.

As interesting as the life of a railroad ticket are some of the operations in connection with its collection by the conductor and the accounting through the auditor's office. Cash fares collected

Conductor's punches "have a meaning all their own," and are changed frequently

by conductors from passengers who have not provided themselves with tickets beforehand are reported by the conductors on a special form. A separate report is also made of scrip coupons honored. The conductors forward these reports to the auditor, with a report of tickets "honored but not lifted," together with lifted tickets or coupons reading to destinations on their respective runs. This enables the auditor to keep a complete check of the earnings of the various passenger trains.

When cash fares are collected the conductors issue duplicate receipts, one to the passenger and the duplicate portion for the auditor. The cash so collected is deposited by the conductor with the agent at the end of his run. The agent issues a deposit receipt in triplicate, retaining the triplicate and giving the original and duplicate to the conductor who retains the duplicate for his record and forwards the original to the auditor, with cash fare report. This cash so given to the station agent is deposited by him with his other station receipts in a local bank, subject to the check of the railroad's treasurer.

USUALLY, at small stations, the ticket agent is also the freight agent. From an accounting and traffic standpoint, the agent's duties embrace a comprehensive study of tariffs and circulars to enable him to issue tickets at proper fares and over correct routes, and to be generally informed about his railroad so that he can furnish information requested by the traveling public. He keeps a stock record book to show all ticket stock received from the ticket supply clerk and enters in this book the forms and numbers of tickets sold at his agency each month. He also keeps a daily sales book and a daily cash book to show the value of the tickets sold as against the cash received and must maintain a balance between the ticket sales and the daily totals in the cash book, taking into account not only the cash received, but also the value of scrip tickets, prepaid orders, and United States Government transportation requests that are honored. He is required to keep his accounts in such condition, at all times, that the traveling auditor can satisfactorily check them when he pays his periodic visits to the agency.

After the conductor has examined and punched all tickets and coupons, local and inter-line, collecting those terminating on his run, he assembles his reports and arranges the tickets and coupons he has collected, separating coach from Pullman passengers for statistical and rating purposes, and puts them all in a large envelope addressed to the auditor. The envelope is then forwarded by "train mail."

These envelopes, filled with tickets, coupons, and so on, which have been collected, and the various reports of the conductors, are found each morning piled high on the mail table in the office of the auditor of passenger receipts. The mail clerk sorts the envelopes according to divisions of the road as represented by the territory covered by the run of each conductor.

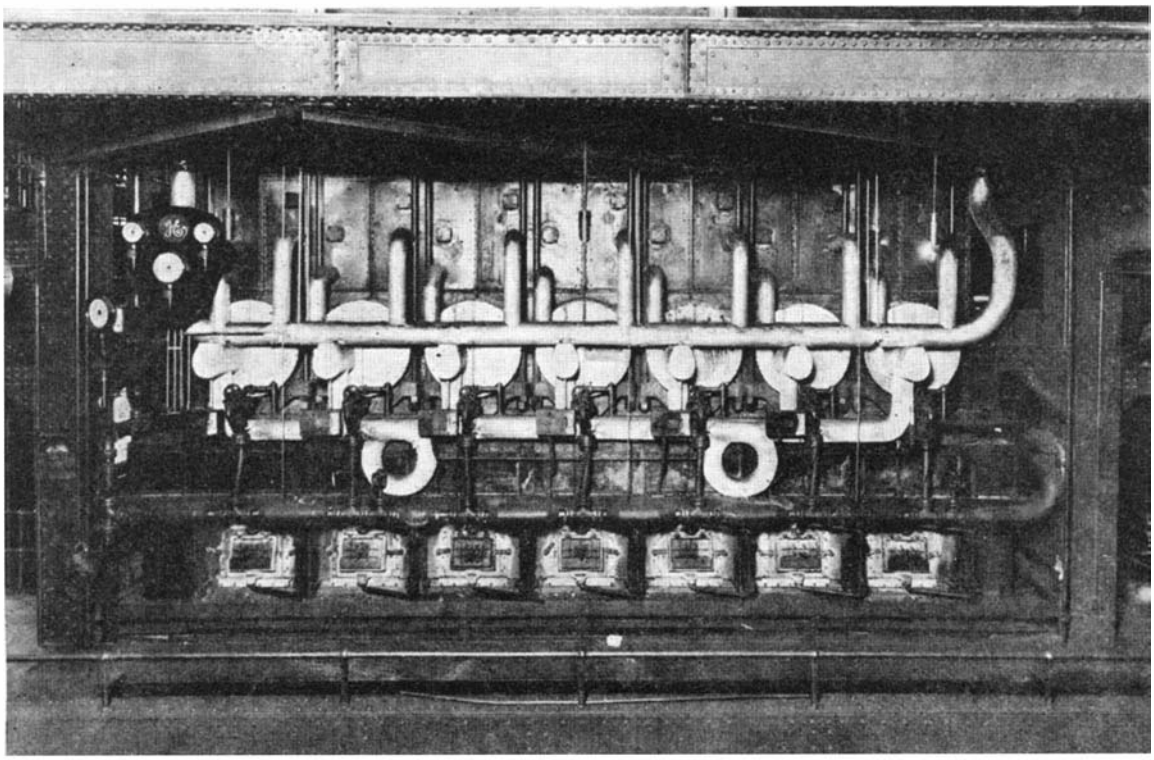
The train earnings bureau next receives the envelopes, and from the contents the clerks "work" the revenue and earnings of each train by divisions. In this great mass of tickets and coupons has arrived the coupon of the ticket of the Nappanee-to-Boston passenger, which may be taken as an example of how all tickets and coupons are handled on the train earnings desks. Since the work of compiling train earnings and individual statistics is divided among the clerks on a divisional basis, the clerk receiving the coupon compiles the miles traveled and the revenue derived from this ticket for the Washington-New York distance only, because the miles traveled and the revenue accruing to each division between Nappanee and Washington have been compiled from the "honored but not lifted" reports of the initial and intermediate conductors.

After the train earnings clerks have completed their records, the local and home inter-line tickets are assorted into selling station order and filed in the ticket cases. At the end of each month these filed tickets are checked against the agents' ticket reports, and the fares, at which the tickets are reported, are checked against the authorized tariffs so as to insure proper accounting.

TICKETS issued by other railroads, known as "foreign inter-line tickets or coupons," are assorted by the names of the companies issuing them, being checked against the reports rendered by their respective companies. The proportions of the through inter-line fares are also audited to ascertain whether sufficient revenue has been received for the service given. The extensions and additions on the reports of the agents, as well as those appearing on the reports of foreign carriers are rapidly checked in a bureau equipped with modern calculating machines.

The home inter-line bureau supervises the apportionment of fares among various carriers that may have provided service in connection with a passenger. The passenger from Nappanee to Boston has long since gone about his business, but that portion of his ticket fare from New York to Boston finds its way into the figures of the home inter-line bureau, where that portion is set up as a credit to the carrier that performed the service, and a subsequent report is made to the interested carrier.

The end of all tickets; they are macerated and headed for the paper mill whence they came. Destruction is by permission of the Interstate Commerce Commission



View of the front of the mercury boiler of the mercury vapor power unit at the South Meadow station at Hartford. Soot blowers, level gages, and the equalizer pipes connecting the mercury drums are shown

MERCURY VAPOR POWER TO THE FORE

VERY often some outstanding development will be announced, discussed widely for a time, will even be sensationalized much to the annoyance of the originator, and then, so far as the layman is concerned, it disappears from sight. If the development is meritorious, the silence is usually due to the fact that long years of experimentation are necessary to prove its full worth. The average man, however, does not realize this and is inclined to believe the worst.

This has been exactly the sequence of events in the case of the mercury vapor power generation scheme about which so little has been heard during recent years. This scheme has now proved not only commercially practicable but also, as the early discussions claimed it would be, more efficient than ordinary steam plants; and two new, and larger, mercury vapor units have been ordered. One of these is to be put into operation at the Schenectady plant of the General Electric Company and the other at the Kearny station of the Public Service Electric and Gas Company of New Jersey.

The mercury vapor process was invented by W. L. R. Emmett, of the General Electric Company nearly two decades ago. After preliminary experimentation, a trial equipment was built and operated in the Schenectady plant, from 1915 to 1917. In 1923, a combined mercury vapor and steam power unit was built for the Hartford Electric Light Company. This was the first mercury-vapor power installation in the world, and was described in the February, 1924, issue of SCIENTIFIC AMERICAN. The practical operating experience obtained with this first unit led to the construction of a 10,000-kilowatt mercury-vapor turbine, installed in 1930 in the South Meadow station of the Hartford company. The records of this installation show a substantial saving in fuel over usual steam generating equipment.

BRIEFLY stated, mercury offers decided advantages over water in turbine operation because it boils at a much higher temperature. The efficiency of any heat engine may be increased by increasing the temperature range through which it works.

One way to do this is to lower the temperature of the exhaust and a second way is to raise the temperature of the supplied steam. It is for the latter reason that steam turbines have been constructed to operate at higher temperatures and higher steam pressures. The minimum exhaust temperature is, of course, limited by the temperature of the available cooling water. The temperature of the supply is limited by the temperature of the combustion of the fuel, and in a steam engine is further limited by the properties of steam. At reasonably high temperatures, the pressure of steam becomes too great for convenient commercial operation.

The properties of mercury, however, are such that high temperatures can be obtained without high pressure. For example, mercury vapor at a temperature of 958 degrees, Fahrenheit, has a pressure of 125 pounds gage while steam at a temperature of only 569 degrees, Fahrenheit, has a pressure of 1200 pounds gage.

Mercury is boiled and vaporized over a fire just as water is boiled and vaporized in a steam boiler. This mercury vapor then drives a mercury turbine, just as steam drives a steam turbine in an ordinary system. At the exhaust end of this turbine the mercury vapor is still hot enough to boil water and make steam at pressures which are in common use. Therefore, instead of circulating cooling water through the mercury condenser as in the ordinary steam condenser, a level of water is held in the condenser just as in a steam boiler. The water boils and makes steam. A large part of the power generated from the mercury turbine is obtained at very high efficiency since

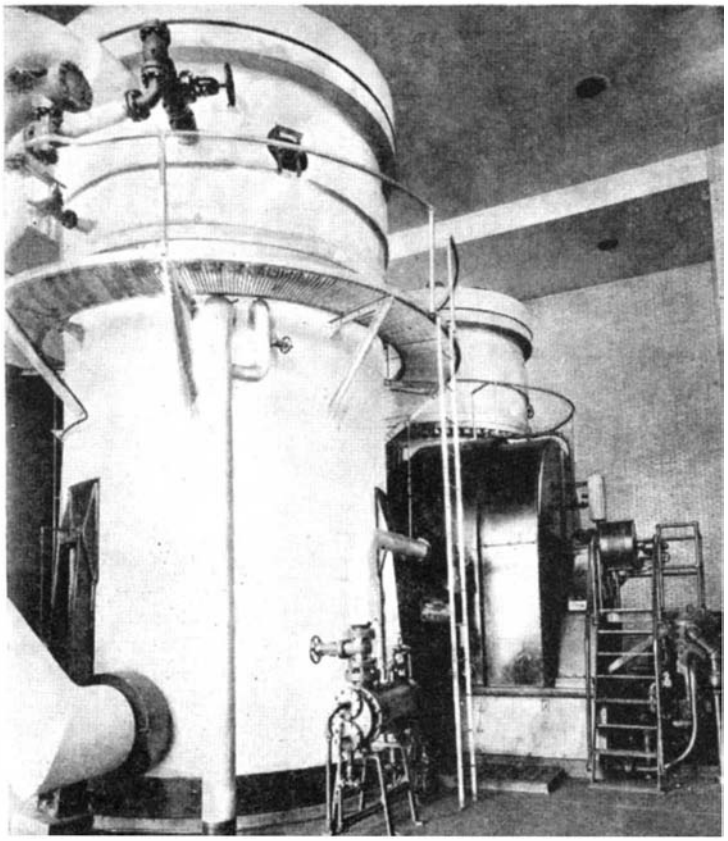
the heat in the exhaust is not lost but is used in the steam production. Thus the mercury takes up heat from the fire and delivers it as work to the mercury-vapor turbine and also as heat to the water in the mercury condenser.

In view of the announcement of the two large mercury-vapor turbine-generators which will be installed in Schenectady and in New Jersey, the following data regarding the performance of the Hartford turbine in 1930 is of interest. The Hartford unit has been in continuous operation since February 4, 1930, except for occasional weekends and during nine days in May of that year when minor changes were made. The ease in starting and operating the apparatus, and the lack of appreciable vibration and noise of the 10,000-kilowatt mercury turbine, is apparent. During the nine months from February to October, inclusive, the performance of the unit was as follows:

Coal burned	69,187,540 lbs.
Water evaporated	572,415,000 lbs.
Output mercury turbine	42,297,000 kw-hr.
Equivalent output from steam	56,910,660 kw-hr.
Total station service	1,924,390 kw-hr.
Total net output	97,283,270 kw-hr.
Coal rate on total net output	0.712 lb. kw-hr.
Hours in service	5,030

The ease in operating this apparatus was fully demonstrated in 1930, and experience during the year indicated that maintenance costs will be less than with standard steam plants. Low fuel consumption was obtained consistently over the entire nine months, as shown by the month-by-month figures and by the figure of .712 pounds of coal per kilowatt hour for the entire period as noted in the table above.

No data are available on the New Jersey mercury boiler and turbine plant except that it is to have a rating of 20,000 kilowatts and will be ready for use in the fall of 1932. The 20,000-kilowatt mercury-vapor turbine generator which is to be installed in Schenectady in a new power plant, however, will be outstanding in several respects, it has been announced by Burton L. Delack, manager of the Schenectady Works of the General Electric Company. It will be the first outdoor plant of its kind; and it will be the first plant ever to have co-ordinated industrial requirements and utility sources of power. The mercury-vapor turbine will be twice as large as the Schenectady-built unit in service at the South Meadow station and, because of increased pressure and temperature of operation, it will be even more efficient than the Hartford installation, which itself is so much more efficient than regular steam generating stations.

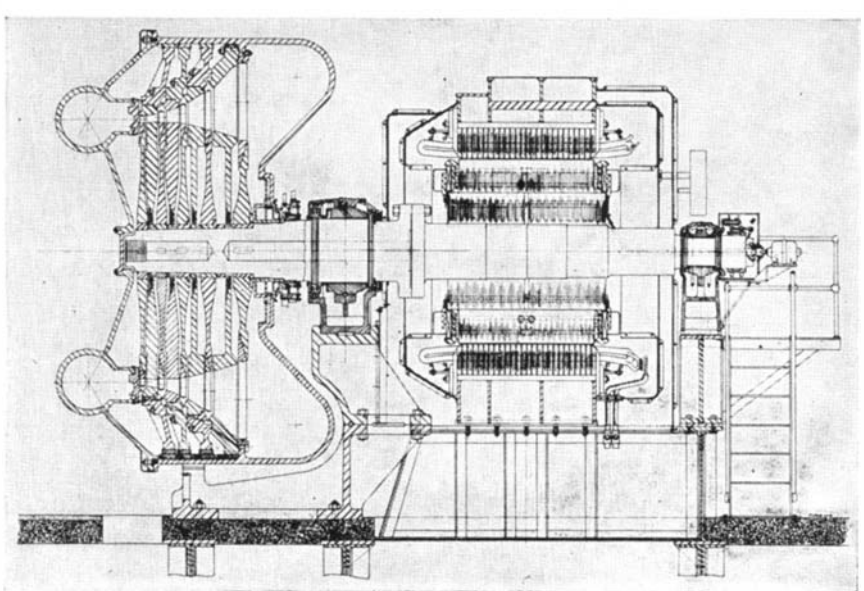


Hartford 10,000 kilowatt unit, showing end of generator and the mercury vapor condensers. The boiler is shown on opposite page

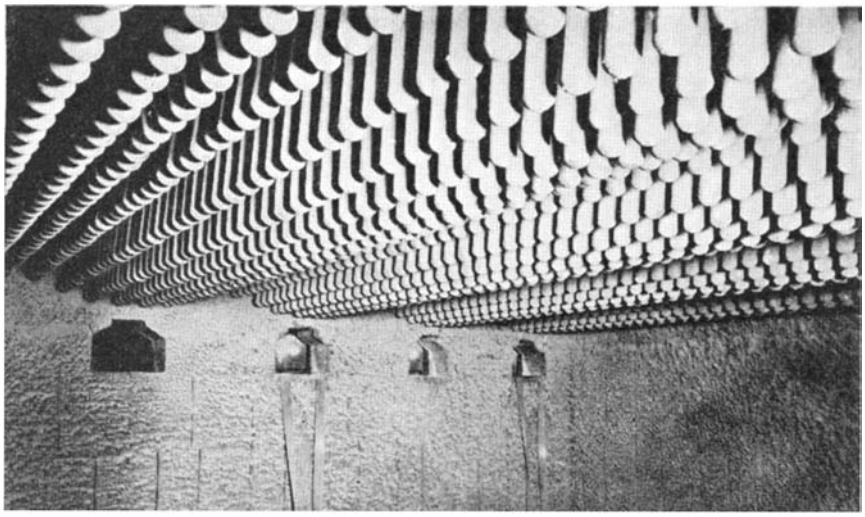
The new generating station, which will be leased and operated by the New York Power and Light Corporation, will supply electricity for the power company's transmission system and steam for use in the General Electric factory. The 4,000,000-dollar development will be located on General Electric Company property, on land recently made available for development when a city road was moved from within the property to the bank of the Mohawk River.

ONE of the present steam generating plants of the General Electric Company, near the front end of the plant, will no longer be used—its 20 old boilers will be dismantled. Steam for the operation of the non-condensing steam turbine in the building will be supplied from the new power station, being conveyed there in pipes in a reenforced concrete tunnel more than three fifths of a mile long. The other generating station within the General Electric works, which will be connected with the new station by a tunnel a few hundred feet long, will be retained for some years to come.

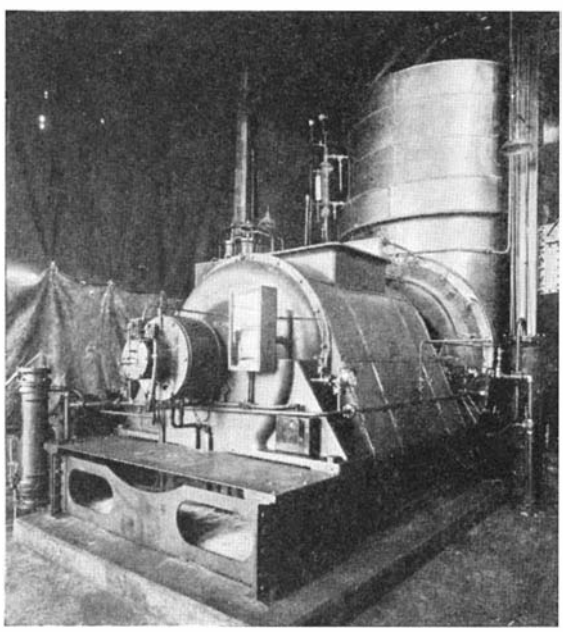
In addition to the 20,000-kilowatt mercury boiler and turbine, the new outdoor station will include a steam



Longitudinal section of 10,000 kilowatt turbine-generator unit at Hartford. The mercury turbine has five stages, and the speed is 720 revolutions per minute



The high cost of mercury necessitates a suspended tube boiler design that will give a maximum amount of heating surface with a minimum quantity of mercury



The 1923 installation of the mercury vapor process unit at the Hartford light company's plant

boiler to supply 300,000 pounds of steam per hour, in addition to the by-product output of 330,000 pounds per hour from the mercury condenser, for process, heating, and testing steam in the General Electric works. Adjacent to the power station site is the substation, through which the electric energy from the mercury turbine is supplied to the 110,000-volt transmission system of the power company. It is through this substation, too, that the electricity for the factory is supplied by the power company at 13,800 volts, the voltage at which the mercury turbine-generator will operate.

The mercury required in the boiler will weigh a quarter of a million pounds —but so heavy is this liquid metal that such a weight occupies a cubical space less than seven feet on a side.

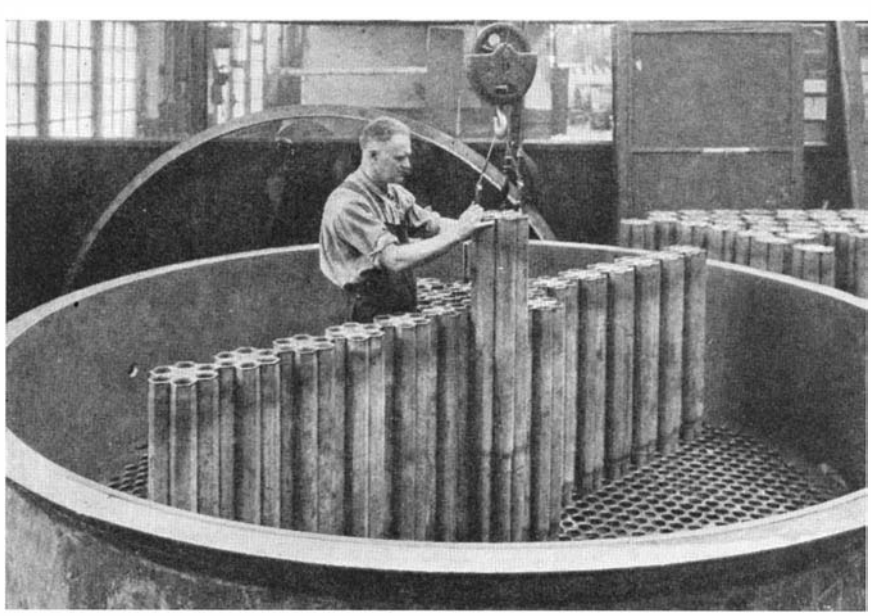
For the Schenectady installation, the mercury boiler drums will be longer than those of the 10,000-kilowatt equipment at Hartford, but the furnace width will be no greater. The design of the unit was based on generating 20,000 kilowatts from the mercury turbine and 240,000 pounds of steam per hour made by condensing mercury (the additional 90,000 pounds of the 330,000 pounds already referred to is obtained from the water walls referred to below). The doubling of the Hartford capacity will be obtained by increasing the mercury pressure to 125 pounds gage and by installing a mercury heating surface on the upper portion of the furnace walls. By thus protecting the furnace walls, the heat liberated in the furnace can be greatly increased over that at Hartford, where the furnace walls are air-cooled. Moreover, the combustion air can be preheated to a higher temperature than was considered desirable with the Hartford furnace. Therefore, a low flue-gas temperature to the stack can be obtained without the use of a water economizer. This will permit a greater application of regenerative feed heating with the steam cycle in case condensing steam turbines are used for generating power.

This 20,000-kilowatt apparatus can be installed in a space no greater than that needed for the 10,000-kilowatt equipment at Hartford.

WHEN pulverized fuel is burned, the lower portion of the furnace walls will, for the present, be protected by water heating surfaces. The fuel economy will be somewhat impaired with this arrangement of furnace as additional fuel is needed to generate steam directly in the furnace walls. Further experience is needed before the entire furnace walls can be protected with mercury heating surfaces.

With a load of 20,000 kilowatts on the mercury turbine and with the power developed from the 240,000 pounds of steam generated at 400 pounds pressure and 350 degrees, Fahrenheit, by condensing the mercury vapor, the expected fuel rate will be 8800 B.t.u. per net kilowatt-hour. With water cooling in the lower part of the furnace, the fuel rate will be from 9100 to 9500.

The design and erection of the new Schenectady plant are being handled by the Construction Engineering Department of the General Electric Company, of which A. R. Smith is in charge, with engineers of Stone and Webster and of the New York Power and Light Corporation in advisory capacity.



Another part of the 1923 installation: the mercury boiler interior. These tubes, filled with mercury at an equalized level, project downward into the fire box

AUSTRALIA'S GREAT METEORITE

By CHARLES P. OLIVIER

Director, Flower Observatory of the University of Pennsylvania; President of the American Meteor Society; Author of "Meteors," "Comets"

READERS of the SCIENTIFIC AMERICAN have had the opportunity in recent years to see several articles which dealt in considerable detail with the famous Meteor Crater in Arizona, and the more recent Siberian fall of 1908. A few smaller craters, more or less certainly identified as due to impact, have been announced in various publications. But only in the past few weeks has the news spread that in Australia was to be found a group of meteor craters which will rank in size next to that in Arizona. Thanks to one of the members of the American Meteor Society, Mr. R. C. Shinkfield of Adelaide, the writer has received detailed and presumably authentic information about this new discovery.

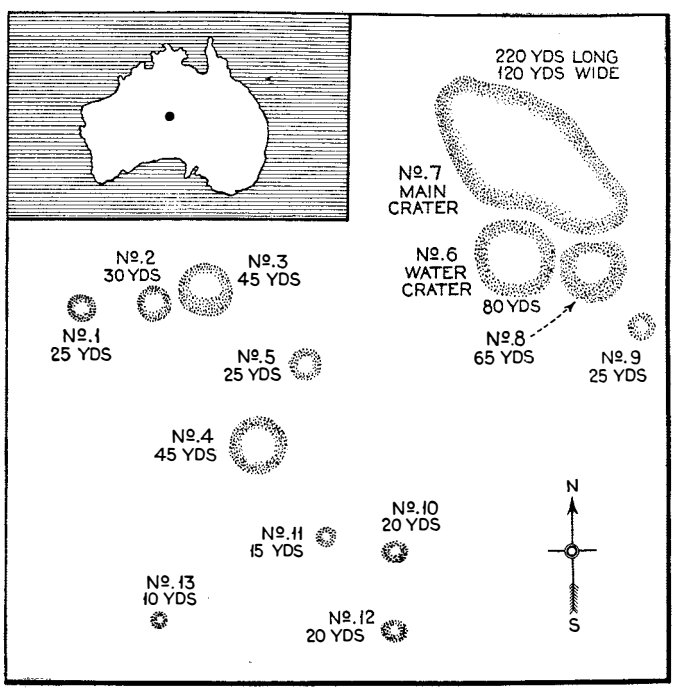
THE craters are 13 in number and are scattered over an area one half mile on a side. They are seven miles west-south-west of Henbury, on the Finke River in Central Australia, and are locally known as the "Double Punch Bowl." The position is in longitude 133° 15′ East and latitude 24° 30′ South. All but the largest are approximately circular, but that is an oval of dimensions about 220 by 120 yards. The others are approximately: one 10 yards in diameter, one 15, two 20, three 25, one 30, two 45, one 65 and one 80. The latter two are almost in contact with the largest, which is the north-easternmost of the whole group. Their proximity has perhaps modified its original shape, as the masses forming them may have fallen some seconds later than the largest mass which formed it.

The craters evidently were made a long time ago, as the walls have washed down and the interiors are largely filled. Indeed the largest crater is now only 50 feet deep. On the outside their rims have slight elevations and very gentle slopes. Within they are covered with coarse grass and other vegetation of the region.

From their distribution the writer infers that the original masses came from the south-west, the larger ones going farthest. From what has been said, their age makes them less spectacular than if they had been due to a recent impact. That they must have been formed long ago is borne out by the fact that the natives have no legends nor stories about them.

They were first announced by a prospector, J. M. Mitchell, who wrote to Professor Grant Kerr of the University of Adelaide concerning them. He sent a meteoric mass to substantiate his deductions. This was in January of the present year. In May, A. R. Alderman and F. L. Winzow, both lecturers in the University, were sent to investigate, and the details here given are from their report. They located about 800 meteoric fragments, which were mostly found on the western sides of the craters. They are quoted as being of the opinion that this indicated that the objects came from the east. The writer, on the slender evidence at hand, believes that it came from the south-west, as already mentioned. Many of the smaller fragments have been completely oxidized and have disintegrated into iron oxide. It is stated that pieces of melted sandstone were picked up. In several of the craters there were low ridges of rock radiating from the edges. The idea expressed was that the force of impact drove the surrounding rock upward, along these ridges. This phenomenon has not been reported elsewhere.

This group evidently represents an intermediate type between the Arizona and Siberian falls. The first must have been due to a very compact group of immense size and mass; the second to a dispersed group of perhaps 150 individuals each big enough to make a recognizable hole. The Australian fall, however, contained at least one single mass or very compact group, which was capable of making a crater of considerable size, while the smallest one is quite comparable to the largest of those in Siberia.



Plan showing the size and areal distribution of the group of meteor craters in Australia. *Insert:* Location of the group

WE may well presume that all craters up to ten feet in diameter, in Australia, would by now have been obliterated by erosion, while in Siberia, as they were found only 20 years after formation, even the small ones could still be recognized. Geologically speaking, however, even the Australian fall is recent. Hence we may no longer consider such catastrophes as very rare, and doubtless many other cases will be recognized as the less well explored territories of the earth are better known. Such discoveries give a constantly increasing interest to all studies of meteoric and cometary bodies, the two kinds which can actually reach the earth's surface without being formed on it.

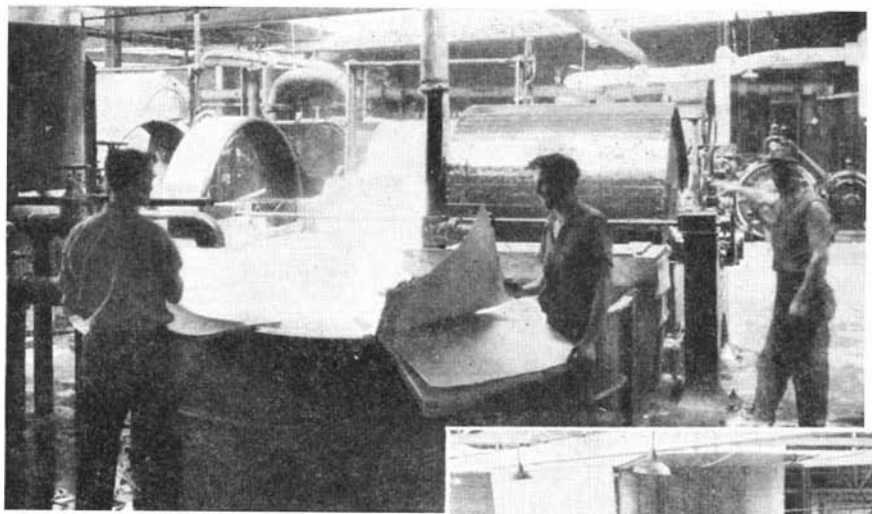
Petitions have been presented to declare the area a public reserve, under the Australian Federal Government, in order to prevent unauthorized spoliation. It is hoped that this will be done, as the craters are of great scientific interest and should be protected in every way. Meantime, everyone interested in science will await with impatience a complete survey and study of this new discovery in Central Australia.

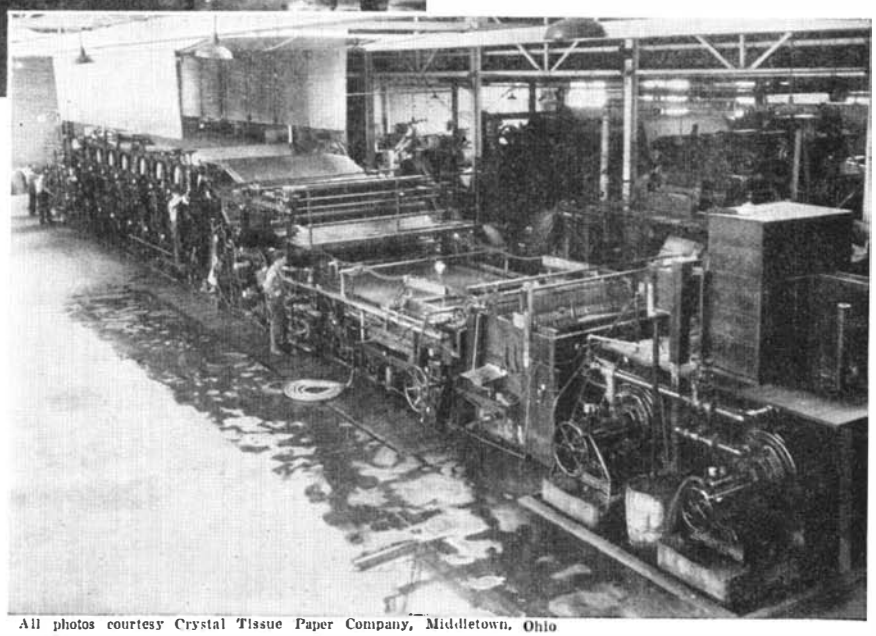
When further facts become available these will be published.

—THE EDITOR

PAPER'S THINNEST WEB

By H. W. VOGLER





All photos courtesy Crystal Tissue Paper Company, Middletown, Ohio

Upper left: **Pulp is fed into the beater where it is mixed with water, bleached, and beaten until the fibers are made ready for paper machine.** ***Above:*** **The "wet end" of paper machine where the fibers are consolidated, forming a web**

THE process of making tissue paper really begins in the selection of the trees from which the paper pulp is made—a selection which is of the highest importance in determining the characteristics of the finished paper. Cellulose fibers are found in all trees, but fibers from different trees differ somewhat in their nature. The most satisfactory fibers for tissue paper come from the sturdy spruce trees. Spruce contains a larger percentage of cellulose than most woods and the fibers are longer, more flexible, and stronger. Saws cut up the logs into two-foot lengths. The bark contains no cellulose fibers and is therefore stripped off.

BROADLY speaking there are two pulping processes—chemical and mechanical. Sulfite, sulfate, and soda pulp are made by the chemical process; groundwood by the mechanical. If we were to visit a groundwood mill, we would see the logs being torn to pieces by pressure against a huge grindstone. The grinding, with the aid of a constant flow of water, reduces the wood to a pulpy mass. Afterwards, the watery pulp is screened to remove slivers, knots, and other impurities, the water is squeezed out, and the pulp is cut into squares and folded into laps for shipment. Groundwood is the lowest class of pulp made and it is, therefore, used in only the cheaper grades of tissue that are used for stuffing purposes. Groundwood contains only about 55 percent cellulose and the fibers are so short and stiff that they do not "felt" or interlace properly.

In a chemical pulp mill the two-foot lengths of log are torn into chips on a machine consisting of a massive iron disk with steel knives projecting from its surface. As the disk revolves, the logs are applied to its surface and small chips fly off. There are also a number of high iron tanks called digesters into which the flakes of wood are charged. Cooking liquor is added, which, in the sulfite process, consists of bisulfite of lime, made by combining sulfur dioxide gas with water and lime. The digester is then closed tightly, the temperature is raised to from 325 to 365 degrees, and steam pressure of from 70 to 80 pounds per square inch is applied. Thus the wood is thoroughly cooked until the acid combines with the ligneous materials, leaving the cellulose fibers free for paper making.

It takes about eight hours to complete a "cook" by the direct or quick-cook method, or from 24 to 28 hours by the slow-cook or Mitscherlich process. Then the outlet at the bottom of the digester is opened and the steam pressure forces the material into a large bin with a screen bottom through which the liquid drains off. There the pulp is washed for several hours to remove the dissolved lignins after which careful screening removes all impurities, leaving the fine cellulose fibers. These are dried, matted together in sheets and packed in bales or rolls for shipment to the paper mill.

If we start at the beginning of the papermaking process, the first thing we see is the beater room. Here the minute fibers are cut short or flattened out or frayed in whatever manner is dictated by the requirements of the sheet that is to be made. There is an old saying among paper makers that "paper is *made* in the beaters," which means that here the fibers are so manipulated as to produce the characteristics desired in the finished sheet.

A beater is a big oval tub, divided lengthwise by a partition called the "mid-feather" which stops short of both ends, thus making a channel all around the beater. Across this channel, between the mid-feather and one of the side

walls of the beater is a large roll set with knives, covered by a hood.

The pulp remains in the beater for hours, slowly circulating around and around. Then, after it has been beaten sufficiently and bleached, washed, dyed, and sized, a valve is opened and it is allowed to drop down into a storage chest. Here a big revolving paddle wheel keeps it constantly agitated until the paper machine is ready for it. The pulp is subsequently put through a Jordan engine, where the beating process is carried further.

The paper machine, that massive series of wires, felts, and drums on which the web of tissue is actually formed and dried, holds the center of the stage in the machine room. The first thing we see on the paper machine is the vat, and if we look down upon the thin swirling liquid it contains, we marvel at the thought that out of it can be drawn a sheet of tissue paper. By the time the stock reaches the vat, enough water has been added so that only 0.2 percent of the solution is fiber.

There are two ways of forming a sheet of tissue from the solution in the vat. That is to say, there are two types of paper machine—cylinder and Fourdrinier. In the Fourdrinier machine, there is a fine wire screen in the form of an endless belt. A continuous uniform stream of stock flows from the vat to the endless wire screen, over a rubber cloth or apron. The size of the stream is regulated by a gate called the "slice." The Fourdrinier screen is out in the open and we can easily see the water drain out of the paper. It is helped along by a series of little brass "table" rolls over which the wire moves, and by several suction boxes. We may wonder, as we watch the Fourdrinier, why the entire frame on which the wire moves is roughly vibrated back and forth, just at the point where the stock flows to it. This shaking arrangement is decidedly important. It helps cross the fibers, reducing very materially the grain of the sheet.

The Fourdrinier has a so-called "couch roll." We see it just at the point where the endless wire belt begins its return journey. An endless web of felt passes around the couch roll and the paper adheres to it in preference to the wire. This felt carries the paper through two smoothing rolls called presses to a denser top felt which carries it to the driers. As we follow the paper to the driers, we see a long series of revolving steel drums arranged in two tiers on a frame. These are filled with steam and as the paper passes around each of them, some of the water is evaporated. By the time the paper reaches the end of the series, it is perfectly dry. The paper passes over the top of one drier and then around the bottom of the next and this brings both sides of the sheet alternately in contact with the drying surface.

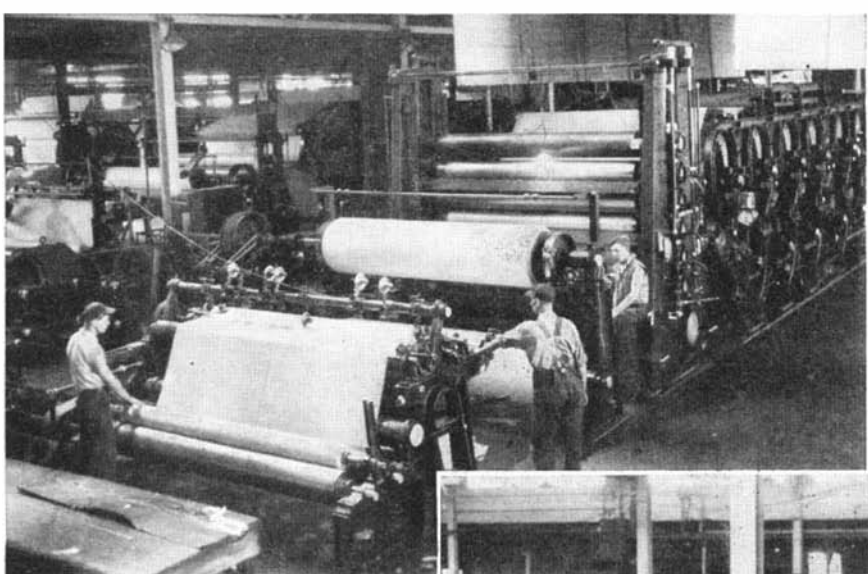
At the end of the driers we see the endless sheet of paper passing back and forth several times between a stack of heavy steel rolls. These are the calenders which iron out the sheet, giving it a smooth even surface. It is then wound on a large spindle called the reel.

There are two reels at the end of the machine so that when one is full, the web of paper can be transferred to the other. The paper on the first reel is then rewound into rolls. Up to this point, the paper extends across the entire width of the machine, but in rewinding it passes between sets of circular slitter knives which slit the sheet into its proper width.

THUS is tissue paper made, but before it can be used for packing fine gowns or for wrapping dainty gifts, it must be converted from rolls into sheets. Let us visit the finishing room and see how this is accomplished.

There we see a huge frame, on which are mounted 24 "jumbo" rolls of tissue. Unwinding from these rolls are 24 continuous webs of tissue all of which run simultaneously through sets of slitter knives which trim the edges and cut the paper to the proper widths. As they proceed a little farther, we see them clipped off to the proper lengths by a heavy knife set in the face of a revolving drum. As the 24 sheets proceed, a steel arm comes down, forcing the entire quire between a set of rolls which folds it. Twenty 24 sheet quires make a ream; each ream is wrapped and ten reams are packed in a bundle. If the tissue is to be sold at retail for use in the home, it is wrapped on tubes.

Of course, there are many uses for tissue other than for wrapping. Much of it is shipped out of the mill in machine rolls for converting into other products. Household waxed paper, for example, is all made from tissue. So are the so-called "fiber" rugs so widely used for porches and summer homes. There are literally hundreds of other places where tissue is used.



Above: **The paper is formed from the fibrous material into a web of paper which is dried so as to form a continuous moving strip which can be spooled and cut.** ***Right:*** **Girls puting up tissue in rolls for holiday trade**

WHERE NOT TO LOOK FOR OIL AND GAS*

By DR. CAREY CRONEIS

Assistant Professor of Invertebrate Paleontology at the University of Chicago; Geologist, Illinois State Geological Survey

IN spite of the seeming deluge of oil, many a disillusioned prospector will tell you that "oil and gas, like gold, are where you find them." So they are—but through the intelligence of man in general and of engineers and geologists in particular, and, I must confess, through sad experience as well, we have learned that they are almost invariably found in *certain* places. Where are these certain places?

A study of a map of the world's oil resources (Figure 2) reveals the fact that the great oil producing areas, although widely scattered, are limited to rather definite zones, and that very large sections of the face of the earth are entirely without oil reserves. Let us now examine a map of the world (Figure 4) designed to show, first, the plateau of ancient rocks; second, the lowlands of ancient rocks; third, the great folded mountain ranges; and fourth, the lowlands of younger rocks. If we have kept in mind the distribution of the world's great oil fields we are struck by the fact that none of them is located either on the plateau or the lowlands of ancient rocks, and equally apparent becomes the still more significant fact that oil and gas *are found either along the great mountain chains or in the lowlands of recent rocks which border those chains.*

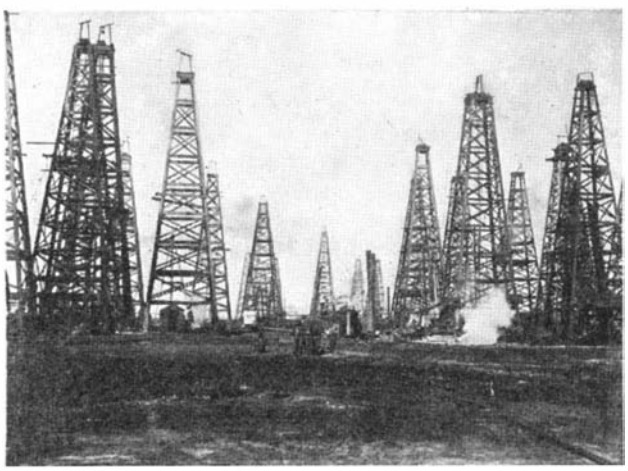


Figure 1: **Cause of our deluge of oil: overdrilling**

SUCH a world-wide alinement can hardly be coincidental. Thus there seems to be a fundamental relationship between mountain building and the distribution of oil and gas.

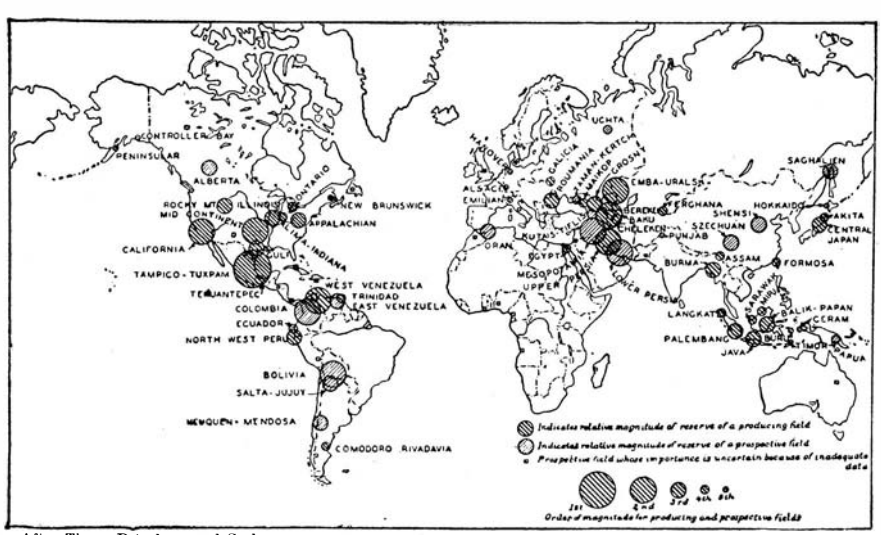
To appreciate fully the real significance of this relationship we must inquire somewhat further, if briefly, into the origin, migration, and accumulation of oil and gas.

The question of the mode of origin of oil and gas has engaged the attention of scientists for more than a century, but it has not yet been surely answered. The theory that they have originated from the chemical combination of natural inorganic substances has been advocated mainly by chemists, and is based chiefly upon laboratory experiments. It is possible to form hydrocarbons through inorganic agencies, and the theory cannot summarily be dismissed; but geologists, for a number of reasons which cannot be entered into here, find the large quantities of petroleum and natural gas in sedimentary rocks incompatible with such a mode of origin.

Nearly all geologists are now convinced that oil and gas are of organic origin.[1] They believe that natural hydrocarbons have been formed by the decomposition of organic material deposited with the sediments. As to whether the organic material consisted of plant or of animal remains, or of both, there are still several different opinions. It is clear, however, that under certain conditions the natural decomposition of the remains of either or both animals and plants (Figure 3) *may* supply the hydrocarbons found in oil and gas. It therefore seems reasonable to suppose that some oils are solely of animal origin, that others were derived from plant remains alone, and that many have originated from a combination of the two.

Although we now know that both oil and gas may migrate relatively great distances from their place of origin, nevertheless if they have formed in the manner geologists believe, then the position of oil and gas pools today must in some measure be influenced by the sites of deposition of the animal and plant remains from which the oil and gas were derived. Marine life is most prolific along the strand, and in shallow waters, that is, down to depths to which sunlight penetrates. It also happens that organisms living in such a habitat are at their death subject to burial with the sediments which are constantly being washed into the sea in such positions. In other words, the sites of abundant marine life and conspicuous marine deposition are in most

[1]See H. Ries, "The Origin of Petroleum." *Scientific American* January 1929, pages 56-59. —*Editor.*



After Thom, Petroleum and Coal

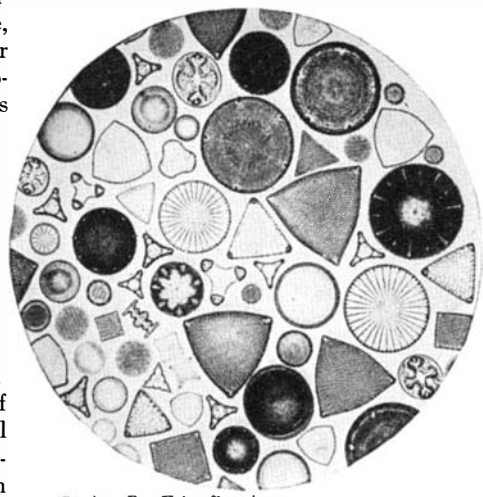
Figure 2: **World petroleum resources. These occur in definite regions**

*Extracted from the *Journal of the Western Society of Engineers* (Chicago)

cases the same. Hence along ancient shores the muds that were washed out to sea buried either organic material, later to be converted to petroleum, or globules of oil which were already formed as a result of a special type of putrefaction carried on under the influence of marine waters. In either case, and here I am passing roughshod over many of the most difficult of the petroleum geologist's questions, the shales formed from the compacting of these muds are regarded as the most important "source beds" for oil and gas. Thus it becomes apparent that the geologist is supremely interested in ancient shore lines, for their position in large part determines the location of the original source rocks.

But what, you may well ask, do ancient strands and sites of deposition have to do with the present location of mountain chains and the position of oil and gas pools? The answer is that practically all of the great folded mountain ranges now stand where sediments formerly were being laid down.

This important change in the earth's facial expression has come about in the following fashion: Sites of deposition in the past, at least so far as the sites were located on what are now the continental masses, commonly were shallow marine basins bordered by relatively high lands composed of older rocks. As erosion slowly wore down the borderlands the materials carried to the basin tended to fill it up. With added weight of sediments, however, the basin of deposition, commonly called a geosyncline, gradually sank. Thus more and more material was constantly added to a progressively sinking trough. But as a consequence of the slow sinking, the



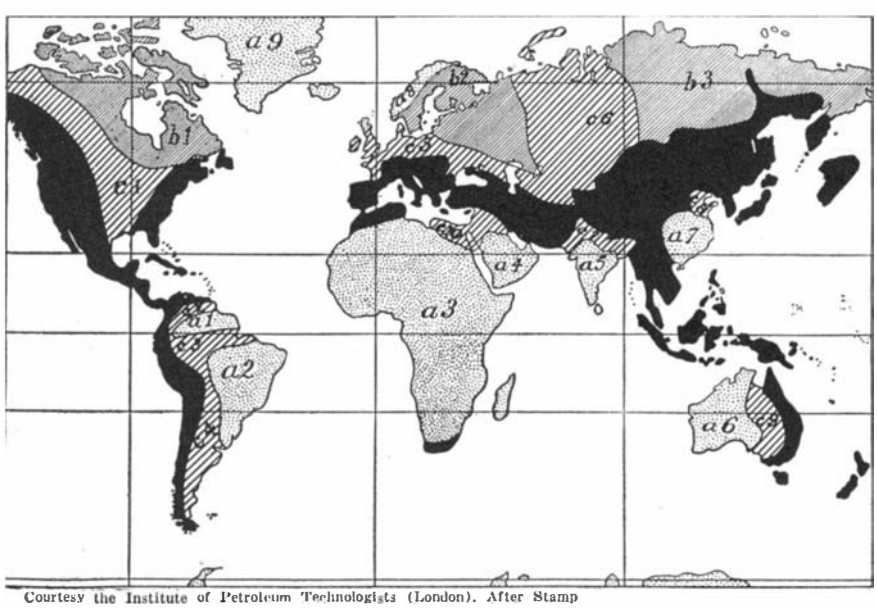
Courtesy Dr. Heinz Rasenberger

Figure 3: **Diatoms, microscopic plants, one probable oil source**

type of sediments deposited remained, throughout the vast thicknesses of accumulated material, essentially of the shallow-water type. Because of this permanency of relatively shallow waters, geosynclinal seas of the clearer type usually teemed with both plant and animal life.

As a further and more important result of the predominately shallow-water type of deposition, these geosynclinal areas have gradually become lines of weakness in the earth's crust. Thus it has happened again and again that "mountains have grown out of geosynclines" (Figure 5). In other words, because of the earth's inherent tendency to resist accumulative stresses for considerable lengths of time, zones of deposition, notably weaker than the bordering highlands, continue as such in some cases for geologic periods. When the gathering forces tending toward contraction of the earth's surface reach such a strength that they can no longer be withstood by the sediments in the geosynclinal area, then the older and stronger rocks which bound the basin move toward each other. As a result the softer rocks between are caught as in the jaws of a gigantic vise, and gradually they are folded and squeezed until the surface of the earth there has been notably foreshortened. Thus do the areas of sedimentation become complexly folded and faulted tracts; and where deposition was formerly dominant, erosion now plays the leading rôle.

All of the long and complicated steps by which basins of deposition are formed and by which mountains finally grow out of them have also played their part in the migration and accumulation of oil and gas (Figure 6). In the early stages of the formation of these products they are both widely disseminated through the sediments containing the animal and plant material from which they were derived. They are then gradually gathered together by many forces among which may be mentioned capillary attraction, displacement, gravitation, gas pressure, differences in specific gravity, and the general circulation of water.



Courtesy the Institute of Petroleum Technologists (London). After Stamp

Figure 4: **Main geologic units of the world. Plateaus consisting mainly of the ancient metamorphic rocks, most of which do not contain oil, are marked *a*; a_1 being the Guiana highlands, a_2 Brazilian Plateau, a_3 African plateau, a_4 Arabian plateau, a_5 Indian plateau, a_6 Western Australian plateau, a_7 South China, a_8 Scandinavian highlands, a_9 Greenland. Units marked *b* are lowlands of ancient rocks, which are also non-petroliferous: b_1 the Laurentian shield, b_2 Baltic shield and Russian platform, b_3 "Angaraland." Those marked *c* are lowlands of younger rocks which *may* contain oil; c_1 being the central plains of North America, c_2 Orinoco basin, c_3 Amazon basin, c_4 Argentine, c_5 North European plain, c_6 West Siberian lowland, c_7 plain of Hindustan, c_8 North China plain, c_9 Australian lowlands, c_{10} Egypt-Iraq. Finally, the black units are the mountainous regions on whose flanks oil fields tend to be concentrated**

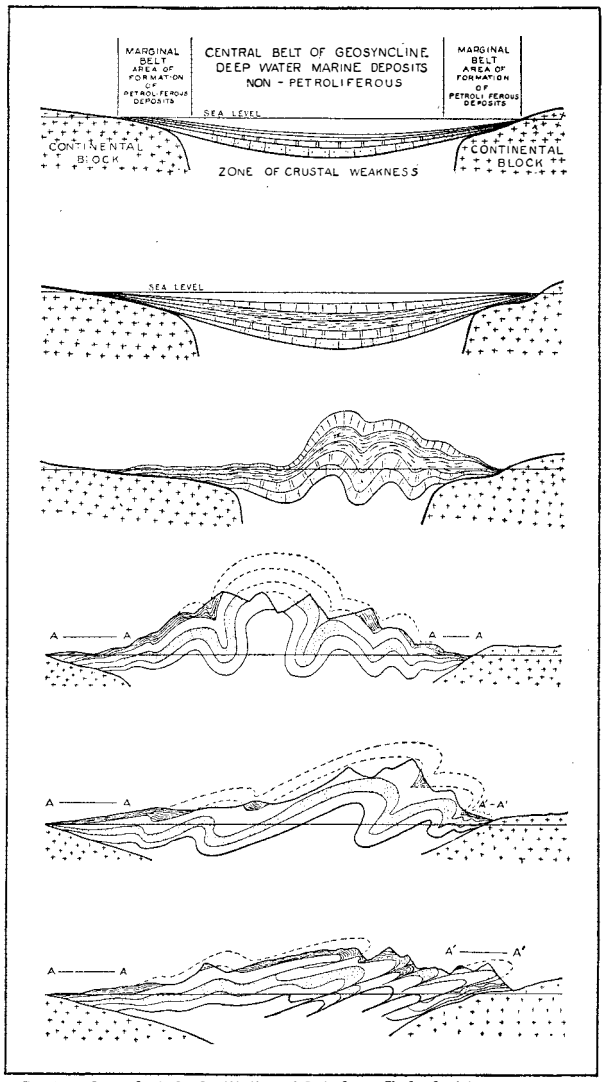
CAPILLARITY, which moves a liquid in all directions through small openings in a solid, moves petroleum through minute pores in rocks much as kerosene rises in a lamp wick. Displacement, an effective cause of the migration of oil and gas, may result from the compacting of the beds in which those materials occur, due to the weight of the overlying rocks. The muds in which oil and gas are assumed to originate are much more compacted than are the associated sands into which the hydrocarbons are driven. The progressive cementation of the pore spaces in these sandstones in turn may cause further migration of the oil and gas, and thus constitute another type of displacement.

Gravitation is rarely an important agent in the migration of oil and gas, and it is effective only where the sands are both porous and free from water. Gas pressure, however, has been effective in the movement of hydrocarbons. The expansion of the gas equally in all

directions as it is formed not only pushes it through the openings in the rock, but tends also to move any liquids present ahead of it. The differences in the specific gravities of oil, gas, and water is a further cause of migration of hydrocarbons, for, as the oil and gas are lighter than water, they are carried ahead of the water in its movement. The general circulation of water has also contributed to the migration of oil and gas, particularly in the early stages of their movement.

THE place of final accumulation of oil and gas after their migration depends largely upon the structure of the beds containing them. This structure in turn is in most cases the result of the mountain building I have just described; in all cases it is the result of movements of one sort or another in the earth's crust. Oil and gas move along tilted and porous beds. In the comparatively rare dry porous beds, the oil moves downward and is concentrated in the synclines, or downward bent strata. If the beds are saturated with water, as they generally are, the oil and gas are driven upward by the water. This upward migration may continue to the surface, where the oil may emerge as "seeps," or it may be stopped in one or more of several ways. If the reservoir bed is lenticular and the lens is overlain by impervious strata, the oil and gas cannot move upward; if the reservoir is sealed by a fault, or by an intrusive mass, or by an asphaltic residue at the surface, these also prevent the escape of the oil and gas. But the most effective, and by far the most common, obstacle to the continued upward migration of oil and gas is a marked reversal or diminution of the dip of the reservoir bed (Figure 7). In such cases the hydrocarbons rise to the highest part of the structure, but further movement is prevented by an impervious layer which overlies the reservoir.

The more desirable of these latter structures are particularly common along the flanks of the great folded ranges where the movement has not been sufficiently severe to fault the reservoir complexly. In these anticlinal structures of large size considerable gas pressure is developed, and upon drilling such a structure the oil may be driven upward by the expanding gas to form a flowing well, or "gusher." The pressure commonly amounts to 500 pounds per square inch, and in many cases it is higher.



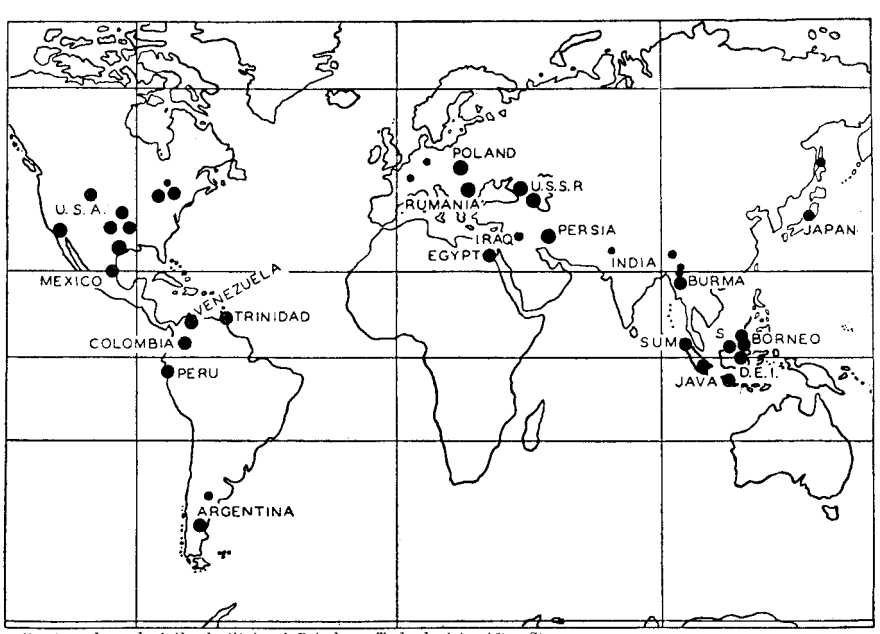
Courtesy *Journal of the Institution of Petroleum Technologists*

Figure 5: **The upper three diagrams illustrate the deposition of sediment and the formation of geosynclinal mountain ranges. The lower three are the main types of folded mountain belts. Oil fields are likely to occur in the regions marked A—A, but in the areas marked A'—A' they are deeply buried**

So far we have been engaged in getting a bird's-eye view of the importance, properties, origin, migration, accumulation, and production of oil and gas; and we must now inquire as to how the geologist goes about finding those products. Is there anything mysterious in his methods? Does he, as many seem to think, practice some scientific hocus-pocus or legerdemain? Is he after all only a "water witch" gone to college?

MY experience with the qualified oil geologist leads me to come to his defense. He is usually thoroughly trained in theory, made wise by practice; he is conservatively optimistic, but expects no miracles; he is willing to pioneer, but unwilling to spend too much of his company's money in following up his own pet theories. He knows that good hard work in the field is better than uncontrolled speculation in the office. Field work completed, he is not above philosophical mental excursions whose results in many cases smack of the miraculous. Geologist by name, he is sometimes a chemist, often a physicist, and always an engineer. In short, trained as a geologist, he employs all of the sciences, yet spurns not common sense.

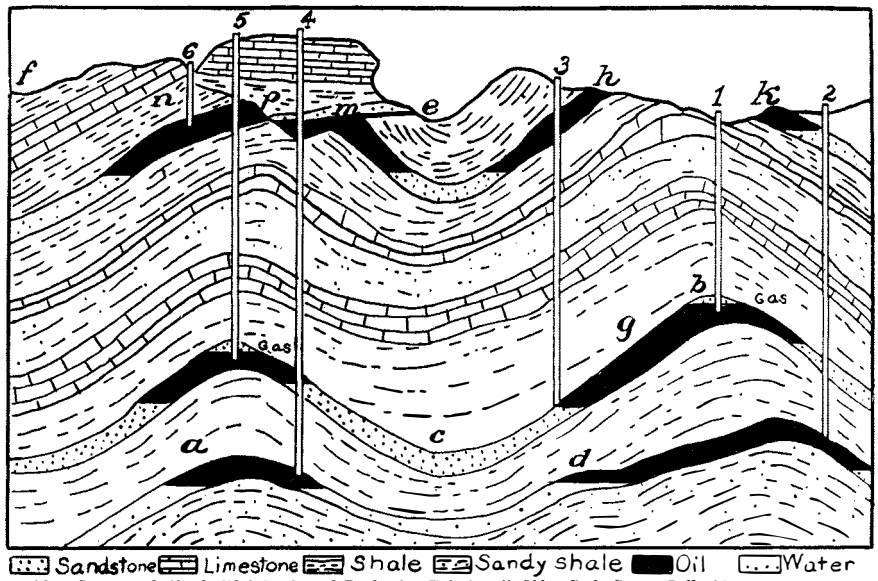
Such an oil geologist, and there are many of them, in going into a new area invariably



Courtesy *Journal of the Institute of Petroleum Technologists.* After Stamp

Figure 6: **Map of the world, showing the location of the principal oil fields. These are situated along the fringes of the mountain belts shown in Figure 4**

asks himself a number of questions somewhat as follows: Are there surface indications of oil or gas, such as seeps? Are the rocks of sedimentary origin? Are the rocks, to be encountered by the drill, of the same age as those in some producing field? Is there a probable or possible source of oil and gas? Are porous beds present? If so, do they have a sufficient impervious cover? Is the structure suitable to the accumulation of oil and gas? Are the beds so slightly metamorphosed by heat and pressure that oil and gas, if once present, have not been driven off? And so on. An affirmative answer to all of these questions, except the first, is regarded as very desirable before drilling in the area is undertaken. Time does not suffice to explain how the geologist answers all of these and other questions, but several of the procedures which he has developed for their solution may prove of interest.



After George and Cloud, "Oil Sands and Production Relations." *Okla. Geol. Survey Bull. 43*

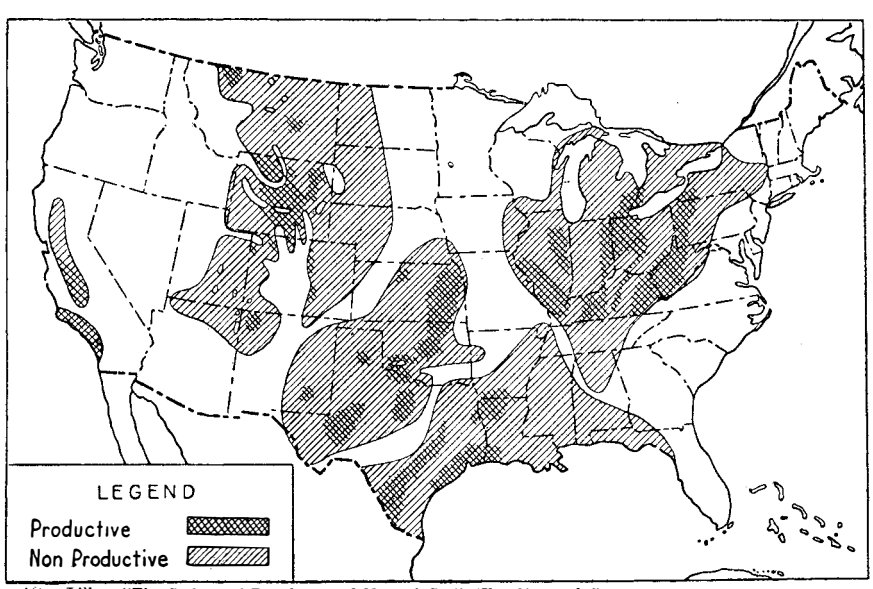
Figure 7: **Sketch illustrating numerous structural features and showing the position and relation of oil, gas, and water to synclines and anticlines. *a* and *b* are anticlines; *c* and *f* are synclines; *d* is a terrace; *e* an oil seep on a syncline; *g* indicates greater accumulation of oil (black) on the closed side of a structure; *h* and *k* are outcrops of oil-bearing rock, sealed by a deposit of paraffin or asphalt; *e-n* is an unconformity; *m* shows migration of oil from older to younger porous rock. At *p* an impervious stratum seals in the oil. Well No. 1 produced gas and oil; No. 2 produced a little oil, then water; No. 3 struck the edge of the water; No. 4 gave a small production, also water from three sandstone strata; No. 5 gave a good production from two sands and would produce from a third if deepened; No. 6 produced from the first sand**

THE degree of rock metamorphism may be determined by several methods, but the most widely used criterion is the carbon ratio of the coal in the area examined. In 1915 David White advanced the theory that the percentage of fixed carbon in pure coal is an accurate index of the degree of metamorphism of the rocks containing the coal, and that the general prospect of obtaining oil in an area in which coal occurs may therefore be determined by a study of the carbon ratios of the coals of that area.

After studying the locations of Appalachian oil fields in connection with the carbon ratios of the coals in them, White concluded that cil in commercial quantities would not be found where the carbon ratios of the coals were higher than 65. In other words, as one moves from the gently folded Appalachians on the west toward the more intensely folded rocks on the east, he finds the coals increasing in their fixed carbon content. He notices also that beyond a certain line no more oil fields occur. Further carbon ratio studies elsewhere in North America, and on other continents, in the main have seemed to justify White's conclusions, and they led him to add that the degree of regional metamorphism in any area determines also the character of oil it contains. Although the entire validity of this theory recently has been questioned by some geologists, most workers regard it as a useful empirical generalization of especial value in ruling out certain areas in which, although otherwise attractive, the drilling hazards are made unduly great by the regional metamorphism.

Another example of the geologist's utilization of scientific methods is his development of geophysical means of locating structures in areas in which the bedrock is concealed. These methods, to the uninitiated, do seem to partake of witchcraft. In the main they are based on (1) differences in the reaction of petroleum, salt water, and different types of strata to the transmission of radio waves, (2) differences in the electrical conductivity of different substances found in the prospective area, (3) differences in the magnetic qualities of different types of rocks, and (4) differences in the density of the different types of material found in the earth's crust as determined by a torsion balance or by the seismograph.

As a result of this last method and other types of detailed exploration over most of North America, it has been possible to pool the data thus accumulated and to point out "petrolific provinces" (Figure 8). That is, as a result of information gathered by independent geologists, oil companies, and by state and federal geological surveys, those areas in which there is some chance for oil and gas have been rather definitely outlined and set apart from those regions in which it is essentially hopeless to prospect further.



After Lilley, "The Geology of Petroleum and Natural Gas" (Van Nostrand Co.)

Figure 8: **Petrolific provinces of the United States. The five shaded areas are, from left to right, the Pacific, Rocky Mountain, Mid-Continent, Gulf, and Eastern provinces. Note that only parts of the several areas are producing oil**

ELECTRICAL AIDS TO BLIND FLYING

By PROF. ALEXANDER KLEMIN

Daniel Guggenheim School of Aeronautics
New York University

THE human being with normal senses can fly very successfully in fair weather, although he has the unusual problem of governing his craft around three axes. Flying "blind," as in fog, he is baffled. Man is accustomed to one accelerating force—gravity—which always acts vertically downwards. Aloft he is subjected to much larger forces which may act in any or all of three directions. A spin so disturbs the internal fluid of the ear that the pilot may think spinning still persists long after it has ceased. In a fog, he may imagine his craft to be flying level and straight ahead, when his plane is in reality in a spin. Once the horizon disappears he is truly helpless.

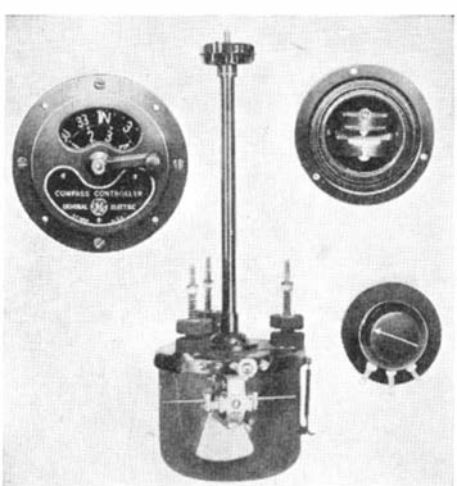
Pilots who once argued for the reliability of their senses are now firmly convinced that instruments are essential. Instruction in blind flying, with covered cockpits, is becoming general. (See page 528, December, 1929, page 470, June, 1930, and page 430, December, 1930 SCIENTIFIC AMERICAN.) Complete instrumentation for blind flying is being achieved.

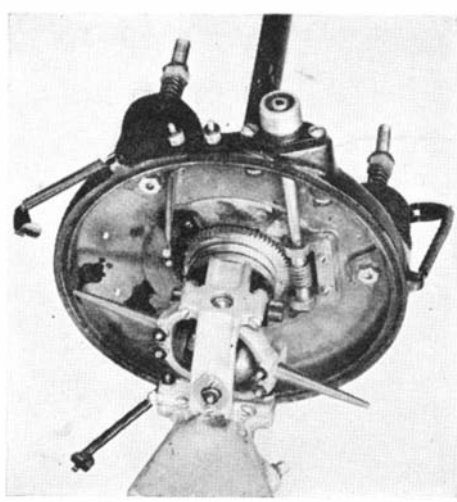
WHILE at the end of the 19th Century, applied science and engineering had got fully into their stride, invention was still largely a matter of individual effort or the result of effort by small groups. It is true that entirely original developments in applied science are still likely to be achieved by brilliant individuals, but the solution of technological problems which are clearly indicated by the requirements of an industry is far more apt to lie in the hands of a well organized industrial group.

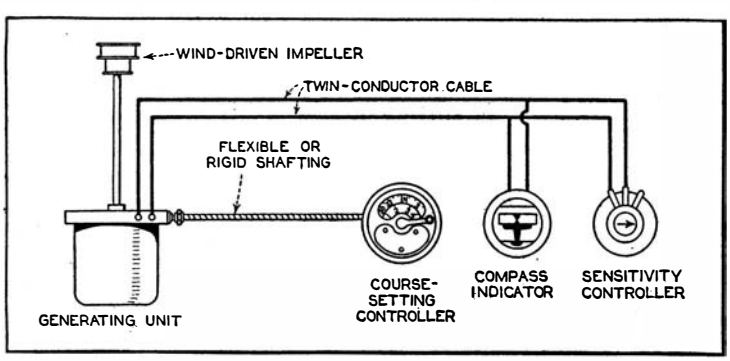
The General Electric Company, in its research and engineering departments, provides perhaps the ideal group for industrial research. Laboratories of every description, supported by full facilities for experimental construction, specialists in every branch of applied science, and executives who recognize the value of research and invention and support experimentation to the limit without too great an anxiety regarding immediate profits, provide an ideal set up.

When, with the growth of air transport, the problem of complete instrumentation in flying became of importance, the General Electric Company found an excellent opportunity for its splendid research organization. While government bureaus, other industrial organizations, and the universities have all contributed to the problems of blind flying, it is remarkable how nearly the instruments of this company cover the entire field of blind flying.

The General Electric "magneto compass," a rival of the "earth inductor compass," has given the airman an instrument far superior to the ordinary compass. The magneto compass is expensive, relatively heavy and not simple, but its application in aerial navigation is more than justified. It consists essentially of a generating unit, a remote-indicating instrument, and a course-setting mechanism. The generating unit is mounted in some part of the airplane relatively free from disturbing magnetic influences, such as "aft" in the fuselage near the tail assembly. It is located inside the fuselage with the drive shaft extending outside so that the wind-driven impeller is turned by the relative air velocity in flight, thus driving the generator. The other component elements which are unaffected by local magnetic disturbances are mounted on the instrument board in the pilot's cockpit.



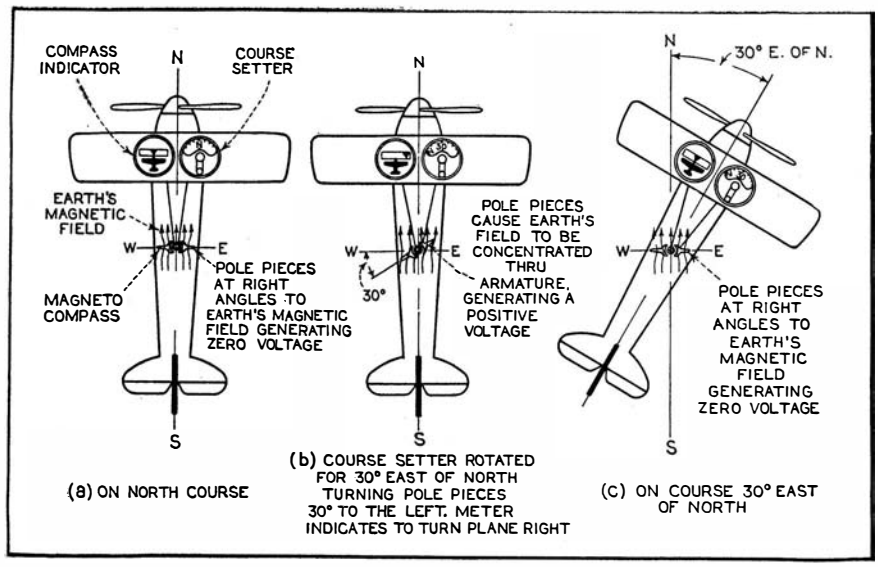




Upper left: **The new magneto compass generating unit, controller, indicator, and potentiometer.** *Upper right:* **Interior of magneto generating unit, showing course-setting control.** *Drawing:* **Diagram of connections of units of the magneto compass**

THE magneto compass generating unit operates just like a direct-current generator. It has an armature and a commutator but uses the horizontal component of the earth's magnetic field as its field of force. Pole pieces of Permalloy serve to concentrate the magnetic lines of force because they prefer to pass through the alloy rather than through the adjacent air spaces. When the pole pieces lie parallel with the earth's lines of force, that is, magnetic north and south, the generator field strength is maximum, causing a maximum generated voltage. When

the pole pieces are at right angles to the earth's field, that is, magnetic east and west, the generated voltage is zero. Thus, with the pole pieces pointing east and west, the indicating instrument pointer is on zero in the center of the scale, above the nose of the miniature airplane which remains stationary. A swing of the pole pieces from the east-west position picks up some of the earth's field and causes the generator to generate "positive" for one direction and "negative" for the other. A corresponding movement on the indicating instrument shows that the airplane has turned to left or right of the east-west course.



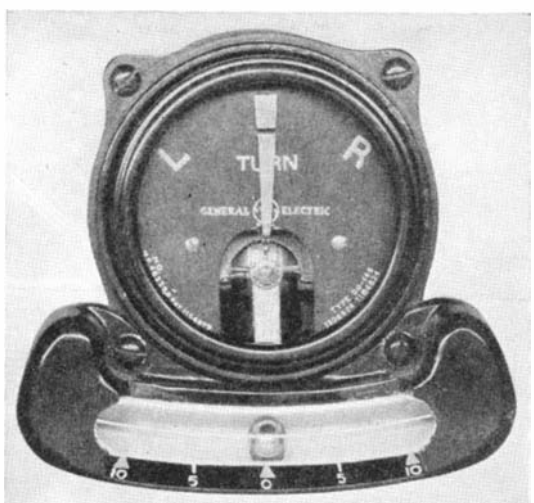
The fundamental principle of course setting with the magneto compass

TO eliminate the effect of the vertical component of the earth's magnetic field, when the plane is not level, the pole pieces swing together with a pendulum, which is damped to prevent oscillation.

The directional effect being obtained by means of the position of the pole pieces and not by depending upon the exact position of the brushes, no errors are introduced by brush wear. Further, since the pole pieces are guarded against the effects of pitch or roll by the pendulum, the armature can be driven through simple shafting from the air impeller without the introduction of universal joints.

The compass indicator, of the galvanometer type, needs no detailed description, as beyond heavy jewel-type bearings and shock-absorbing mounting ring, it resembles the usual electrical instruments of this type.

When the magneto compass is installed, the course-setting controller is mechanically connected to the pole pieces of the generator and rotates them by means of either a flexible or rigid shafting, so that when the pointer of the indicator is centered the ship is headed in the direction indicated on the dial of the controller. The course-setting controller consists essentially of two concentric dials with a gear reduction so arranged that one revolution of the crank moves the outer scale a distance of ten degrees. Inasmuch as the inner scale is divided into ten equal parts, each of its divisions represent one degree. The combination of the two scales acts as a vernier to adjust the compass accurately and to indicate the course thus established by the pilot.



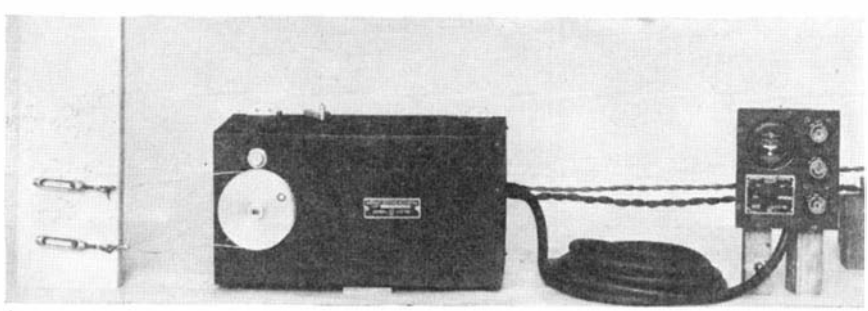
The electric turn indicator, combined with lateral inclinometer, is described in the text

While the pole pieces of the magneto compass generating unit are kept horizontal by the damped pendulum, the pendulum will not do everything. Rotation of the plane introduces centrifugal forces which act on the pendulum also, and the pendulum becomes incapable of indicating the true vertical (this is why so many means of stabilization on the pendulum principle have failed), and the effect of the vertical component of the earth's magnetic field introduces errors. When flying due north, in the northern hemisphere, the compass actually indicates a turn opposite to the one being made. This is the well-known northerly turning error. Accordingly, a turn compensator has been introduced. It consists of an electrically operated gyroscope and a zero center scale instrument connected by a single two-conductor wire of any required length.

THE gyroscope is essentially a small electric motor mounted with its shaft horizontal and free to precess about another horizontal axis when affected by the turning of the aircraft. This precession changes the electrical balance of a circuit, causing the indicating instrument to read "right" or "left" turn as the case may be. The amount of precession is proportional to the rate of turning. The gyroscope is operated from the storage battery of the aircraft or from any equivalent source of electric energy.

The electric gyroscope may be used to compensate errors introduced by turning with the magneto compass. By means of a potentiometer, a potential is impressed upon a circuit of the magneto compass to buck the potential of the compass itself caused by the turn. The gyro unit may be mounted at any position in the plane and particularly is it useful when flying northerly courses in the northern hemisphere and southerly courses in the southern hemisphere, where the northerly turning error is of such importance.

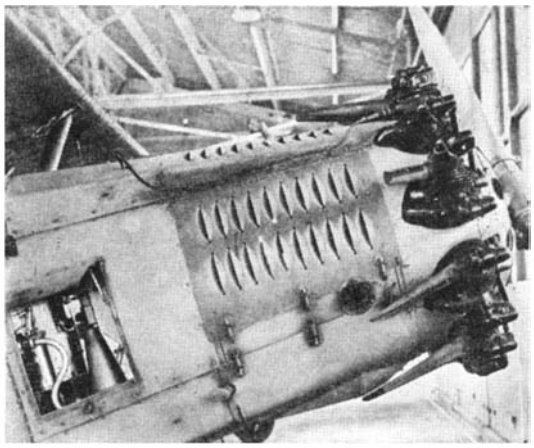
The gyro element of the turn compensator may be used independently of the compass as a turn indicator to aid in maintaining the plane in straight



Automatic steering control used with the magneto compass

flight. A separate indicator is then provided for this use. Thus, the pilot has before him an indication of turns away from the course as well as the indication of the combined instrument in the magneto compass.

With the help of the magneto compass it is not only possible to give the pilot the exact course, but it is also possible to modify its use in such a manner as to give automatic steering. In this work a contact-making microammeter replaces the compass indicator, and controls a clutch within the steering mechanism itself. It is, of course, necessary in such application to amplify the current generated in the magneto compass. The whole is a self-contained unit connecting directly to the control cables of the plane. Cost of automatic steering equipment has, so far, kept it from commercial use, but there is no doubt that, ultimately, automatic steering will come to the help of the commercial pilot, particularly as transport planes become larger and carry greater pay loads.



Panel in fuselage open, to show installation of the sonic altimeter in an Army airplane

THE magnetic compass is very accurate and, as we have seen, it is protected against pitching errors and against errors introduced by turning; but it is not protected against drift due to side winds. Visual drift indicators are sometimes employed for such a purpose, with specially arranged sighting devices which show whether the airplane is really following a compass course or drifting sideways to left or right of this course, but when there is fog, such drift corrections cannot be made; radio must then be employed.

Two types of radio signaling apparatus are now in use on the airways; aural and visual. With the aural beacon, the pilot listens for the dot-dash code of the beacon signal. When he hears a code letter of one kind, he knows he is to the right of his true course and steers to the left until the signal changes to a series of long dashes. When he goes past his course to the left, another signal apprises him of the fact.

With the visual type of beacon the pilot watches two vibrating reeds which are tuned to the frequencies of the beacon signal. Deviation to the right or left of the course is indicated by the unequal amplitude of the reeds. (See "Radio Guides the Airway Traveler," March 1929 SCIENTIFIC AMERICAN.)

For flying off the established airways, there has been developed a wing loop homing device which couples with a standard receiver and indicates to the pilot, by means of a meter on the instrument board, whether he is on or off his course. This device uses the ordinary broadcasting band and consequently may be directed at any broadcasting station within range of the receiver. Tests have shown that a pilot can fly to an average powerful broadcasting station from a distance of 200 miles.

A RADIO echo altimeter, by using radio waves reflected from the ground, gives accurate indications of altitude at periods of half the wavelength of the set. (See "A Radio Altimeter," December 1929 SCIENTIFIC AMERICAN.) In the early development of this instrument, weights of greater than 80 pounds were required, together with the use of seven tubes. The present outfit has been reduced to a weight of four pounds and uses but a single tube.

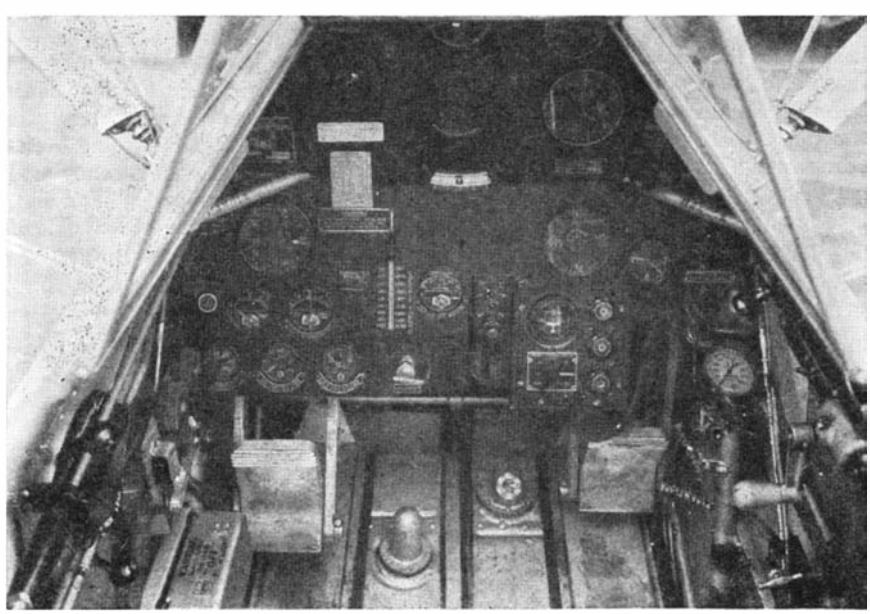
Another type is the sonic altimeter, on which the General Electric Company has expended much time and energy, and which is particularly useful for fog landings. In this device, a 3000-cycle note from an automatically operated air whistle is directed periodically at the ground by a megaphone. The echo of the outgoing signal is received in a second megaphone which is connected through a high-pass filter to a stethoscope worn by the pilot. A timing mechanism makes possible the indication of altitude. (For complete details see "Sonic Altimeter for Fog Flying," April 1931 SCIENTIFIC AMERICAN.)

WE have not mentioned the multiplicity of other instruments with which the modern airplane is equipped. Air speed indicators, temperature indicators, tachometers, pressure gages, fuel gages, and so on, form a bewildering system. The photograph of the special Douglas airplane cockpit gives an indication of the complexity of the nervous system of the modern airplane.

Nor have we discussed the light beacons, auxiliary airport beacons, airport markers, floodlights, and other aids to navigation; nor the system of weather broadcasting so useful at the present time. (See "The Pilot Phones His Airport via Radio," July 1930 SCIENTIFIC AMERICAN.) Space also will not permit us to deal with the radio methods for guiding the plane when quite near the airport, which have permitted the pilot to take off and land absolutely blind. Such experiments carried out by the Bureau of Standards have remarkable promise, though still only in the development stage. (See "Flying Blind—Guided by Radio," July 1931 SCIENTIFIC AMERICAN.)

Credit for such work is due not onlv to the General Electric Company and the Bureau of Standards, but also to the Pioneer Instrument Company, the Sperry Gyroscope Company, and many other organizations.

The intensive effort now put forth will soon result in perfect navigation under all conditions, with fog, the last of the great enemies of flying, completely conquered.

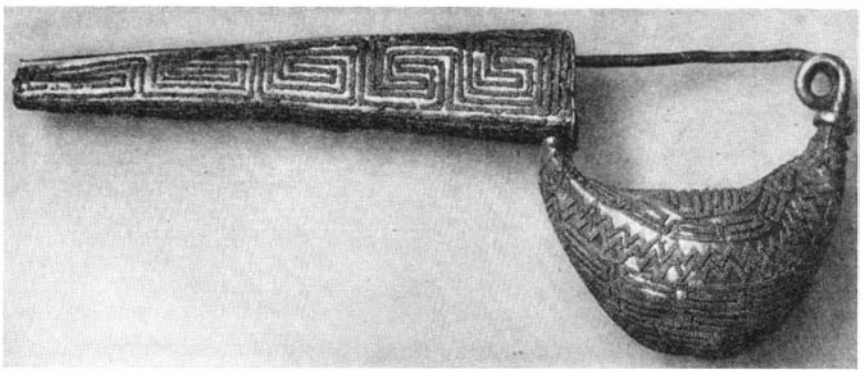


The complex instrument panel in a special Douglas plane

FROM THE ARCHEOLOGIST'S NOTE BOOK

An Etruscan Safety Pin

THE Metropolitan Museum of Art has just acquired a 2700 year old Etruscan gold fibula. It is one of the exquisite trinkets which are characteristic of the 7th Century Etruscan tombs. The pin is of stout gold wire, and the decoration is made up of double geometric rows of gold granules in zigzags and meanders. The length of the whole pin is 2¼ inches.



An Etruscan gold fibula with granular decorations, forerunner of safety pins

Eastern Stucco Statues

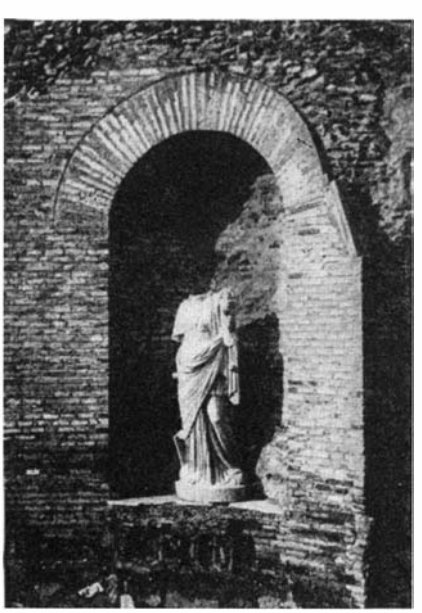
THE Stora Art Galleries of New York recently showed some remarkable stucco statues found in the neighborhood of Tash-Kourgan (Chinese Turkestan) to the east of the Afghan border.

Curious stucco figures from Chinese Turkestan show Gothic-Buddhist and Indo-Hellenistic influences

They display a mixture of Greek, Gothic, and Indo-Buddhistic features. For the artists of the Tarim valley stucco was what marble was for the Greeks. The modeling was done while the stucco was still damp. This period of Indo-Hellenistic culture sprang up in the wake of Alexander's conquests. This location was in the path of the "old silk road" which crossed the Gobi Desert. It is difficult to explain the Gothic influence in the one on left.

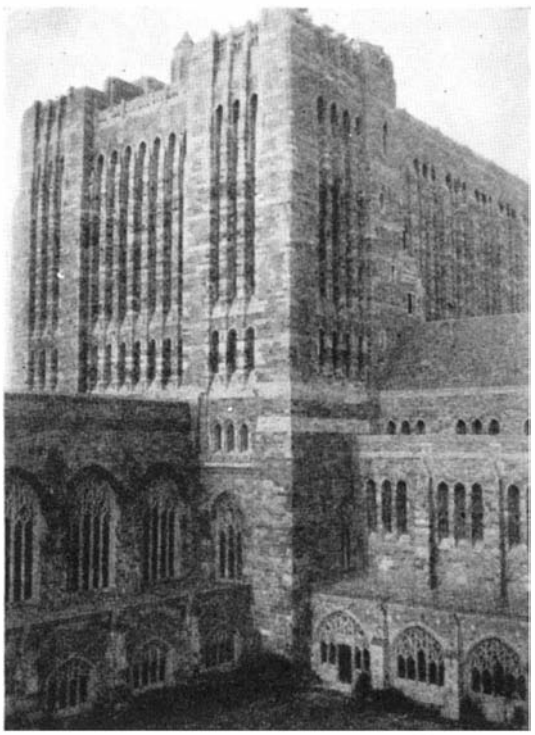
Excavating Rome's Seaport

WHILE Rome is being properly excavated in many quarters, its seaport, Ostia, has not been neglected by Premier Mussolini. Ostia is located at the mouth of the Tiber, 13½ miles from Rome. It was founded in the 7th Century B.C. The excavated ruins date chiefly from the 2nd-4th Centuries A.D. and include great harbor works, granaries, temples, fora, and theaters. The small bath which has recently been excavated has yielded an important headless statue. A complete necropolis has been uncovered in Ostia's island across the Tiber, where Aeneas landed.



Ostia, the port of ancient Rome, is being scientifically excavated and explored. *Left:* One of the small baths. *Above:* The statue of the Goddess of Fortune in a niche

A MODERNIZED UNIVERSITY LIBRARY



The book tower dominates the entire structure, is 16 stories high and houses 3,500,000 books

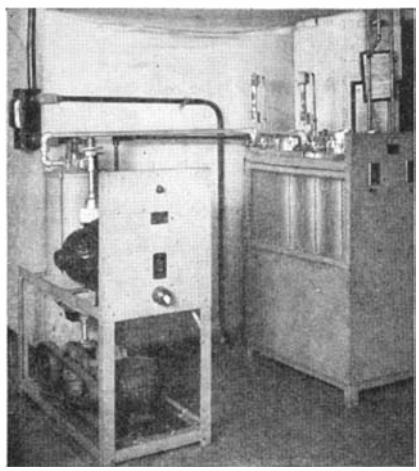
IN building a library, the tendency is to veer to the monumental. The stack is usually obscured behind a screen of monumental rooms or becomes the rear façade. In reality the essence of a library is the bookstack where tier after tier of self-supporting shelves house the books with narrow aisles giving access. In the recently dedicated seven million dollar library at Yale University the dominant idea was the placing of the stack in the most accessible and important position on the site as the dominating feature of the façade. This external expression of the functional core of the building gives the library a structural dignity and symbolism worthy of the great traditions of the University.

Architecturally the Yale library is a masterpiece and the symbolism and illustrative ornament stamp it as one of the outstanding buildings of the world. The Sterling Memorial Library was named after the donor of the Sterling Foundation which has administered the funds bequeathed by Mr. Sterling.

At the base of the tower and in front of it the main hall, like the nave of a church with vaulted aisles, provides a dignified approach to the rooms of a more public nature, like the reading rooms and the exhibition rooms. The Gothic architecture adapted to library needs gives a feeling of spaciousness and calm which has an excellent psychological effect. The delivery desk at the end contains complete equipment for communicating with the stack and the various reading rooms. Access to the book stack is immediately behind the delivery desk. No visitor is admitted to the stack without a pass.

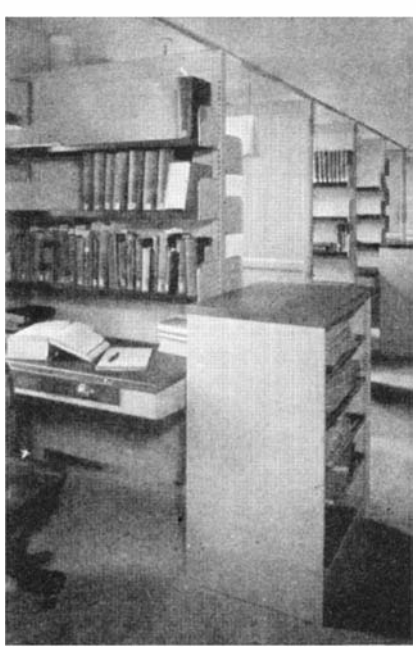
The bookstack tower is a working laboratory which is intended to bring readers and books quickly and easily together. The tower rises to a height of 150 feet and is built like a skyscraper with low ceilings. It is subdivided into sixteen floors or tiers by means of thin marble deck-floors, one and one quarter inches thick, and supported in the light steel horizontal framework of the bookstack. The waste space of thick floors is thus avoided, and the maximum cubical capacity of the building is utilized for the storage of books. Two thousand tons of steel and iron entered into the construction of the stack, and 1000 tons of marble in the floor and stair treads. All the steel connections were welded instead of riveted, resulting in a solid self-supporting, free standing, massive unit of steel. This was the largest welded job up to the date of construction. There are six and one half miles of aisles in the bookstack tower. The capacity of the bookstack tower is approximately 3,500,000 books.

Two stack tiers are equivalent to one building story and each two tiers of stacks serve special departments. Books housed together for one department of study are, as far as possible, made accessible to all departments. The serious student need not use the main or special reading rooms as student carrels or cubicles are provided. The stack floors are equipped with cubicle partitions at the windows; in all there are 330 cubicles, each four by five feet. They are so designed that students studying spe-



Ozone generator makes ozone for ventilating system, preventing mold

***Above*: Reproduction, Yale library of 1742. Over 60 percent of the books were in the original library. *Right:* One of the 330 student's new stalls with shelves and desk**



cial subjects may be conveniently located with reference to their material in the adjacent stack sections. Each carrel is equipped with three adjustable shelves and a desk with a drawer. Here the student can collect the books which he needs and work in peace without the exasperation of finding the critical volume in the possession of another.

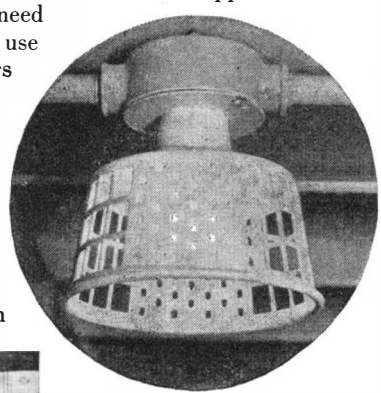
Naturally, readers who do not need facilities for such specialized work use the reading room. Book conveyors are of the greatest importance in connection with the stack. The conveyor pours down a continuous stream of books out of the stack tower to the delivery desk. The conveyor (described in the November 1929 SCIENTIFIC AMERICAN) consists of an endless chain which is continuously operated at an

Specially designed perforated light shades protect stack attendants from glare yet illuminate shelves

average speed of 75 feet a minute. Any obstruction causes an automatic overloading device to stop the conveyor instantaneously. Pneumatic tubes are used to send the call slips from the delivery desk to attendants' stations in the stack. Once the book is located it is placed in the carrier at the stack level and is automatically combed from the carriers into a receptacle at the delivery desk. The time required to transport a book from the farthest point in the tower to the desk is two and one-half minutes.

There are six elevators and two dumbwaiters. Two of the elevators are used principally for returning books to the shelves. Two of the elevators carry operators and are used by the students who enjoy stack privileges. The dumbwaiters are intended to carry small loads between the floors of the stack and are controlled by push buttons.

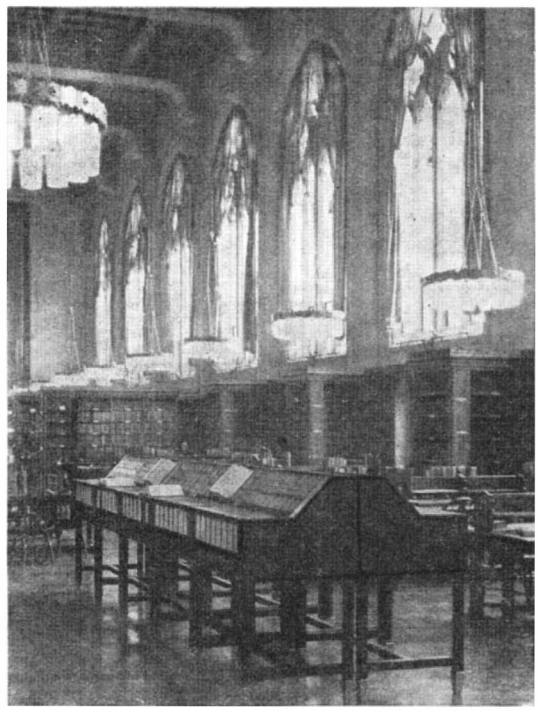
The heating and ventilating system is designed to meet local climatic conditions and three fundamental requirements. First, books and their preservation; second, the occupants of the building, both employes and students, and their comfort; third, equipment simple and durable and, at the same time, as inexpensive to operate as possible. There appears to be a



more or less well defined opinion of engineers that conditions good for human beings are good for books. The ideal recommendations are 68 degrees, Fahrenheit, dry-bulb temperature and 40 percent relative humidity.

The system at the library is called the "split system;" that is, sufficient direct radiation is installed to keep the temperature of the building at 70 degrees, Fahrenheit, and the air for ventilating is delivered at room temperature. Equipment is provided to deliver 100,000 cubic feet a minute to the stack space. The air is delivered by three fans, one for the lower third of the stack which is entirely surrounded by other rooms, one for the center third which has some

Book conveyor brings books to delivery desk from all parts of stack



Main reading room contains every convenience including mechanical dictionary racks

walls and windows exposed to outside temperatures, and one for the top third which has an exterior wall and windows on three sides. The plant includes air filters, humidifiers with steam coil and temperature coils in addition to fans, motors, and ducts. An interesting feature is an ozone apparatus from which ozone may be added to the circulated air. The object is to prevent mold from forming in the book bindings. Heat and light are provided from the central power plant of the University.

THE lighting of the stacks is peculiar and the plan was evolved for this library by the builders of the stack. In the aisles of the stack the shades are perforated with openings of various sizes and shapes to allow light from the lamps to illuminate the upper shelves, while the reflected light illuminates the lower shelves. The blank spaces and the spaces having the small holes serve to shield the eyes of those using the stack from the glare that is usually a part of book-stack illumination.

The public rooms of the library are very fine, including exhibition rooms, rare book room, and lecture rooms. A hall of "Yale Memorabilia" includes a section of the famous fence. There is also a room designed to reproduce as exactly as possible the Yale Library of 1742. Paneled in white pine and lit from narrow wood casements this room gives the atmosphere of nearly 190 years ago. Owing to the existence of an old manuscript catalogue it was possible to find and locate 60 percent of the volumes which originally belonged to the old collection.

WHY QUESTION THE REASONING OF ANIMALS?

By S. F. AARON

THERE seems to have arisen a sort of foregone conclusion among biologists that all animal behavior is merely the result of instinct, however variously that word is defined. Mechanical automata is one phrase, inherited propensity and spontaniety are others, but there does not seem to be a clear comprehension of the workings of these forces or of their limitations.

The precise influences of heredity upon nerve-endowed creatures is too little understood and many observations bearing on the question have either been overlooked or commented upon illogically, even by such careful students as the accepted dean of American out-of-door naturalists, our late nature-loving ex-President, and many deservedly high-positioned natural scientists. There is, however, too much data on the subject, the interpretations of which are all too plain and the conclusions too obvious to permit the automata theory longer to rest content.

There is no need to resort to the far-fetched or the well-nigh impossible to prove the existence of the reasoning power in animals, though this too often has been employed. The writers of fanciful yarns wherein the impressions of hero wolves, bears, foxes, and rabbits have been rated in human values have hurt the cause of truth by exaggeration. On the other hand, much that has been designed to disprove animal intelligence has been absurd, as with the case of Burrough's cow that ate the straw with which the skin of her calf was stuffed.

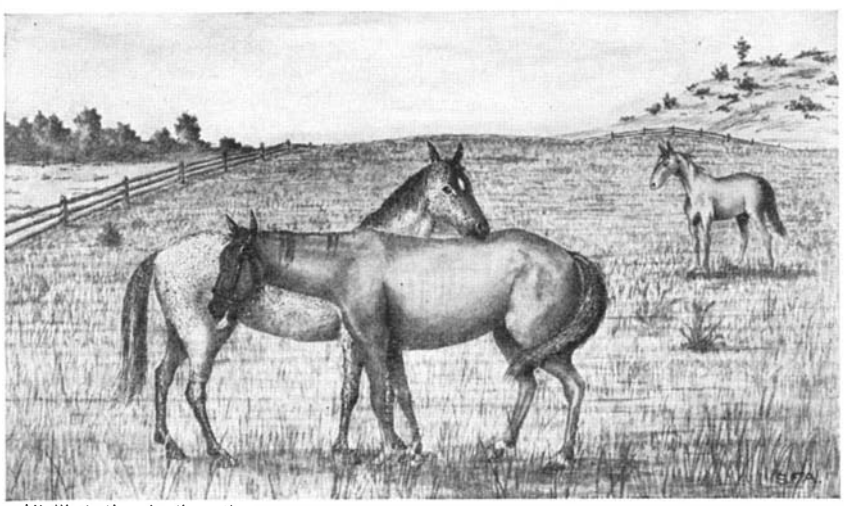
ANIMALS can be impressed, and therefore must think and reason only within the scope of their own observations and memory. They possess little imagination or none, except as regards the fear of possible enemies. They also possess curiosity, which may be akin to imagination. One might as well suppose a South African bushman or a Hottentot should reason upon the transit of Venus or manage a problem in algebra as a cow to comprehend anatomy or taxidermy. Bossy knew her calf by the smell of the skin; she had no conception of what constituted its original interior. In fact, if fresh hay had exuded from her own sides she would have eaten that.

Consider the simple matter of nest building. In the construction of their houses beavers use more judgment with regard to floods than do many humans, and they always learn the value of caution. Is it fair to say that they do not weigh, compare, and decide intelligently regarding the most suitable spot for a dam and colony house, as influenced by the breadth and depth of the water, abundance of food and least danger of surprise?

I watched an orchard oriole select a position for her pensile nest in a pear tree not 20 feet from my study window. She fetched a long stalk of grass and stretched it from one branch to another, but it was not long enough to permit the slender upper end to give a firm hold when twice enwrapped. As though with impatience, she tore this away, let the stalk hang and, discarding the position, commenced to entwine a new strand of grass of the same length between closer branches five feet higher up the tree. She seemed to know she could obtain grass of this maximum length only. Is there any difference between the reasoning shown here and that which an Indian would show if his tepee poles could not be firmly implanted in one spot and he should change to another?

The crested flycatcher places a cast-off snake skin at the entrance to its nest in hollow limb or woodpecker hole. This forms no part of the actual egg-confining construction, but is supposed to be designed entirely for scaring away squirrels and egg-eating bird enemies. It is common for countrymen in remote sections to leave a light burning all night long as a warning to marauders. How much difference in the method or degree of reasoning is there between the adoption of these two means of protection? Or does each individual man get his idea independently and the bird only as a hereditary habit? Sometimes the birds omit the skins when these are plentiful. The human can explain his own purposes, but because the bird has not the power to convey in any way the reason for its choice of snake skin, can we assume that its universal act is only instinctive?

The Moro of Mindanao builds his hut of pita fiber, entwining it in a definite manner; this knowledge and the reason for his choice of material he has gained by long inheritance. The vireo builds its nest of grape-vine fiber, the choice of which is a hereditary matter, of course. Both man and bird somewhat vary the construction, the latter with its needle-like bill making rather the better job of it. No doubt both encounter difficulties that inherent knowledge could not have foreseen and both must use head work.



All illustrations by the author

When old bay has an itching back, he touches young gray on the back at the exact spot corresponding to his discomfort, and gray starts to scratch. At the same time, guided by gray, bay massages a fly-bitten spot on gray's leg

Choice as between two or more ways of reaching an effect must indicate a certain cogitation and the necessary comparisons are influenced alone by reason, though the ingenuity employed may be very largely an inherited tendency. There is a deciding point that compels a decision for the apparent best; otherwise there would be no variations, though these occur. The selection of chimneys instead of hollow trees by the swift, the adoption of bird houses and hollow gourds on poles rather than old woodpecker holes by purple martins, the improvements in nest building that one oriole shows from season to season over that of its first efforts, the use of paper, string, and rags by the catbird, cardinal, vireo, and other species, indicate clearly the reasoning selection of better materials, safer positions, and more care.

More remarkable, and still comparable to the methods of man, are the manners and habits of hunting, as specifically and variously practiced by

the more intelligent carnivora. The stealthy approach may be merely instinctive as is the sudden well-timed and measured leap, but overcoming the difficulties set by the intended victims, which often show an equal intelligence, demand nothing less than thoughtful strategy. With regard to this there is the choice of direction. It meets with varied, comparative illustration.

When feeding chickens a simple experiment may be practiced by opening the yard gate, and then, as the flock surges through and follows a little way along the fence on the outside, a handful of grain is thrown over the fence and inside the yard. Most of the younger fowls and some of the adults instantly will try to sift themselves through the wire in a vain and frantic effort to get at the corn, but chanticleer and a few of the wiser hens will gaze but a moment at the delectable treat, then turn and make for the gate, going at first almost straight away from the grain. Now, hardly anyone can expect reasoning sense in a hen; her admirable care of her new brood is almost entirely instinctive, even in the brave battling against enemies, but to turn tail on food plainly in sight because of the memory of a sure way around can be nothing short of reasoning, however simple.

My trained setter loved nothing better than a run with his too indulgent master, but the director of domestic affairs had decreed that dogs, however well behaved and lovable, were not to trespass on the smooth floors and rugs of dining-room and hall. So Count, when called, dared to come, after careful instruction, only to the kitchen-dining-room door and there prance in expectant glee until hat and jacket were donned. The call of "come boy" and the opening of the hall door had no other effect than to send him directly away from the coveted invitation, out through kitchen and shed doors, into the yard and around the house, to join me at the front door. Is that reason or automative instinct? Analyze it for a clear answer.

On much the same basis our cat, which was a great hunter, though deprived of the opportunity by being kenneled throughout the bird-nesting season, spent some time in trying to surprise rabbits, especially one old long-eared buck that frequented the overgrown garden. On one side a large briar patch bordered the woods and in this bunny found ready asylum. The cat well knew that the rabbit could easily outrun him; the only hope was stealthy approach and surprise, but no method held any chance within that dense mass of thorns. So bunny was followed only to the edge of the briars, though the greedy feline eyes could easily discern the retreating hare within the shadows. What then? Merely an instinctive longing, or a further effort to brave the numerous thorns?

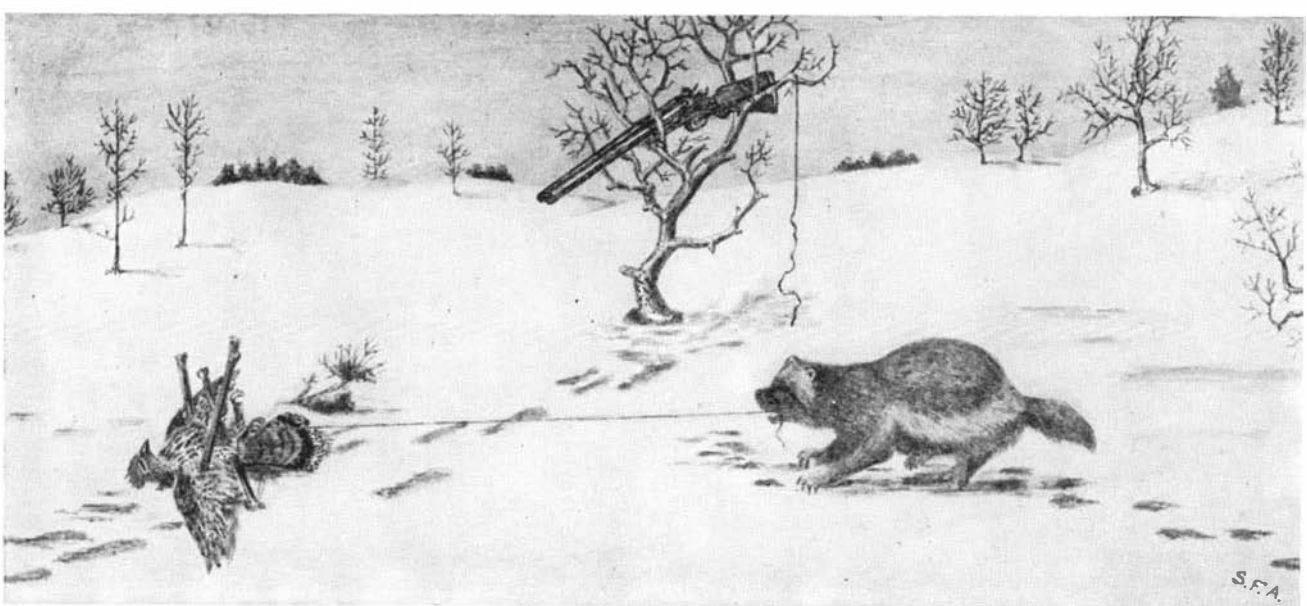
TRUST the cat's better brains; instantly he comes away and, out of sight of the rabbit, makes a wide detour, reaches the far side of the thicket where bunny is likely to emerge and there lies in wait, patiently, motionless, with a very good chance of successfully surprising the coveted quarry. If this is not reason pure and simple, then there must be some special name for it.

There is one trustworthy account, repeated many times in many localities, concerning as many dogs of various breeds, that clearly shows canine reasoning. These dogs are hunters of woodchucks and the dog so inclined watches long for the appearance of the digger, sneaks forward with belly close to the ground, gains a strategic position and suddenly dashes forward, not at the now alarmed groundhog which speeds for its burrow, but straight for the burrow, to head off the slower marmot.

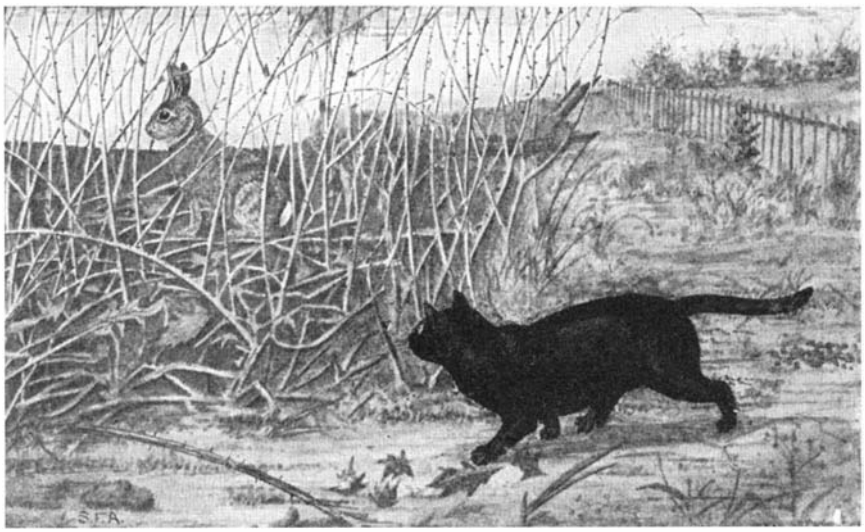
Here is a sense of relative distances and an appreciation of the particular direction which is to be the most effective. I have witnessed a similar occurrence when a large weasel chased a red squirrel. The latter had gone up a trunk on a branch-to-branch course toward its nest tree. The weasel must have been formerly observant of the chickaree's dwelling-place, for instantly the killer ceased the futile pursuit upon vertical surfaces where the squirrel excels and, watching the latter's direction, immediately ran to the nest tree, ascended to a spot near where the squirrel would leap and waited for the out-maneuvered rodent.

The tricks, subterfuges, and actual wisdom of working elephants, the keen sensibilities of trained dogs, seals, and horses permit actual ridicule to be cast upon the assumption that animals act only through hereditary instincts. Perhaps we cannot entirely credit the yarn about the fox plucking wool from sheep, or selecting a mossy stick and then backing slowly into water until all the fleas have retreated to the wool or moss held just above the surface; whereupon reynard dives and lets the current carry the jumpers to their fate. Nor are we obliged to credit that old story of one closely pressed fox in the hunt leading the hounds to a certain leaning hollow tree where a fresh companion in hiding leaps out and away to distance the baffled hunters, the tired fox remaining in hiding. This latter would indicate a definite understanding akin to language.

But we do know from unquestioned



There is an authentic story of wolverines breaking the thread of a set-gun and then dragging the bait away without coming in range of the gun or setting it off. It must be conceded that mere instinct could not account for such a procedure



A cat, knowing the impossibility of pursuing a rabbit within the thicket, makes a well-planned detour to lay in wait where it feels sure the rabbit will emerge

observation that two prairie wolves will engage in co-operative hunting of jack rabbits, one coyote squatting where the too swift-footed and always circling quarry is started, the other running his best for one round and then dropping to rest while the fresh one takes up the chase. Thus they trade with each turn until they wear down the poor jack. This does not entail such a complicated understanding as to need a language; mates hunting together may chance on the opportunity and act each partially independent of the other, but both comprehending the advantage of co-operation, nevertheless.

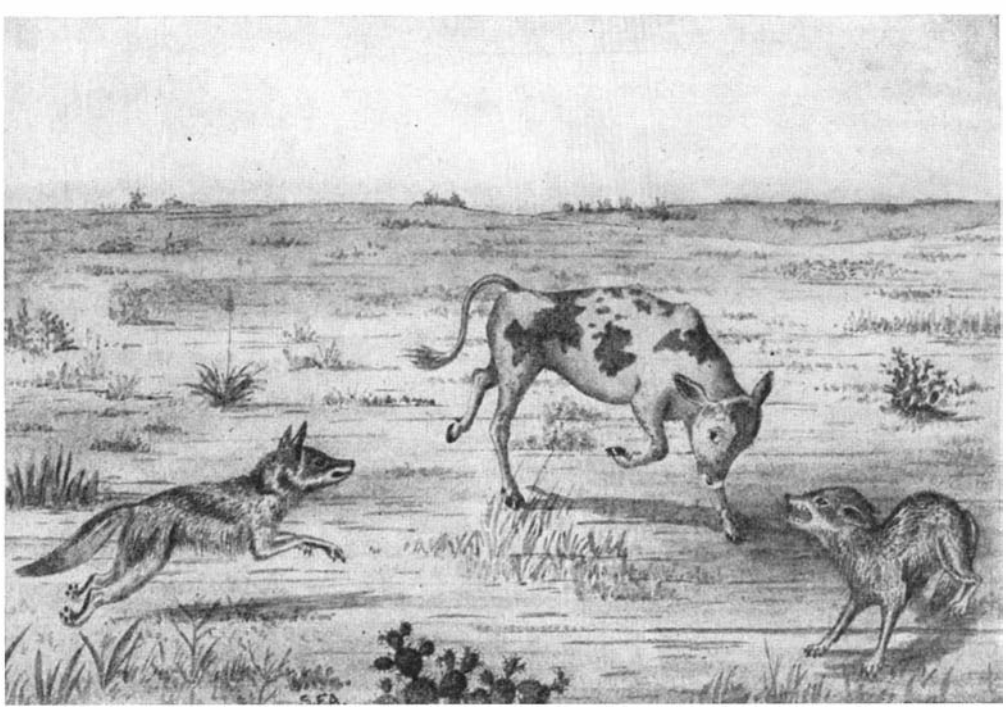
I witnessed the co-operation of two coyotes in attempting to pull down a calf, which would have been successful but for my interference. One coyote tried it alone, but was very effectively butted; it disappeared and in ten minutes came back with another coyote. This strongly suggested some kind of sign language, no doubt exceedingly limited, as is also shown by one sheep-killing dog inviting a hitherto innocent dog to join in a foray. Or does the second beast merely recognize the scent of the prey upon the first offender?

But because animals cannot in any certain manner express their thoughts and impressions or give even a partially lucid suggestion as to the purpose or choice of their actions, is it just that we should deny them the possession of ideas governing their conclusions? That able naturalist, Dr. Elliott Coues, in his remarkable monograph on the fur-bearing quadrupeds, can hardly be questioned as to accuracy, and while he quotes many authorities with regard to the wonderfully intelligent wolverine robbing traps, springing set-guns, avoiding deadfalls and the like, there must be a semblance of truth in the combined conclusions—enough to insure the belief in the creature's keenest reasoning powers. Others of the weasel family—notably the mink and pekan and that fellow long credited with wisdom, the fox—show degrees of intelligence by avoiding traps that can be due only to clearly defined reason.

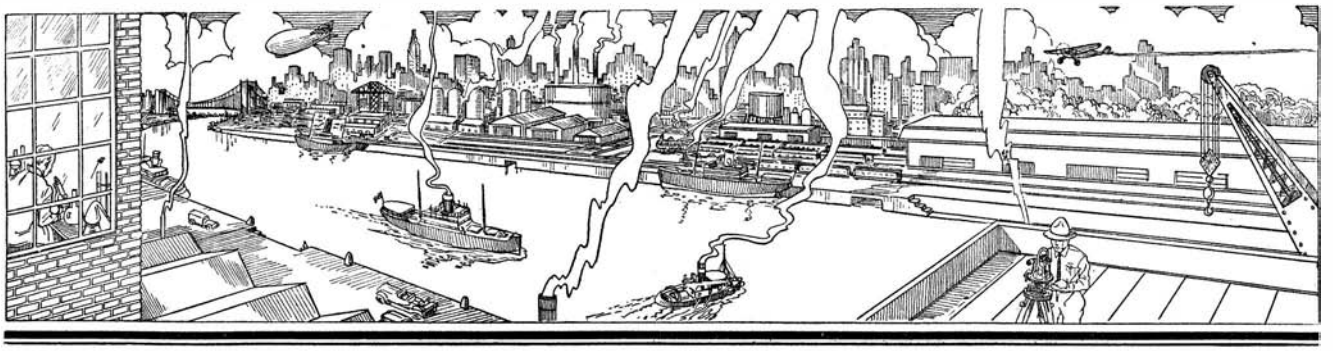
The horse is by no means the intellectual leader among dumb animals; it possesses a rather limited understanding of dangers and often a perverse stupidity. However, we may look to the horse for the simplest, most easily obtained and entirely unquestionable evidence of thoughtful and reasoning action. Anyone with a little time and patience may go into rural pasture fields where two or more grass-filled and contented equines are resting in the shade, and witness the following demonstration. Gray and bay for a time assume a friendly attitude and stand head to tail, largely for the purpose of having flies switched from the heads of each. There is nothing they like better than to have their frequent itchings allayed, for which purpose they seek tree trunks, fence posts, and low limbs against which to scratch. But better is the tooth or tongue scratching that they give each other in a most decidedly co-operative and understanding manner. Gray has a fly bite on his hind leg and with his nose he gently touches bay's leg in the spot to correspond with his own itching. At the same time bay, having an itching back, barely touches gray on the back. Whereupon instantly bay begins to scratch gray's leg and gray begins to scratch bay's back.

NOR is this all. Should one wish the other to use its tongue instead of teeth it indicates this by touching the desired spot on the other with its tongue. Gray, having his itching allayed, merely lays back his ears and bay stops; then gray touches bay on the ribs and bay gets busy on gray's ribs.

I have witnessed the above on several distinct occasions and I think it may be included with other evidence to settle once and for all the question as to the reasoning of animals.



A coyote attacks a range calf and finds that he cannot finish the job alone. He trots away and shortly returns with a companion and the two make the kill. Is this "instinct" or reasoning?



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

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

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American Navy Building Program Lags

JULY 21 was the first anniversary of the ratification by the Senate of the London treaty for the limitation of naval armament, but in those 12 months Congress did not authorize a single ship of any of the types covered in the treaty. It did appropriate money, however, to begin the construction of 11 destroyers which were authorized more than 15 years ago as a part of the 1916 program.

When the London treaty was signed, and after it was ratified, the Navy Department began working out a construction program to modernize the fleet to conform to the provisions of the treaty.

A program calling for a first treaty authorization of one aircraft carrier, three submarines and two 10,000-ton cruisers armed with 6-inch guns, one of them an experimental type and the other to be a flying-deck cruiser, was sent to Congress with the approval of the administration.

The program made no headway at all, and the destroyer appropriations which had been postponed year after year, were finally authorized only after pressure from the White House.

The other powers signatory to the treaty have been moving forward, however, in the direction of achieving treaty strength.

In the years prior to 1930, back to 1922, when the Washington treaty for limitation of naval armament was signed, the United States laid down no destroyers. Moreover, the first of the 11 appropriated for by the last Congress will not be laid down until the coming winter.

In the 1922-30 period Great Britain laid down 22 modern destroyers, France 48, Italy 37, and Japan 47. In submarines during those eight years France laid down 67, Italy 32, Japan 35, Great Britain 19, and the United States 3. One of the American submarines is to be completed in August of next year, the second in 1933, and the third late in 1934.

Now one year after ratification of the London treaty, the United States has 11 vessels under construction, all of pre-treaty authorization; Great Britain has 30, Japan 17, France 60, and Italy 19.

In addition, the United States has 11 appropriated for, Great Britain 19, France 18, and Italy 29. The figures for Japan are not available.

Of the authorized vessels the 11 of the United States are destroyers; Great Britain's comprise four 6-inch-gun cruisers, nine destroyers and six submarines; France's, one 6-inch-gun cruiser, six destroyers and 11 submarines; Italy's, one 8-inch-gun and two 6-inch-gun cruisers, four destroyers, and 22 submarines.

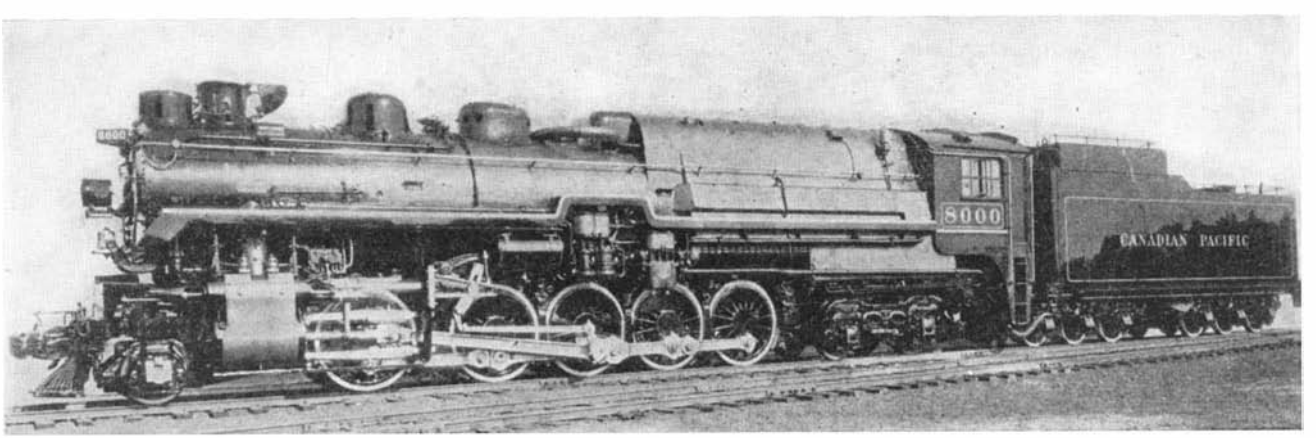
Of aircraft carriers the United States has two completed and one building, Great Britain has six in commission, and Japan one building and three in commission.

Even when the *Ranger*, now building, is completed, the carrier tonnage of the American Navy will still be 45,000 tons short of the treaty limit. Congress failed at its last session to authorize the second carrier of the *Ranger* type asked for by the Navy Department.

During the life of the London treaty the United States is permitted to lay down in new tonnage 44,914 tons of aircraft carriers, 80,000 tons of 8-inch-gun 10,000-ton cruisers; 87,000 tons of 6-inch-gun cruisers; 150,000 tons of destroyers; and 52,700 tons of submarines.

The ancient vintage of the destroyer and submarine tonnage of the Navy is apparent in that the new tonnage alloted for these classes, so far as the United States is concerned, is the maximum limit fixed in the treaty. The 80,000 tons of 8-inch-gun cruisers is completed or building, although 30,000 tons cannot be completed during the life of the treaty. The 6-inch-gun cruiser allotment of new tonnage remains untouched.

Great Britain and Japan have their 8-inch-gun treaty tonnage in the water, Great Britain having completed about 40,000 tons and Japan about 75,000 tons of their respective allotments. In aircraft carrier tonnage, Great Britain has only 19,650 tons and Japan only 12,030 tons to go before reaching the limit fixed by the treaty,



The largest and most powerful locomotive on the North American continent: The Canadian Pacific's new "8000" type, multi-pressure locomotive. Its length is 100 feet and its weight 400 tons. It is to be used in heavy freight and passenger service in the Canadian Rockies where it will afford a saving of one third in fuel costs. Firebox and combustion chamber have a total of 3½ miles of seamless steel tubing wherein steam is generated from *distilled water* which is recirculated without loss. The tender carries 12,000 imperial gallons of water and 4100 imperial gallons of fuel oil

while the United States remains 44,914 tons below the limit.

The 1931-32 programs of the treaty navies provide: For Great Britain three cruisers, nine destroyers, and three submarines of a total tonnage of 33,375; France, three cruisers, including one of 23,000 tons and

Unfolding the light brackets under the new illuminated bridge table

two submarines of a total tonnage of 38,600 tons, and the United States 11 destroyers of 16,500 tons. The Japanese and Italian programs for 1931-32 are not available in Washington.

When the new Congress meets in December, the Navy will offer its 1932-33 program. It probably will call for one aircraft carrier of 13,500 tons, two 6-inch-gun cruisers of 10,000 tons each and at least six destroyers and two or three submarines. However, there is no indication that Congress will approve such a program.

Well, there's one consolation. We now have Old Ironsides back in commission. Then too, we still have the *Rochester*—and the *Galveston* could be recommissioned in an emergency.—*Our Navy*.

Angle Trisection Impossible with Ruler and Compass Alone

TRISECTING the angle with ruler and compass alone is just as impossible today as it was in the days when the ancient Greek mathematicians worried over the problem centuries ago, mathematicians commented recently in connection with reports that this problem had been solved.

A simple exercise in the theories of numbers which is worked by juniors and seniors in college mathematics courses demonstrates the impossibility of trisecting angles in general without the use of complex curves. There are a few special angles that can be trisected by use of the straight line and circle alone. When claims are made that the angle has been trisected by plane geometry, it turns out that one of these special angles has been used or there is some mistake in the work.

By using special curves such as the conchoid or the quadratix of Hippias, trisection of the angle is possible, but the use of these three-dimensional curves was frowned upon as unsportsmanlike by the Greek mathematicians and solution by conic section methods was not considered a true solution of the original problem.

Squaring the circle, duplicating the cube, and trisecting the angle were the three problems that intrigued the Greek mathematicians and started them on the way to discoveries of many important results in mathematics. During the centuries many thousands of attempts have been made to solve the trisectional problem. —*Science Service.*

Vitamins in Apples

BY peeling apples before eating, one deprives oneself of the most healthful part of the fruit, according to the results of recent studies reported by the British Food Investigation Board. It has been found that the vitamin content of the peel is at least six times that which exists in the region of the core.

The same source reports that while studying the diseases of apples in cold storage it was found that healthy fruit absorbed acetaldehyde, and, at the same time, protection from the attack of fungi was afforded.—*A. E. B.*

Illuminated Bridge Table

CONVENIENCE is one keynote in our daily mode of living and particularly is it desirable to entertain in our homes with as much ease and comfort as possible. When the entertainment is to be an evening devoted to bridge, it is indeed a pleasure to know that the game will be played under comfortable seeing conditions. Mr. Dan A. O'Connell, Jr. and Mr. A. Buchan at Nela Park, Cleveland, appreciated these facts when they recently designed a novel bridge table on which a patent will soon be issued.

As the illustrations show, this lighted bridge table has the lighting equipment built as an integral part of the design. Two diagonally opposite legs of the table carry the lighting fixtures. Small sections of nickel-plated pipe, with thumb screw joints for adjustment, support lamp sockets and trough reflectors which accommodate 25-watt T-10 bulb Mazda lamps. The lamps and reflectors are located slightly below the eye level so that the light is directed on the playing area and concealed from each individual's eyes. Uniform distribution of light results. Ornamental, as well as useful, ashtrays have also been provided as a part of the plan, and, a cigarette lighter may be conveniently attached to the receptacle provided.

At the conclusion of play the entire equipment on the table may be folded away beneath the table.

Making Dollar Bills From Cotton

AMONG the many suggested ways of ending the business depression is that of the wag who proposes that money should be made out of rubber so it could be stretched further. In all seriousness, however, champions of the cotton belt have proposed the use of paper made entirely from cotton for Uncle Sam's paper money as a step to improve the plight of the cotton growers. Upon investigation, however, the Treasury Department has rejected the suggestion that all-cotton paper be used in the manufacture of one-dollar bills instead of linen-cotton, which is now employed for all U. S. paper money because it has been found more satisfactory.

In rejecting the suggestion, which came from the Galveston Chamber of Commerce, the acting secretary of the Treasury said that cotton paper once before had been used in the manufacture of currency but that it lacks certain essential properties. —*A. E. B.*

Pellagra

SCIENTISTS of the National Institute of Health at Washington are seeking to ascertain the crops having the highest pellagra preventive values which may be grown most easily by farmers in the areas in which pellagra is prevalent. The nutrition specialists of the United States Public Health Service, working at the Institute, hope that their studies will result in a practical solution of the problem of preventing pellagra, a nutritional disease, which has become widespread in parts of the dry area. When the most valuable anti-pellagric crops are determined, this infor-

The illuminated bridge table in use. Note absence of glare

mation will be passed on to state, local, and county health units by the Public Health Service.

In conjunction with its study of the nutritive value of crops, the National Institute of Health is attempting to concentrate—and if possible to isolate—the pellagra preventive vitamin. The anti-pellagric vitamin never has been isolated, although its presence in specific foods is proved by the pellagra preventive effects of such foods when they are eaten.

The Institute, or Hygienic Laboratory, as it was known then, discovered the cause of pellagra. This discovery is probably one of the most significant steps forward in public health advancement during the last decade. The late Dr. Joseph Goldberger of the United States Public Health Service found that pellagra was caused by the lack of a certain nutritive substance, or vitamin, in the diet. (See page 272, October, 1931 SCIENTIFIC AMERICAN.) This finding threw a new light on pellagra, and has made possible the beneficial work now being done by the Public Health Service in attempting to eradicate pellagra.

Vinegary Beauty

AMONG the latest aids to beauty is the vinegar shampoo. In conveying the vinegar to booths in the beauty shops, pure nickel tubing and fittings are used because they resist the corrosive effects of the weak acid present in the vinegar.

"Rub-less" Floor Polish

"RUB-LESS" polish is one of the latest developments based on recent chemical discoveries. Thanks to new and efficient emulsifying agents, wax can be kept in a homogenous solution which, when applied to certain surfaces, hardens with the typical gloss and sheen that was formerly attained only at the cost of much "elbow-grease." The polish dries in about 10 minutes to give a high luster surface which is more durable and less slippery than that obtained in the old-fashioned way.

These new polishes are marketed in the form of plastic, emulsified carnauba wax to which an equal amount of water is added, with stirring. The resulting solution is spread uniformly, like a thin coat of varnish, over the surface to be polished, and allowed to dry. It is being successfully used on asphalt, cement, linoleum, mastic, marble, oilcloth, rubber, terrazo, and tile. —*A. E. B.*

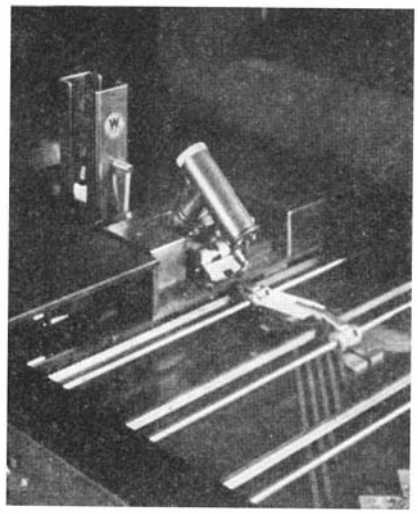
Machine Plays Solitaire: Sorts Cards

A ONE-EYED machine that can read and assort millions of ordinary printed cards at a high rate of speed, science's latest tool for use in accounting departments of large organizations for the classification of bills, checks, tickets, and other records, was announced recently by S. M. Kintner, Vice President of the Westinghouse Electric and Manufacturing Company.

Developed and designed by Douglass A. Young, an engineer of the Westinghouse organization, this ingenious machine not only reads cards, but places them in any of the 100 compartments in the machine where they belong without any human hand touching them. The machine, which is operated by a single photo-electric tube, reminds one of a man playing solitaire, and resembles in appearance a miniature railroad switching terminal with the card being routed over its proper track and delivered to its proper destination.

The development of this latest electrical and mechanical device is the result of a request from an executive of a large corporation. This particular company, like many others throughout the country, sends bills to its customers every month. Part of the bill (the stub) is returned to the company by the customer with his remittance. The classification of these stubs, which are returned at the rate of many thousand per day throughout the month, upsets the entire organization as it is almost impossible to keep help on the tedious and monotonous grind of sorting and filing the returned remittance stubs.

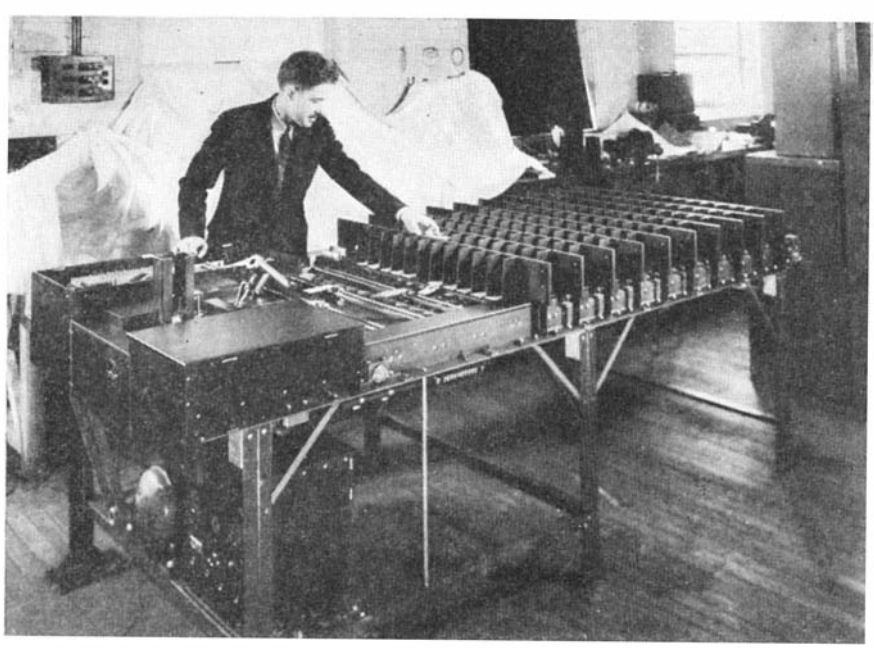
Operation of the machine is so simple that it requires the services of only one person. When the names and addresses are stenciled on the bills, a number is printed also. This number guides the sorters in the classifying of the stub when it is returned. With the new sorting machine, this same principle is carried out, except that a simple printed code is substituted for the numbers. By this code system, according to Mr.



The photo-electric cell which scans the cards and does the "brain work" of the card sorting machine

Young, it is possible to get over one hundred million combinations of numbers on a card 1½ inches wide by 3¼ inches long and still have enough room for the name and address of the customer.

When the operator is ready to start sorting, after turning on the power, he places a stack of cards in the feeding receptacle of the machine. A weight is then placed on the top of the cards which puts pressure on the card at the bottom of the pack. This lower card is then picked up by an ingenious device covered by live rubber, which operates effectively even with badly mutilated cards. The rubber-covered device then pushes the card forward under the photo-electric cell and the coded number is read before the card is routed to its proper place. The reading of this card by the cell is done in the fraction of a second that the card passes under its gaze. After reading the code on the card, the photo-electric cell transmits signals to the relays and trip switches and these cause a mechanical hand to respond ready to take the classified card to its proper place in any of the 100 compartments in the machine.



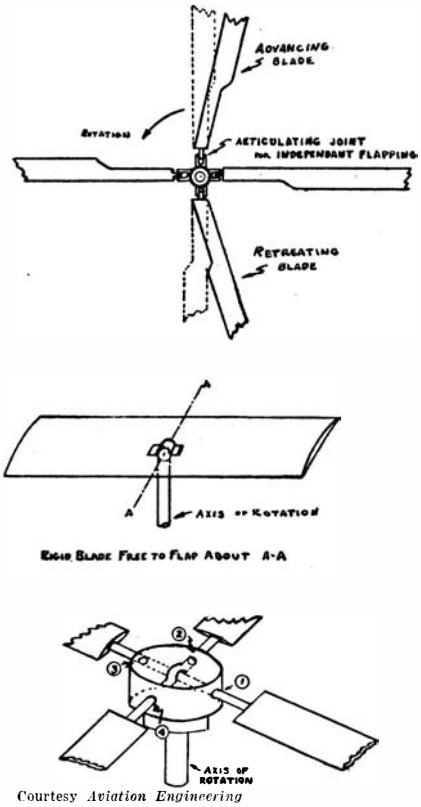
The machine that accurately sorts cards by the million

Pills Instead of Spinach

IF you have any youngsters of the spinach-refusing age, you may soon be able to offer them the stuff that spinach supplies in a form which they may not like any better—as a powder or a pill.

Carrotin, a yellow coloring matter that is present in green leaves as well as in the yellow carrots for which it is named, seems to be identical with the long-sought basic material of vitamin A. By a new process, described before the American Chemical Society, it can be produced from carrots in highly concentrated crystalline form, at low cost, and comparatively rapidly. The discoverers of the new process are Drs. Henry N. Holmes and Henry M. Leicester of Oberlin College.

If you dislike both eating spinach and



Courtesy *Aviation Engineering*

Different rotating airfoil principles as discussed in the article at right: A Rival of the Autogiro?

swallowing pills, you can get your vitamin A or your carrotin by taking a "shot in the arm," with a hypodermic needle, just as protection against a lot of infectious diseases is now commonly administered.

The discovery that the injections are possible was announced by Dr. R. G. Turner of the Detroit College of Medicine and Surgery. He gave such injections to a lot of animals suffering from a lack of vitamin A, and compared their rate of recovery with a set of "controls" given vitamin A with their food in the ordinary manner. The injected animals recovered their health.

Although carrots have thus been shifted from their old job as a "beauty food" to a new one as a health food, chemists still come to the rescue of beauty in distress. Beauty parlors are beginning to use solid carbon dioxide, sold under the trade name of Dry Ice, for post-massage rubdowns instead of the old familiar, but somewhat wet and messy, lumps of ice. Solid carbon dioxide evaporates into a dry gas instead of melting into water.

It must, however, be rubbed on lightly and skillfully, warned Dr. D. H. Killeffer of New York, for it is so cold that a too intimate contact will result, paradoxically enough, in a painful burn.—*Science Service.*

Trial Flights of the "Akron"

THE *Akron* has been christened by Mrs. Hoover and the huge airship will soon be taken over by the Navy. But that does not mean that the *Akron* will immediately pass into practical service. First she will have to pass a rigid and exhaustive series of airworthiness tests, flying 75 hours in at least five separate flight tests.

The maiden flight will be a short trip of two hours duration at normal cruising speed. Then she will be tried out with various combinations of the engines in use, so that characteristics with any combination of engines out of commission will be ascertained. An endurance test of 48 hours duration will have to be met, with a speed of 50 knots maintained for at least 12 hours. The *Akron* must also show that she can climb at least six meters (over 18 feet) per second and descend at more than 12 feet per second.

An airship normally gets its lift from the buoyancy of the gas cells, but if its nose is raised in flight she has a dynamic or airplane type of lift. (Hence the frequent suggestion of a combination plane and airship type.) The dynamic lift is a safeguard against overweight and the *Akron* will have to be able to maintain altitude when actually 10 tons over weight.

Coming in and out of hangars, cross winds are often a source of trouble. The *Akron* must be taken out of the dock at least once in a wind higher than 10 miles an hour with a sidewise component exceeding five miles per hour.

When Commander Charles E. Rosendahl, assisted by a competent staff of technical officers, has put the new ship through all these paces, the American public may be quite sure that the Navy has made a worthwhile though expensive acquisition.—*A. K.*

A Rival of the Autogiro?

THE wide-spread public interest in the Autogiro and its remarkable accomplishments, give more importance to other systems in which lift is obtained from a rotating blade system in lieu of the fixed airplane wing.

By courtesy of *Aviation Engineering* we reproduce a diagram of three of the systems which may be employed.

In all three systems, the blades are free to rotate about a central, almost vertical, axis. No power is transmitted to the blades, but when the craft is set in forward motion by an ordinary engine-driven propeller, the sustaining blades are set into auto-rotation by the action of the air, and turn like giant horizontal windmills.

In the first system shown in the diagram, the one employed by Cierva, the blades are hinged at the center on a horizontal pin, and are therefore free to "flap" up and down. The blades, being free to flap, take up a position of equilibrium determined by their weight and the centrifugal force. The blade advancing into the wind rises, the blade receding from the wind falls, and lift equalization is complete.

This lift equalization on either side is one of the first problems which the designer of a rotating airfoil system has to solve.

The second system of a rotating airfoil is simpler in principle. The blade is continuous on either side of the machine, and is hinged about a single horizontal pin. The single surface rotates about a vertical axis, and flaps about the horizontal hinge to equalize the lift on either side. A machine built on this principle was not very satisfactory, but more may be heard of this system in the future.

In the third system, the blades do not "flap" but "feather" or oscillate about a hinge which runs parallel with the length of the blade. The center of pressure of the feathering blade is placed behind its hinge, so that the blade advancing into the wind has its angle of incidence diminished, while the blade receding from the wind has its angle of incidence increased. Thus equalization of lift is again obtained.

E. Burke Wilford, who has been active in developing this third system of the revolving airfoil machine, is shown in our photograph with his third machine of this type, which is still in the experimental stage, and has only risen a few feet from the ground so far.

For the Wilford Gyroplane, as it is termed, the aerodynamic equivalent of the Autogiro is claimed, as are also certain mechanical simplifications. The Gyroplane has, however, to meet certain other difficulties.

It is for the good of the revolving airfoil idea that there should be emulation between various principles. Therefore further experiments with the Wilford Gyroplane are awaited with interest.—*A. K.*

Improving Rules for Airplane Safety

THE increasing safety of scheduled flying is in a large measure due to the cooperation between the Department of Commerce and the transport operators. At least once a year, representatives of the Government and of the operators meet in Washington and after much argument amend existing rules and agree on new ones. This year's session raised some particularly interesting points.

How often should the engines be overhauled? The existing rules call for overhaul at least once each 400 hours. The operators,

Courtesy *Aviation Engineering*

Mr. E. Burke Wilford, inspecting his Gyroplane, a distinct departure from the well-known Autogiro

pointing to the increased reliability of the aircraft power plant wanted the period extended to 750 hours, or even left to the discretion of the air line!

Should there be a co-pilot? The argument in favor of the co-pilot is that a single pilot may become unconscious or unable to carry on for some reason or other. A co-pilot is now required in any plane accomodating 15 or more passengers. Operators object to this rule and suggested that a co-pilot should be required only in a multi-engined plane, with more apparatus to watch over and only when the pilot has to fly 6 or more hours in one day. Even though the pilot's pay has gone down considerably,

the salaries of flying personnel are an important item in the operators' budgets.

The Department's rules call for a steward in all aircraft having a passenger capacity in excess of eight. Secretary Young concurred in the elimination of the steward, even though there have been cases recently of a passenger becoming violent and having to be subdued by force.

Universal requirement of two-way radio seems to be closer as a result of the last conference. Flight is prohibited under 500 feet altitude. Operators were anxious to reduce this height and the Department presented a tentative regulation prohibiting operation over clouds unless the "ceiling" at the terminal airport was known to be under 300 feet, or, alternatively, 2000 feet over the route at the time of take-off.

These and other points will gradually be settled as experience accumulates until the rules of the air assume the same comprehensive and satisfactory character as the rules covering vessels at sea. At this stage no one can be said to know exactly what the rules should be to cover all possible contingencies.—*A. K.*

A Debate About the Autogiro

THE editor of the London *Aeroplane*, C. G. Grey, has been a familiar and important figure in aviation for many years. An Irishman, he has a witty and caustic tongue, and a still more caustic pen. Sometimes this critic is completely wrong; sometimes he is completely and discomfitingly right: always his views are striking and thought provoking. Recently Mr. Grey took a bad rise out of the Autogiro.

An Autogiro lands very much more slowly than an ordinary airplane, but its high speed is correspondingly less. Mr. Grey's view is that if an airplane were built that had as much power as an Autogiro, carried as little useful load, and flew as slowly as the Autogiro, then that hypothetical airplane could get off the ground just as quickly as the Autogiro and could be made to land just as slowly. An Autogiro could get in and out of a football field, but so claims Mr. Grey could this hypothetical airplane.

What Mr. Grey would like to know is how the Autogiro would behave under a dead-stick landing. Also his fears are roused by the possibility of one of the blades being injured in some way and by the dangers of an unbalanced rotor system.

The New York Times gave Harold F. Pitcairn, the energetic, persistent, and able exponent of the Autogiro in the United States, an opportunity for rejoinder.

Mr. Pitcairn's arguments are all the stronger because they are based on experience and not conjecture. The reply as to slow speed merits direct quotation.

"Regardless of wing area and loading, airplanes cannot be made to land as slowly as Autogiros. All heavier-than-air machines support themselves by deflecting air downward. In other words, the machine is supported because air has weight, but since the air weighs so little a tremendous quantity must be deflected to support an aircraft. This means that if lift and control are to be maintained the surface or surfaces which are deflecting the air must move at a high rate of speed. Therefore, slow flight requires that the speed of the lifting surface be independent of the speed of the aircraft. Also if the wing loading of an airplane is very light, it will be immeasurably harder to land in high winds than an Autogiro. Lightly loaded airplanes are notoriously rough in bumpy air. The Autogiro on the other hand smooths out many more air bumps than does a heavily loaded airplane."

Mr. Pitcairn supports his views by relating personal experiences. For a month he has flown his Autogiro from the lawn of his house to the factory, much as he would use an automobile. He and his pilots have made innumerable dead-stick landings. Mr. Pitcairn has flown in weather so thick that he would never have ventured forth in an airplane. "The ability to come almost instantaneously to a momentary complete stop when flying at 40 miles an hour and then descend practically vertically into a small plot of ground has incalculable value when flying in thick weather."

The American constructor makes light of the danger of hitting a bird or otherwise damaging a rotor blade: "I do not attach any importance to Mr. Grey's mistrust of the revolving joint that attaches the rotor to the fuselage, since in all cases this is made with exceptionally large factors of safety. Neither am I afraid of the rotor blades being struck by birds, because I have known of pilots who have made every effort to hit birds while flying airplanes, but I have never known of a bird being hit. Birds see the machine coming and get out of the way."

A Kellett built Autogiro flying low but at ease over a golf course

The writer of these notes has recently had a delightful ride in the Autogiro with Mr. Pitcairn himself as the pilot. It made a lasting impression, and the writer is tempted to set both Mr. Grey and Mr. Pitcairn right, but that perhaps would be in dubious taste. Far better to give them both merely the courtesy of the column! —*A. K.*

Courtesy *Aviation Engineering*

The third experimental Wilford Gyroplane, which is similar to the Autogiro in having a rotating airfoil system, but in which the blades feather about their longitudinal axis instead of flapping up and down about a central hinge

"Cruisers of the Air"

THIS book, by C. J. Hylander, is a concise and well illustrated story of the development of the airship. Neither original nor profound, it is nevertheless an interesting book for a boy wishing to know something of the airship or for an adult seeking an elementary background for the important lighter-than-air developments of the day.—*A. K.*

Separating Water and Gasoline

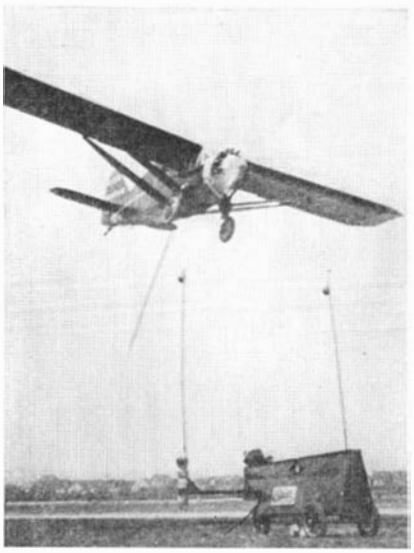
MANY an aviator has found himself on the brink of disaster when water or dirt have got into the gasoline and disturbed the delicate jet system of the carbureter.

It is at present the custom, in the Army Air Corps, to filter the gasoline through chamois strainers held in a fueling funnel. The process is tedious and troublesome, particularly because the chamois cloth has a way of developing mysterious holes. The

patience of the most trustworthy mechanic is apt to be sorely tried, the filtering process unduly hastened, and the way paved for an unfortunate stoppage of the airplane engine.

Master Sergeant David Samiran, with full co-operation of the Army Air Corps authorities has now developed a simple yet highly effective "gasoline segregator."

The segregator takes advantage of the natural tendency of water and gasoline to separate due to the difference in their specific gravities. The segregator's fluid chamber is so arranged that when the liquid fuel enters the chamber, the heavier water is delivered to the bottom of the chamber with a minimum turbulence while the gasoline is delivered to the outlet at the top with a minimum turbulence, after passing through an efficient sediment strainer. When enough water has accumulated in the bottom of the segregator, a float rises automatically, opens a valve, and the water is discharged. When the water is gone, the float falls and the water valve closes.



The Cabot airmail pick-up—latest of its kind—being tested in conjunction with a Bellanca plane

Laboratory tests, as well as installations at airports and at filling stations for motor boats have given excellent results. Small size segregators will help the ordinary motorist.

We believe this simple device will have wide and useful applications.—*A. K.*

A Mail Pick-up Device

SINCE the construction of an airport where mail planes may land means a minimum expenditure of some 30,000 to 40,000 dollars and a certain amount of annual expenditure in upkeep, the use of an airmail pick-up device has long been considered attractive. A number of inventors have attacked the problem, and one of the most persistent and thorough workers in the field is Godfrey Cabot of Boston. Demonstrations given recently of Mr. Cabot's invention have drawn favorable comment from many authorities. Its use in smaller cities, where stopping the transcontinental mail planes would hardly be justified, is quite a possibility.

The device consists of a catapult actuated by a series of half-inch shock cords and mounted on top of a light three-wheeled vehicle. The catapult propels a carrier along a runway. When ready for action the device is so oriented that the incoming plane may fly into the wind. The mail sack is placed in the carrier, and the 50-foot pick-up cord is placed on the tops of two 16-foot uprights, which are mounted on the body of the vehicle. These uprights are attached to the trigger of the device so that when they are moved slightly forward the trigger lets go and the catapult is released.

The uprights are 15 feet apart and the pilot aims to strike, with the pick-up hook, the middle of the cord stretched between them.

The moment the hook strikes the pick-up cord, the catapult starts and the carrier goes forward in the direction of flight at the same speed as the plane. The result is that the mail sack is lifted from the carrier without a jarring shock to the airplane.

The plane is equipped with a windlass which is automatically operated. The pick-up hook guide, 12 feet in length, is of steel and has a lengthwise groove in which the hook rides. The moment the weight of the mail sack is felt by the hook, a windlass begins to turn automatically and in less than a minute the mail sack is wound up into the cabin of the plane, through a port in the bottom of the fuselage. It is only necessary to release the windlass to unreel the shock cord. In practice this cord would be dropped at a specific place and a post-office employee would pick it up for further use.

The action of the catapult can be adjusted so as to suit the speed of the plane.

In official tests the specifications of the Post Office Department were followed. The loads picked up ranged from 5 to 40 pounds, although it is claimed that loads up to 1000 pounds could be handled. The tests did not fail in one instance.

It would be interesting to see the device actually tested in service on an airmail route.—*A. K.*

Lessons of the DO-X Flight

HERE is what we learn from the flight of the *DO-X*—its many troubles, mishaps, and minor shortcomings notwithstanding:

That a practical giant flying boat of a gross weight of some 106,000 pounds can be built.

That it is perfectly possible to co-ordinate and properly run a power plant consisting of 12 engines.

That the limit of size of the flying boat can be vastly extended and that while the *DO-X* is not the last word in speed and economy of operation, the way is clearly open to very large flying boats.

That very large flying boats lend themselves to the installation of radio and other equipment as complete in character as that of an ocean liner.

That seaworthiness increases with size (as we have always anticipated).

That steadiness in the air and comfort of the passengers increases with size.

The design and construction of the *DO-X* constitute a remarkable achievement, not because the *DO-X* will be immediately put into practical and profitable operation, but because it points the way for the constructor and operator, and because it shows conclusively that in a very few years, boats of even greater size may be possible both from a technical and commercial point of view. We may even look forward with confidence to regular seaplane operation across the Atlantic.

The flight of the *DO-X* constitutes a historic event in spite of the malicious jokes at its slow and cautious trip from Germany to New York.—*A. K.*

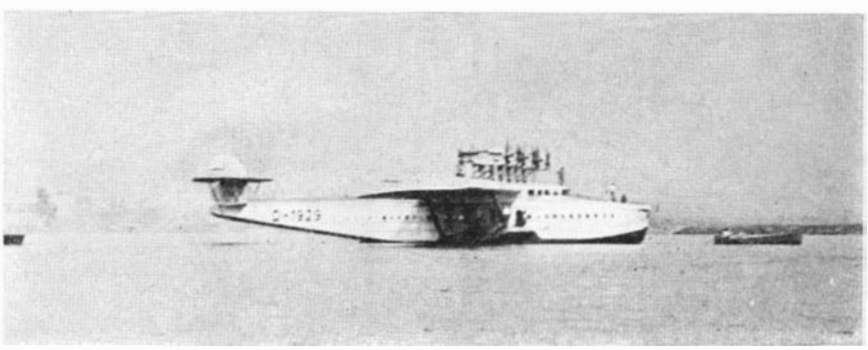
Save the Pieces

WHEN the housewife sweeps, she is not trying to recover some missing pieces of costly platinum. However, in factories where lamps for switchboard signals are manufactured, this is one of the jobs the sweeper must do.

Platinum wire is used in this manufacture and some of the platinum gets lost in handling, particles dropping on the floor. One way of getting them is with a small magnet, but a magnetic sweeper is also used. The sweeper consists of several individual magnets placed side by side on a frame, which has wheels and a handle. Several times a day the sweeper goes over the floor collecting bits of platinum.

The First American Book on the Helicopter

ALTHOUGH the helicopter has been the subject of innumerable articles in the daily and technical press, we do not remember ever having seen a book written in English dealing with this most interesting type of aircraft. "The Problem of Vertical Flight," by Parlee C. Grose is therefore very welcome, though it is not free from many criticisms on the score of technical accuracy.



The giant flying boat *DO-X* after her arrival at New York

The direct lift machine has received attention from very early times. Leonardo da Vinci left sketches of a machine involving an immense screw turning about a vertical axis. Sir George Cayley, in 1809, experimented with a model in England which involved four large airscrews for vertical lift and two smaller four-bladed propellers for horizontal flight. In 1877 Enrico For-

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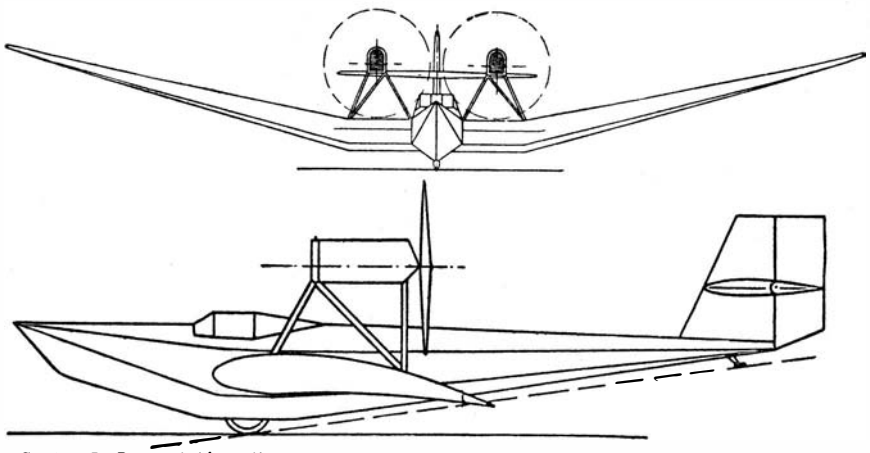
lanin (of Italy) designed a model helicopter powered with a miniature steam engine which established a record — the machine was the first to leave the ground vertically. Edison undoubtedly gave the type much thought in the early stages of his career. Since then scarcely a year has passed without some new inventor coming on the scene.

Two screws, coaxially mounted, and rotating in opposite directions have been tried; two screws mounted on either side of the fuselage and turning in opposite directions have been used; there have been combinations of lifting airscrews with ordinary airplane wings, combinations of lifting airscrews with gas filled balloons, inclination of lifting screws to give forward speed, combinations of lifting screws with smaller propellers to give forward propulsion, and so on and so forth.

While complete success has not yet apparently been attained it would seem that the ultimate solution is coming closer and closer. Misleading as Mr. Grose's book may be in many technical points, it is nevertheless interesting as a concise and fairly complete review of the history of this particular art.—*A. K.*



Courtesy *Le Document Aéronautique*

Diagrammatic sketches of Dr. Merkel's combination wing-float

A Combination Wing and Float

THE question is often asked why a seaplane or flying boat should, for the same weight per horsepower, be slower or else carry less payload than a land plane. The answer is that the flotation system is likely to be heavier and to offer more air resistance than a landing gear.

Dr. W. Merkel, a Director of the German Lufthansa now proposes a combination wing and float which offers a chance of removing this handicap for the seaplane. The new type of craft is also an amphibion.

The amphibion in question is a low-wing monoplane with two engines mounted high above the wing. The well streamlined central body is at the same time a hydroplane float. Instead of having tip floats for lateral stability, the wings themselves, at their central section, act as flotation bodies, and therefore provide the necessary lateral stability. The outer portions of the wings are raised so as to be clear of the water. Of course the aerodynamic properties of the wing will not be quite as good as those of conventional wings, but the combination as a whole may be very efficient.

To avoid the possibility of damaging the wings in rough water, they are given a certain elasticity of construction, with the trailing edge portion elastically supported in reference to the rear spar.

As can be seen from the sketches, a single central wheel and a tail skid give Dr. Merkel's design the ability to alight on or take-off from land.—*A. K.*

Oil For Chronometers

WHAT kind of oil should be used to lubricate clocks and watches? Expert clock makers will tell you that there is only one kind of oil that is entirely satisfactory, namely the oil extracted from the head and jaw of the porpoise and blackfish. For many years, this oil has been standard for the purpose but now it can not be supplied in sufficient quantity to meet the demands, the price of the oil being in the neighborhood of 125 dollars per gallon. The other fatty oils in general, such as olive oil, cottonseed oil, and so on, are, as prepared at the present time, objectionable on the grounds of chemical instability, corrosive action on metals, and the relatively high temperature—not much below 0 degrees, Centigrade—at which they solidify. The petroleum oils are open to the objection that they have a tendency to escape from the bearings by spreading out over the plates and bridges of the timepiece. They are also less effective in reducing friction than fatty oils under conditions such as those encountered in timepieces.

In co-operation with the Clock Manufacturers Association of America, chemists of the United States Bureau of Standards have been investigating the lubrication of delicate mechanisms, such as clocks and watches, aeronautical instruments, and so forth. The importance of this subject has increased greatly with the increase in number and diversity of these instruments. Many are ruined and much money is lost by unsatisfactory lubrication.

Chemists hope either to prepare a very pure grade of vegetable oil, treated to insure its stability or else to produce a new synthetic oil free from the limitations of natural oils.—*A. E. B.*

Outboard Motor Digs a Cistern

THE outboard motor has proved to be a handy contrivance for a great variety of odd jobs. The latest application to which it has been put is to dig cisterns.

Cottagers and resorters dwelling on the shores of lakes that are shallow have been experiencing much difficulty with mud and sediment in pumping their water supply from the lake, and to remedy this, one outboard owner conceived the idea of placing a cistern in the lake. A hole 20 feet in diameter and six feet deep to receive this cistern was dug by the wash from an outboard motor on a boat that was anchored securely. The cistern, holding about 1000 gallons of water was then rolled in place.

It is said that this cistern is proving very satisfactory and that in pumping water out of the cistern it is as clear as though pumped from a well. The cost of installation is considerably less than it would be to run a pipe line into deep water. Four cisterns have already been installed by this method in a lake in Lodi, California.

What Is Glass?

BY the latest view, glass is a liquid in a trance!

Its three ingredients are lime, soda, and sand. According to George W. Morey, of the Carnegie Institution, these have a particularly low melting point when mixed in the right proportion, and when the melted materials cool to the "freezing" point, the mixture is so stiff that the molecular change which would cause the glass to become opaque can hardly take place. If the glass loses its transparency, something was wrong with the mixture.

In this respect, glass is a product peculiar to itself—there seems to be nothing else like it.—*A. E. B.*

Do the Tides Do This?

HERE is an experiment not mentioned in any of the scientific literature the editor has seen. If we carefully stand a rod of metal or any substance on end on a flat surface it will remain there until something topples it over. Such is ordinary experience.

Now suppose we extend the rod to several feet in height. As we do so, the difficulty of standing it on end in stable equilibrium will increase. This doubtless is due largely to the lack of rigidity of the rod. Suppose, however, we had an infinitely rigid, perfectly homogeneous, non-magnetic rod, perfectly straight, with a perfectly square end, stood on a perfectly level flat surface. Would such a rod remain in stable equilibrium if placed

The wash from an outboard motor on an anchored boat digs a hole in the lake bed to receive a cistern

within a larger tube (to keep off air currents) and protected from all shock?

This problem has been submitted by J. Ford Nelson of Greenfield, Massachusetts, who apparently has been experimenting.

The editor has not experimented on this problem—because, for one thing, a steady base or a steady anything is almost out of the question in New York, which shakes like jelly and quakes all day and all night. It is, however, believed that solar and lunar attraction would tip over the rod if it were high enough.

The next question is, who wants to stand a rod such as this on end, anyway, expecting it to "stay put?" Nevertheless the problem is interesting and scientific.

Water Purifier Prevents "Athlete's Foot"

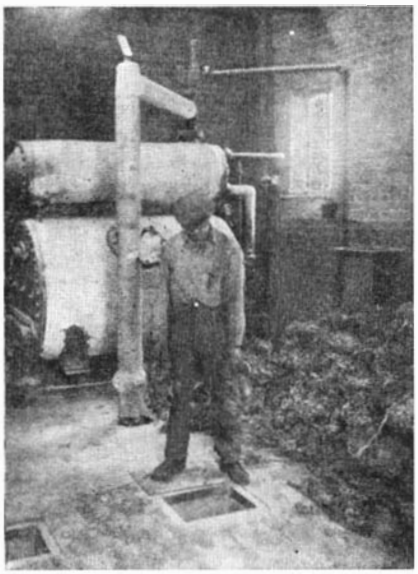
A COMMON chemical, sodium hypochlorite, used in purifying city water supplies, has been found to be an effective preventive of ringworm infection of the feet by two Buffalo workers in medical research, Dr. Earl D. Osborne and Miss Blanche S. Hitchcock. This disease, also known as "athlete's foot" and similar nicknames, has spread spectacularly with the post-war rise of sports involving the use of common dressing-rooms and other gathering-places where athletes trample around barefooted for a time. There the spores of the fungi that cause the disease are spread from foot to foot, later causing irritation, cracking of the skin, and itching, watery blisters.

Dr. Osborne and Miss Hitchcock state in their report to the official publication of the American Medical Association that they have not been able to find a record of sodium hypochlorite being used or suggested as a fungus-killer before. They made some preliminary trials with cultures of various fungi in test-tubes, using solutions of the chemical in concentrations stepped up from 0.001 percent to 0.5 percent. The latter concentration seemed the most effective, and was chosen as standard for a clinical trial.

With the co-operation of the physical training department of the Buffalo high schools, heavy rubber pans were installed in all the gymnasiums, and students going to and from gymnasium classes were required to wash their feet in a 0.5 percent solution of sodium hypochlorite. The solution was renewed every day. In a new high school a shallow "well" for the solution was built into the corridor passing from the dressing room to the showers. Later, the strength of the solution was increased to a full 1 percent because of possible dilution through use.

The results of the experiment are reported as most encouraging. The spread of the infection was completely checked. "Our records fail to show a single new case, although numerous ones have appeared from the surrounding towns," the two experimenters report.

The hypochlorite solution, however, is not to be looked upon as a cure for already established cases. The report continues: "So far as cure of the disease is concerned, we do not believe that 0.5 percent solution hypochlorite or even 10 percent sodium hypochlorite would be any more efficacious in curing an established case than any other methods employed at present in the



Over the extractor, on the floor above, is the door through which rubber scrap is introduced

treatment of this stubborn condition which troubles so many people."

The sodium hypochlorite treatment is the second efficacious prevention for ringworm of the feet reported recently. A short time ago Dr. W. L. Gould of Albany, N. Y., described how he had stopped the spread of the disease in the junior high school there with a 10 to 15 percent sodium thiosulphate solution used in a similar manner. The sodium thiosulphate solution is colorless and nearly odorless, so there is no objection to its use. If the bath is not convenient, a 20 percent powder of sodium thiosulphate in boric acid may be successfully used, Dr. Gould reported. This powder should be dusted lightly over the entire foot, between the toes and around the nails. It may also be used inside the shoes and stockings. A combination of bath and powder was reported as ideal at times.

Dr. Osborne and Miss Hitchcock, however, believe that their sodium hypochlorite solution offers certain advantages. It is cheaper, and when the quantities used in gymnasiums and similar places are considered this is a distinct advantage.—*Science Service.*

Rubber and Cotton Reclaimed From Tire Scraps

OF the contributions of chemistry to the every-day comfort and convenience of thousands of people, no example can be instanced more striking than the tremendous improvement in the quality of automobile tires during the last generation. One has only to recall the early days of the automobile when punctures were an accepted incident of nearly every ride to realize that our modern balloon type cord tires represent progress equal to that of the automobile itself. Most of the credit for better tires is due to the chemist, who is also largely responsible for the gradual reduction in the cost of pneumatic tires.

The modern tire could not be sold at present prices if the manufacturers did not practice every economy that science has been able to develop. One example of this fact is revealed in a recent paper by Charles S. Powell of the Firestone Tire and Rubber Company, who describes therein a newly developed process for salvaging the scraps of rubber and cotton which are trimmed from uncured tires during manufacture. The scraps consist of cotton cords embedded in uncured rubber. A thousand pounds of these trimmings are loaded into a revolving cage with walls of monel-metal screen. This cage rotates within a steel shell, which is then filled with benzene and the cage rotated for 2 hours, after which the benzene is drawn off, and fresh benzene added for another half-hour "washing." Six consecutive washes, the last two using hot benzene, dissolve out practically all the rubber, leaving clean, white cotton shreds. The cotton still contains some benzene, however, which is removed by turning steam into the extractor, driving out the benzene into condensers at the right of the extractor where it is recovered for use. The cotton is removed from the extractor, dried, shredded, and sold for paper manufacture or as a filler in cheap felt compositions; or, finely ground, it is sold as cotton floc.

The rubber extracted from the scrap remains in solution in the benzene—about a 6 percent solution. Fortunately, a solution of this kind is used in the tire factory for impregnating the fabric used in the manufacture, so the reclaimed rubber finds its way into a new tire after all.

Neither the cotton nor the rubber are deteriorated by this reclaiming process. One thousand pounds of scrap yield 1200 gallons of rubber solution and 400 pounds of cotton.—*A. E. B.*

Popular Misconceptions That Chemistry Corrects

WHY must blue overalls have threads with white centers? Why must they be a purplish instead of a true blue? Why does the housewife demand cloudy ammonia? Why is yellowish gasoline considered inferior? Why do people prefer blunt crystals of Epsom salts? These, says J. H. Collins, in *Chemistry and You*, are a few of the "trade customs" which cost business a great deal of money every year. Some of them were cunningly created, at some time, to deceive the buyer or the public.

Years ago, a clever dyer learned to save indigo by coloring the outside of the thread, and now the overalls buyer picks and unravels a thread to make sure the center is white—an imaginary test of quality. Natural indigo was impure, and gave a purplish tinge, which still stands for quality, though with modern dyes a perfect blue is easily obtained.

A British concern "put over" the idea that cloudiness stands for "strength" in household ammónia, and produced the cloudiness with a little palmitic acid.

Millions of dollars are spent making white gasoline, or imparting a gay color to the naturally yellowish gas, because the public firmly believes white gasoline better—which it is not.

Blunt crystal Epsom salts used to command a premium in the drug trade, for their supposed higher efficiency—highly efficient bunk.

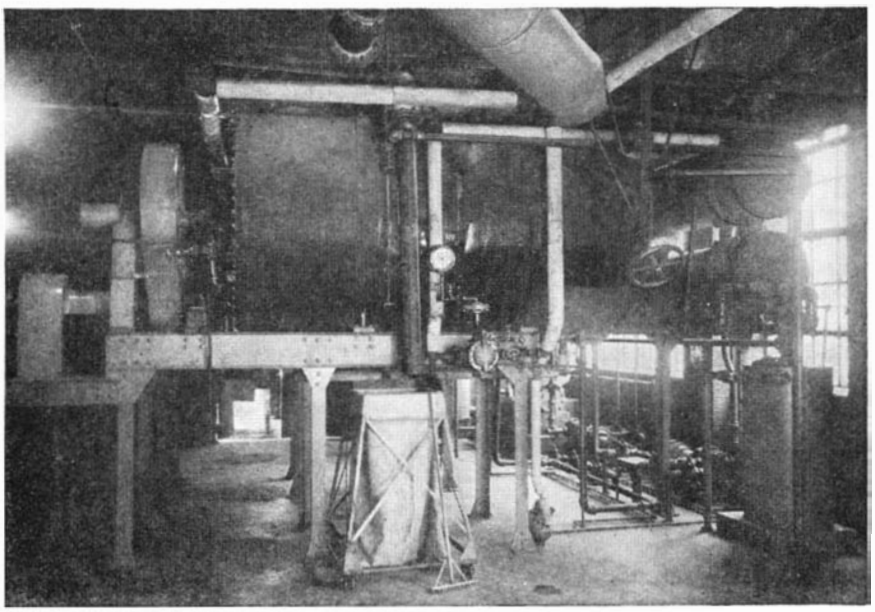
One of the commonest trade beliefs is that a tinge of color in chemicals indicates purity or strength. But such color is generally an impurity—in a word, dirt! At some time in the past, dirt could not be eradicated and so was made an imaginary mark of quality.

One eastern silk factory demands brown in its phosphate of soda solution, and another insists upon white, and both believe they are buying a pure article. But a brown tinge, in this chemical, is not an impurity, while chemical impurities likely to do damage to silk are colorless—and there you are!

Only the chemist can dispel such traditional beliefs by determining scientifically what is fiction, and what is fact.—*A. E. B.*

Whale Oil Food

IN the good old whaling days that sea captains like to talk about, whale oil was an illuminant. Now it is a food. Hydrogen gas is passed through it in the presence of nickel filings—a process of hydrogena-

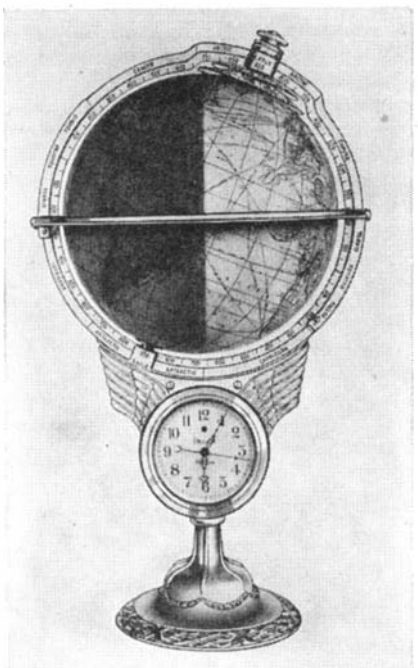


Extractor used for removing the uncured rubber from tire scraps. The scrap rubber is charged from the floor above. The recovered, clean cotton is dumped, at the end of the process, into the bag which is shown beneath the extractor

tion. A rather cheap oil is thus converted into a more expensive hard fat. A good deal of the margarine that is sold outside of America is composed of this promoted whale oil.

The Uniclock

A CLOCK that makes the earth turn over —at least in replica—and which has been aptly characterized as "alive," will be of interest to amateur scientists, particularly amateur astronomers. It consists of a globe of the earth geared to an electric clock in such a manner that the globe keeps step with the earth's axial rotation. It is



The clock which turns a globe which is lighted from within to indicate illumination of the earth by the sun. The other half is dark

made by the Universal Clock and Globe Company of Wilmington, Delaware.

The globe is translucent and an electric lamp within it produces a contrasting light on its surface, showing as it rotates the position of the termination (sunrise and sunset) lines. In other words, one sees the clock as he would see the earth were he far out in space, or on the moon.

The lamp within the globe revolves once a year. Thus the illumination of the earth by the sun at the various seasons is duplicated and in this and other ways this earth clock is educational.

Boric Acid From Steam of Volcanoes

OVER in Italy, the raw material for one of the most unusual chemical industries comes from volcanoes: The Societa Boracifera manufactures boric acid from steam of volcanic origin (the so-called "soffioni," steam spouts) which arises naturally out of the earth but which, in much larger quantities and better condition for exploitation, is obtained from openings in the ground reaching a variable depth of more than 500 meters.

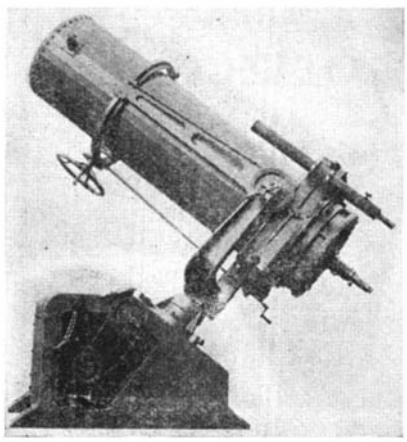
The volcanic vapor brings out the boric acid, ammonia, and other substances mixed

(*Please turn to page* 347)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

THIS month our space is devoted to the interesting work and discoveries of Mr. John H. Hindle, Director of the Union Engineering Works, Haslingden, Rossendale, Lancashire, England. Mr. Hindle



Hindle's compound reflector

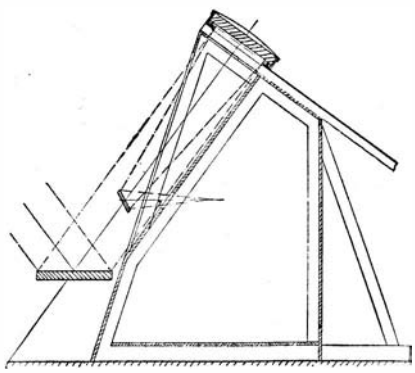
manufactures electric presses and heavy looms, but makes of telescope making an amateur hobby which amounts almost to an avocation. He is a "specialist" in the Cassegrainian and Gregorian—in fact, he is one of a very small number who really understand these types in theory and in practice. He occasionally visits this country and calls at these offices, and at our request he has prepared the following descriptive matter, first, concerning a 20½-inch Newtonian-Cassegrainian, then an enclosed polar observatory (photographs of both are shown), and finally his discovery of a new test for the Cassegrainian and Gregorian.

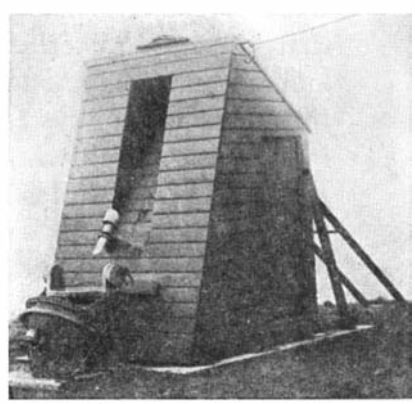
"THE mirror of the 20½-inch Newtonian-Cassegrainian shown above is mounted in a cast iron cell with adjustable edge supports and resting on a mechanical flotation system giving 18 equally loaded symmetrical points, emanating from three adjusting screws. The tube is of timber, built up on aluminium rings. The fine adjustment in declination is operated by a hand wheel and screw from the Newtonian end, and more slowly by means of an extension shaft operated through bevel gears, from the Cassegrain end. The polar axis and fork are cast in one piece, and rotate in ball bearings, the top ball-bearing housing being adjustable. The worm wheel is of large diameter and the worm is provided with slow motion gearing which operates by a hand rod and hook joint, while the clock is running. The drive is by gramophone motor.

"The mirror is of 20.2 inches aperture, is of eight-foot focal length, and has a five-inch hole through the center. Interchangeable spiders for the top end of the tube carry, respectively, the diagonal plane mirror and the Cassegrain convex mirror. The latter is mounted in a cell, about six inches outside diameter, and provides an equivalent focal length of 30 feet.

"The performance of this telescope, which is shown in actual use, will probably be fully described in an astronomical journal by Dr. W. H. Steavenson, F. R. A. S., one of the foremost amateur observers in England, who has erected it in his observatory."

The advantage of an entirely enclosed observatory, which can be heated sufficiently for bodily comfort without spoiling the definition of the mirrors, has been somewhat extensively discussed in the book "Amateur Telescope Making," pages 50–51. Mr. Hindle is responsible for a particular type of polar observatory of which several illustrations are reproduced. One photograph reveals the interior, showing the comfortable method of observing.

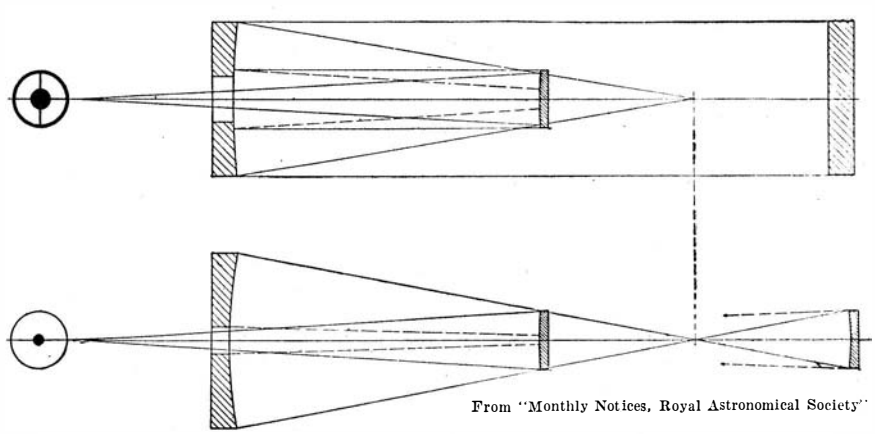




The enclosed observatory, with a sketch (above) showing the layout and, at right, Mr. Hindle observing

"The actual site is N. latitude 53¾°," Mr. Hindle writes. "The primary mirror is paraboloidal, mounted in a cast iron cell, looking face downward from the top of the hut. Actually this mirror is a disk 25½ inches in diameter; the excavation being only 20 inches aperture and the outer flat portion providing a suitable support. The focal length is eight feet and the cone of rays is turned *horizontally* into the hut by means of a slightly elliptical mirror adjustably mounted in an 'A' bracket, which performs the function of the spider in the orthodox telescope tube. The only moving portion is the coelostat, which has a plane mirror of 25½ inches aperture, counterbalanced and pivoted on a surface diameter for declination, and revolving on a polar axis for right ascension.

"Electrically driven reversible variable-speed motions are applied to declination



From "Monthly Notices, Royal Astronomical Society"

At top ("Figure 1"): the old Ritchey parallel ray test. Left to right: area visible for correction; paraboloid; hyperboloidal convex; flat. At bottom: ("Figure 2") new Hindle spherical mirror test. Left to right: area visible for correction; spherical mirror; hyperboloid; ellipsoidal concave mirror (for a Gregorian)

and right ascension, controlled from inside the observatory. An additional elliptical flat, deflecting the rays directly from the coelostat, permits the use of a short finder telescope if required. (This flat shows in one of the photographs, below the bracket. —*Editor.*) A sextant with reading microscope is fixed on the declination axis, and the polar axis reads zero hour when pointing due south. A concrete foundation

The observatory when closed

about a foot thick supports the entire observatory, which is very rigidly constructed and braced, two light I-section beams being provided for sliding the primary mirror up or down in its cell.

"The adjustment of the mirrors to the polar axis is facilitated considerably by the optical combinations that can be obtained in a very interesting manner. The construction of the hut itself insures that the primary mirror and elliptical flat roughly approximate to the polar angle. They are set optically in line with each other, after which the coelostat mirror is moved in declination until it is precisely parallel with the parabolic mirror, which can be observed from the eye position. It is now rotated in R. A. and if the parallelism is lost, then the coelostat base (and polar axis) is adjusted by the base screws until parallelism with rotation are secured. The three mirrors are now on one optical axis and the sextant is set to read 90°. The coelostat mirror, at zero hour R. A., is now brought perfectly level, and the sextant should read $180 - 2 \times$ latitude; in this instance $180 - 107\frac{1}{2} = 72\frac{1}{2}°$ from the pole, or 17½° N. declination.

"In case of an error a fresh optical axis nearer the correct position is selected for the first two mirrors, and the coelostat adjustments repeated. If an inclinometer is available, then the angle of the plane mirror can be tested right away when the two large mirrors are parallel with each other.

"Silvering the mirrors need not upset the adjustment. The coelostat mirror is readily replaced in the same plane. The other two are removed one at a time, and each brought to a correct position by reference to the other. The adjustment to the meridian is checked by the southing of some prominent object at the precise moment indicated in the N. A."

WELL, how many of you amateurs are now going to make a Hindle comfort coop for cozy constellation conning? No frozen fingers, no summer mosquitoes to slap and cuss at. It looks mighty good to ye ed.—and inexpensive, too. In Yankee

(*Please turn to page* 355)

CURRENT BULLETIN BRIEFS

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

LIGHT ON AN IMPORTANT SUBJECT describes an invention born of necessity for lighting book stacks without giving attendants unnecessary glare. It was developed for the great Sterling Memorial Library of Yale University. *Snead & Company, Jersey City, N. J.—Gratis.*

SEEING IS BELIEVING is a beautifully printed brochure intended to help a campaign to lengthen life. The story is told in pictures. It is issued by the Welfare Division of the *Metropolitan Life Insurance Company, New York, N. Y.—Gratis.*

TESTING OF TIMEPIECES (Bureau of Standards, Circular No. 392) describes the interesting work carried on in testing watches and chronometers. The directions for handling watches are excellent and should be in the hands of every one who has a regard for correct time. *Superintendent of Documents, Washington, D. C.—15 cents (coin).*

AERONAUTICS TRADE DIRECTORY (Aeronautics Bulletin No. 3) is a publication giving a list of aircraft manufacturers, makers of supplies of every description and sundries. There is also a list of air transport operators, aerial surveyors, and those furnishing aeronautical instruction. We even find that there are "consulting meteorologists." *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

THE WORKING OF SEMI-PRECIOUS STONES by J. H. Howard is a brief elementary monograph on the lapidary art. The literature on this subject is so extremely limited that a pamphlet for amateurs written by an amateur will be appreciated by many home mechanics. There are a number of excellent illustrations. *Rocks and Minerals, Poughkeepsie, N. Y.—$1.00.*

DISEASES IN CAPTIVE WILD MAMMALS AND BIRDS by Dr. Herbert Fox, pathologist of the Philadelphia Zoological Society and Curator of Pathology is a unique publication containing practical discussions of the effect of diseases, growth, and development of captive wild animals and their relations to man. It contains nearly 700 pages. *Dr. H. L. Ratcliffe, Zoological Garden, Philadelphia, Pa.—$15.00.*

CARPET WEAR TESTING MACHINE (Research Paper, No. 315 Bureau of Standards, Reprint from *Bureau of Standards Journal of Research* Vol. 6, June, 1931) by H. F. Schiefer and A. S. Best describes one of the curious machines designed at the Bureau of Standards; the machine reproduces the bending, slipping, twisting, and compression of the pile which takes place when the carpet is walked upon. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

A YEAR-BOOK OF RAILROAD INFORMATION, 1931 EDITION gives a vast quantity of information in graphic form and in small compass. It shows the wonderful service rendered to the public and what it costs. *Committee on Public Relations of The Eastern Railroads, 143 Liberty Street, New York, N. Y.—Gratis.*

RADIO TUBE DATA is a 32-page loose-leaf pocket-size booklet on radio receiving tubes and presents over 80 graphs giving static and dynamic characteristics of all types of receiving tubes. The information is presented in the well-known "Lefax" form. *Lefax Inc., 9th and Sansom Sts., Philadelphia, Pa.—$1.00.*

SLASH PINE (Farmer's Bulletin, 1256-F, Department of Agriculture) deals with information useful to the grower. This tree produces the heaviest crops of naval stores and also produces valuable timber. *Office of Information, U. S. Department of Agriculture, Washington, D. C.—Gratis.*

FOREST TYPES IN THE SOUTHWEST AS DETERMINED BY CLIMATE AND SOIL (Technical Bulletin, No. 247, U. S. Department of Agriculture) by G. A. Pearson. No other form of agriculture is so completely subject to the forces of nature as is the growing of timber crops. Forest meteorology in this country is still in its infancy. Soil surveys such as are made in agricultural sections are not adapted to forest land. The investigations outline the problem and how it can be solved. *Superintendent of Documents, Washington, D. C.—30 cents (coin or money order).*

TESTS OF WELDED BOILER DRUMS (Reprint from *Combustion*, November, 1930) is a valuable article, for with the rise in steam pressures the fusion welding process appears to be the most practical for boiler drums. The results are described in this article. *Combustion Engineering Corporation, 200 Madison Avenue, New York, N. Y.—Gratis.*

INDUSTRIAL RESEARCH METHODS AND WORKERS (Reprint, *Journal of Engineering Education*, Volume XXI, No. 2) by Edward R. Weidlein, the Director of the Mellon Institute, describes how co-operative research is carried on. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

BUDGETARY CONTROL IN MANUFACTURING INDUSTRY is based on a survey of 288 highly-rated manufacturing companies and gives the facts concerning the operation and effectiveness of budgeting in manufacturing industry, citing the methods used and the results secured. After all budgeting is only careful planning. It is a book which should be in the hands of every major executive in American industry. *National Industrial Conference Board, 247 Park Ave., New York City.—$3.00.*

SNOW REMOVAL AND EQUIPMENT (Bulletin No. 20) gives a survey of needs for and availability of equipment. It gives the scientific and technical principles employed in snow removal. *American Road Builder's Association, Suite 938, National Press Building, Washington, D. C.—Gratis.*

WORKBOOK FOR USE WITH "THE SCIENCE OF EVERYDAY LIFE" by Edgar F. Van Buskirk and Edith Lillian Smith assisted by James R. Wilson is a kind of students note book. It is admirably prepared and is fully illustrated. Some of the subjects include: air, water, foods, forces of nature, homes and clothing, and work of the world. *Houghton Mifflin Company, Boston, Mass. —72 cents.*

OBJECTIVE TESTS IN GENERAL SCIENCE by James R. Wilson is based on the new edition of Van Buskirk and Smith's "The Science of Everyday Life." This ties in with the workbook mentioned above. *Houghton Mifflin Company, Boston, Mass. —24 cents.*

SOLVING FOOD MANUFACTURING PROBLEMS BY RESEARCH INSTITUTE METHODS (Reprinted from *Food Industries*, September 1930) by Lawrence W. Bass deals with the food problems worked out at Mellon Institute. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

CHEMICAL ECONOMICS (Reprinted from *Annual Survey of American Chemistry*, Volume V., 1931) by Lawrence W. Bass gives a review of American literature, 1925–1930 and cites 226 titles. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

HANDBOOK OF FIELD MUSEUM OF NATURAL HISTORY gives general information concerning the museum, its history, building exhibits, expeditions, endowments, and activities. *Field Museum of Natural History, Chicago, Ill.—25 cents.*

PHYSICAL PROPERTIES OF EARTHS (Bulletin 101) by John H. Griffith presents a report of researches on the physical and chemical properties of loam, yellow clay, and blue clay. *Engineering Experiment Station, Iowa State College, Ames, Iowa.—Gratis.*

THE LARGEST STEAM GENERATING UNITS IN THE WORLD describes the three 800,000 pound units installed in the new extension to the East River Station of the New York Edison Company, which is costing 12,500,000 dollars exclusive of site. *Combustion Engineering Corporation, 200 Madison Ave., New York, N. Y.—Gratis.*

OFFICE OF EDUCATION DOLLAR PACKET OF DIRECTORIES is an economical way of buying lists of schools and school officials and is priced at or below the cost of production. *Superintendent of Documents, Washington, D. C.—$1.00 (money order).*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 343)

with carbon dioxide gas. From some openings in the earth is obtained the boric acid water, which is also taken from underground by simple means of removal of deposits, operated by the natural vapors.

The boric acid water is then concentrated by evaporation, and cooled, which (according to the extent of crystallization) varies from 98 percent to a minimum of 82 percent. The acid is then dried and shipped as raw, or refined and used for the manufacture of borax (adding carbonate of soda).

The ammonia contained in the vapor is placed, in convenient equipment, with sulfuric acid, obtaining ammonium sulfate which is purified and sold as talc, or decomposed in retorts with lime to use the ammonia in special chambers to produce, together with carbonic acid, the ammonium carbonate.

The carbonic acid, which is found in great quantities in the natural vapor, is used. It passes into a special section where it is dried and purified. It enters into the preparation of the ammonium carbonate, but chiefly, it is liquefied and sold in bottles.

Other products of the Boracifera factory are sodium perborate and all the special salts which may be required.—*A. E. B.*

Uterine Cancer

DESPITE the fact that the uterine cervix is easily accessible both to sight and touch, cancer in this location is usually in an advanced stage when first discovered. The subjective symptoms in early cervical carcinoma are vague or even absent and are not often recognized by the patient. Therefore, if cancer of the cervix is to be prevented and controlled, it will be necessary to make routine and periodic examinations of this organ.

As the majority of cervical cancer cases occur in women who have borne children, it is suggested that physicians should urge an annual or semi-annual examination of mothers to determine if there be any pathological condition of the cervix. Cancer rarely, if ever, occurs on a normal cervix. It is usually preceded by some chronic lesion and is often associated with tears sustained at childbirth.

Professor W. P. Graves, Harvard University, in a study of 500 cases of cervical cancer found that only 2 percent of the patients had had cervical repair, while, on the other hand, among nearly 5000 women who had received this treatment he found only six who had developed cancer.

The very early stage of carcinoma of the cervix cannot be definitely diagnosed clinically. In all suspicious lesions a biopsy should be employed at once. This is a safe and easy operation and does not require an anesthetic. A biopsy by a competent pathologist offers a quick and definite diagnosis.

Statistics show that 75 percent of early treated cases survive the five-year period while the salvage in advanced cases is comparatively small. Although the majority of cases of cervical cancer occur near the

menopause it must be borne in mind that this lesion frequently is found at a comparatively early age. There are on record at the State Institute for the Study of Malignant Diseases a number of cases in the early twenties and one case in a girl of eighteen who was married when she was fourteen and had borne two children.—*Health News*, New York State Department of Health.

Hot Steam for Cooling Trains

A NEW system of air conditioning and cooling for railway passenger trains, employing steam from the engine as the refrigerating energy and water as the sole refrigerating medium, thereby eliminating gaseous refrigerants, was recently announced by Willis H. Carrier, chairman of the Carrier Engineering Corporation. Mr. Carrier, who is also president of the American Society of Heating and Ventilating Engineers, designed the cooling system in the White House executive offices and the Capitol.

The new cooling system for railway cars is being demonstrated in an ordinary passenger coach enclosed in a building in which a temperature of 106 degrees and high relative humidity has been created. Within the car the temperature is maintained at 77 degrees, with corresponding moderation in the relative humidity. The test is purposely conducted under extraordinary conditions.

The elementary law of physics that water will boil or give off its heat at comparatively low temperatures when the atmospheric pressure is reduced, as in high altitudes, is the basis of the new refrigeration development. A tank partly filled with water is concealed at one end of the car. Steam drawn from the engine is forced under pressure past an opening in the upper part of the tank, thereby creating a vacuum within, and causing the water in the lower half of the tank to boil at about 50 degrees. In boiling the water gives off heat in the form of vapor which is drawn out of the tank by the suction of the steam, and results in lowering the temperature of the remaining water still further to about 40 degrees.

This cold water is then circulated through coils concealed in the roof of the car. Air is then drawn over these cooling coils, where it is cooled and de-humidified, and thence circulated throughout the car by ducts. From the cooling coils, where it acquired heat in cooling the air, the water is returned to the tank. The portion of the water that had been vaporized passes through condensing coils and is likewise returned to the tank. The whole cycle is repeated, the system being almost completely automatic.

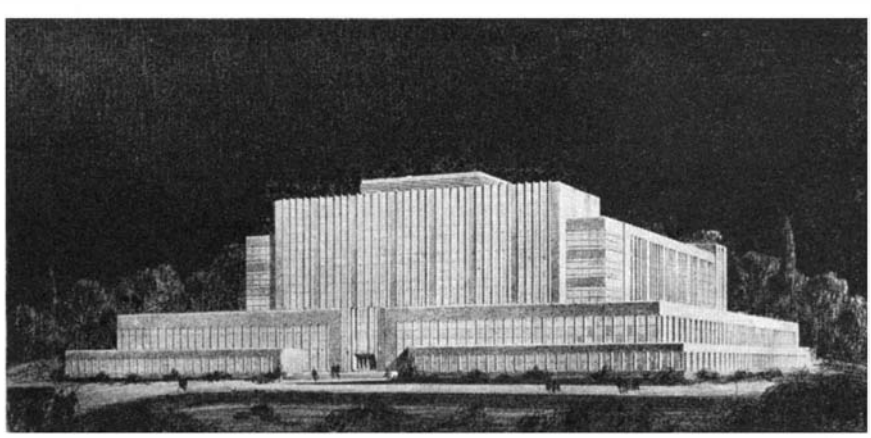
The fact that steam is used to refrigerate the water eliminates the necessity for providing considerable extra electric power for the operation of a refrigerating machine as has been the case with previous systems. Other advantages include lighter weight and less space occupied, as well as low maintenance cost. The use of the existing source of electric current on a train for operation of fans and pumps eliminates the difficult problem of finding a large additional and continuous source of power. Engineers believe the new development foreshadows general application of air conditioning and cooling on American railroads.

Approximately 2000 cubic feet of conditioned air per minute is provided for in each car, affording a complete change of air every minute. The refrigeration capacity in each car is equivalent to about five tons of melting ice per 24-hour period.

Co-operating with the Carrier Engineering Corporation are the Safety Car Lighting and Heating Company of New York and the Silica-Gel Corporation of Baltimore who will be associated in the development and introduction of systems of air conditioning for railway service.

Synthetic Hydrocarbons

CHEMISTS have long known that methane can easily be formed from carbon monoxide and hydrogen, by passing a mixture of these gases over a suitable catalyst at atmospheric pressure and at temperatures as low as 150 degrees, Centigrade. It is only in comparatively recent years, however, that appreciable quantities of higher members of the methane series have been prepared by similar methods from carbon monoxide and hydrogen. Consideration of the hypothetical reactions involved show that thermodynamically the formation of higher hydrocarbons from carbon monoxide and hydrogen should proceed



A government contract has been awarded for the construction of the largest and most complete laboratory for research on wood. In the new building, located at Madison, Wisconsin, the Forest Products Laboratory will continue their work, initiated 21 years ago, to improve the production and broaden the uses of all classes of forest materials. The building will be equipped with all modern scientific and technical facilities to expedite their operations

with greater ease than the formation of methane and that the maximum possible yields are greater.

An exhaustive investigation of this process has been conducted on a small scale at the Pittsburgh Experiment Station of the United States Bureau of Mines, regarding optimum operating conditions, choice of catalysts, and conditions which control yields. In this work it has been demonstrated that the extent of the conversion of water gas to hydrocarbons can be made fairly high; and that the process can be so conducted that the major portion of the yield will be products which are liquids under ordinary atmospheric conditions. With favorable catalysts, 30 percent conversions have been effected with one pass through the converter.

The liquid portion of the product comprises 60 to 75 percent of the total organic products; methane appears as a minor constituent. The liquid product consists mostly of hydrocarbons of the methane series, having only traces of compounds containing oxygen.

Thus it has been demonstrated that a synthetic product resembling petroleum can be obtained from water gas. This fact may in the future cause this process to assume considerable importance as an auxiliary source of liquid fuel, and may offer to the manufactured-gas industry at the present time a means of effecting enrichment and odorization of blue water gas.—*A. E. B.*

200,000 Amperes on Rampage

PRACTICALLY everyone has noticed the attraction and repulsion between two little horseshoe magnets, but few people realize the tremendous mechanical

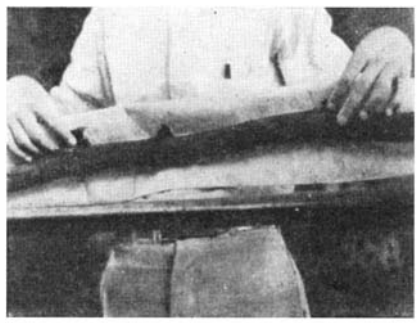
Courtesy Westinghouse Elec. & Mfg. Co.

Cables carrying 200,000 amperes broke their fastenings like twine

forces exerted on modern electrical equipment when it is carrying a large current, and setting up a strong magnetic field.

In a recent test, 200,000 amperes of alternating current was passed through a piece of electrical apparatus. Although the apparatus stood this flood of current, the power leads, as thick as a man's wrist, broke their two-inch* rope lashings, and writhed like monster reptiles in agony.

Although the two 1½" diameter cables were kept two inches apart and tied down every few inches with heavy rope, a little figuring made it clear why the rope gave way like so much twine. It was found that the force between the cables reached a value of 10,000 pounds for every foot the cables were tied together. Not only that, but the force was pulsating at the rate of



Where the lashings did not break, they bit deeply into the insulation

120 times per second; that is, the force reached a maximum and dropped to zero 100 times in the duration of a heart beat.

When such a striking demonstration of mechanical forces produced by electrical currents has been witnessed, one obtains some conception of the skill necessary in the design of large and complicated electrical machines which must withstand many such stresses unharmed.

This test, like all tests on large electrical machinery, was conducted from a safely remote point, so, of course, no one was endangered by the breaking loose of the cables.

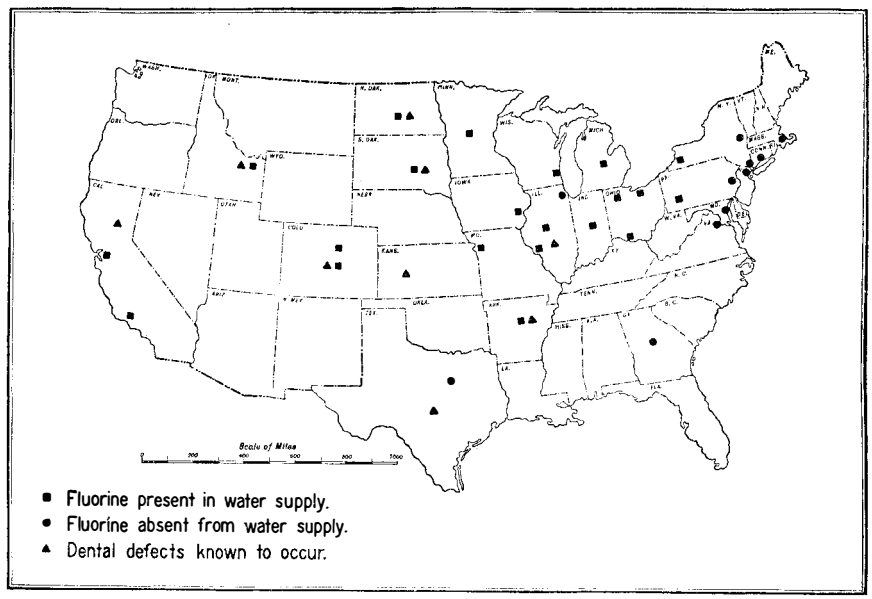
*Many persons, reading in sea stories of 10-inch and 12-inch hawsers, do not realize that the size of a rope is designated by the circumference and not by the diameter.

Typhoid Fever

THE marked reduction in the prevalence of typhoid fever throughout the United States has been one of the outstanding accomplishments in public health during the past quarter of a century. This has been accomplished in cities where the sources of public water supply are grossly polluted, and in such cases it has been done largely by the intelligent installation of approved water purification plants. However, although the purified public drinking water meets the accepted sanitary standards, there often persists in such cities a small number of cases of typhoid fever. This fact stimulated the United States Public Health Service to undertake an extensive study of these persisting or residual cases of typhoid fever, the object being to determine whether they bear any relation to the municipal drinking water even though it did meet the present rigid sanitary standards.

Six cities situated on the Ohio River were selected for study, both because of the polluted character of their raw water supplies and because of the excellence of their municipal water purification plants.

The Ohio River is the source of the public water supply for each city. During the period of raw water consumption, the typhoid fever incidence in each city was uniformly very high in every month of the year—a seasonal distribution which is typical of endemic water-borne typhoid fever. Following the installation of the present public water supplies, the typhoid



Map showing relation between dental defects and fluorine in water supply

incidence promptly fell to a low rate comparable with rates prevailing in other cities on the Ohio River watershed which have had, at least since 1914, safe water supplies. At the same time, the seasonal distribution changed so as to give a definitely summer and fall disease.

Ample evidence accumulated to indicate that routes of transmission of typhoid fever other than the public water supply were in all probability the more usual.

Therefore, the conclusion was reached from the evidence collected that modern water purification plants, such as are in operation in the six cities studied, when properly operated and controlled, effectively eliminate the danger of contracting typhoid fever from the public drinking water, even though the raw water supply be grossly polluted.

Disfigurement of Children's Teeth

FOR 30 years dentists and chemists throughout the world have sought the cause of a disfigurement of children's teeth known as "mottled enamel," but the answer in the one word, "fluorides," came from an industrial chemist, H. V. Churchill, as part of the daily work in an industrial research laboratory.

"Mottled enamel" gives the teeth a dead-white opacity, often stained in disagreeable patches of brown or black. The stains may be accentuated by a corroded appearance of the surface, as if it had been eaten by a harsh acid. The enamel is damaged in its formation on the permanent teeth before they emerge from the gums. Thus only children are victims; the permanent teeth come in, pitifully marred in appearance, although normal in shape. The unfortunate ones so marked are marked for life; no bleaching or abrasion will correct the defect.

Children in widely scattered but well-defined localities are affected and in recent years prominent authorities have blamed some impurity in drinking water as the cause, although unable to determine just which one of the score of water-impurities was harmful. No two localities, it seemed, had drinking water characterized by any mutual abnormality, but nevertheless all evidence pointed to drinking-water as the cause.

Mr. Churchill is no specialist in public health, being Chief Chemist in the research organization of the Aluminum Company of America. In this particular case, Dr. F. C. Frary, Director of Research, had noted mottled enamel among the children of employees at Bauxite, Arkansas, an "aluminum" town where exceptionally pure water was obtained from deep driven wells. At the first intimations that this dental scourge was due to drinking water, the wells were abandoned in favor of water from a distant river. At this time Mr. Churchill attacked his problem of exploratory investigation.

By means of a spectograph, he identified fluorine among the elements present in each sample of harmful water—fluorine, with a "criminal" record among elements as a ravisher of living tissues and a disrupter of normal bone structure.

Although the presence of fluorine had been recognized in certain mineral waters, no one had previously considered the likelihood of fluorides being among the impurities of any ordinary drinking waters. In none of the standard published methods of water analysis is mention made of fluorine content or determination. Fluorides had always been dismissed as non-existent in community water supplies.

Churchill's search for fluorine was based on published records of its harmful effects and on a memory of investigations by Schwyzer. He recalled that about 25 years ago brewers had adopted the use of a calcium fluoride solution to sterilize beer vats because this solution killed wild yeast without harming the cultured varieties. Drinkers of this beer became afflicted with a peculiar bone trouble that was identified as a result of consuming small amounts of the fluoride solution, and the dismayed brewers abruptly ceased its use.

It is held that a daily dose of one milligram of fluorine—about one thirty-thousandth of an ounce—will cause serious systematic disorders.

The revelation that fluorine in drinking water is responsible for the permanent disfigurement of thousands of children imposes a new duty on those who are responsible for the quality of water supplies. Hitherto processes of chlorination and clarification

have been deemed sufficient in water purification but now an additional control is necessary. Chlorination solved the problem of typhoid. The control of fluorine concentration so that it never exceeds one part per million will solve this age-old problem of mottled enamel.

Invisible Riches

RESEARCH is being conducted at the Montana School of Mines to harden gold, silver, and platinum so that almost invisible filigrees of these precious metals —yet strong enough to support great clusters of jewels—may be produced.

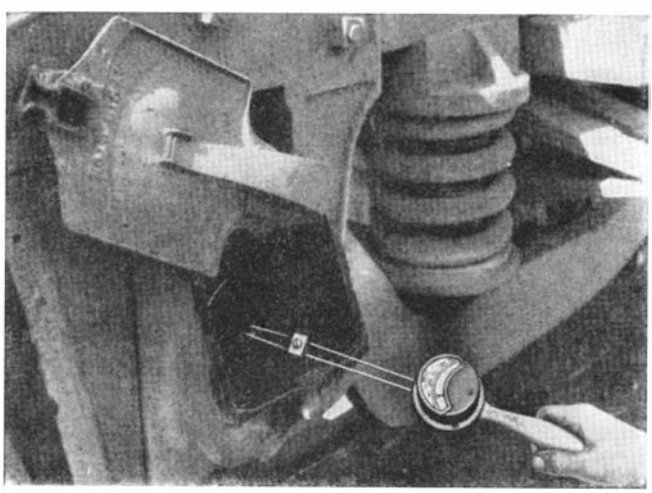
Hot Bearing Indicator

A PORTABLE indicating pyrometer, recently developed and placed on the market by Illinois Testing Laboratories, Inc., Chicago, is now being used in detecting hot bearings on locomotives and rolling stock, as well as for a number of other purposes in railway service.

This instrument, called the Pyro Prod, consists of a highly sensitive yet rugged milli-voltmeter, to which is attached a pair of pointed thermocouple wires. When the points of these wires are pressed against the bearing, the bearing metal completes the circuit and this causes a small flow of electric current to the indicator. This flow of current increases with the increase of temperature and causes the pointer of the milli-voltmeter to deflect over a scale which is graduated in degrees Fahrenheit. Almost instant readings are obtainable, as it is merely necessary to make contacts between the pointed thermocouple wires.

The Pyro Prod can be furnished in several different temperature ranges, but the one most generally used for bearing work is from 0 to 600° Fahrenheit. When desired, the Pyro Prod is furnished with an automatic internal cold-end compensator. This is important where the instrument is to be used out-of-doors and subject to wide changes of atmospheric temperature. Other models of contact-type pyrometers can also be furnished for measuring the surface temperature of other metals such as heated billets, rods, and rails.

When used on locomotives, the Pyro Prod is carried in the cab and at each stop the engineman takes the instrument and goes from one bearing of the locomotive and tender to another, quickly checking the temperatures, and eliminating all guesswork as to whether or not excessive temperatures are being developed, with consequent possibility of train delay. The instrument also has other industrial uses. —*Railway Age.*



Convenient and accurate indicating pyrometer used to show the temperature of a bearing

Pink Lemons Discovered

PINK lemons have been found growing on a tree in California.

However, the tree is a rare specimen and the United States Department of Agriculture warns that there is little chance of the pink lemonade industry switching to the new lemons for raw material.

Pink lemons were first exhibited at the National Orange Show this year. They came from a tree in Burbank and, so far as known, the tree is a bud sport (or freak) of the Variegated Eureka lemon, which was developed from a limb variation of the Eureka lemon, discovered in 1911. The Variegated Eureka lemon trees are not as productive as the normal Eureka lemon trees and they are grown chiefly for ornamental purposes.

The pink fruited lemon tree is identical in appearance to the Variegated Eureka tree, but as the fruit approaches ripeness it develops a decidedly pink color in the rind, flesh, and juice.

Budwood from the pink lemon tree has been inserted in sour orange seedlings and the resulting trees will be studied to see if the pink lemon can be further propagated. Department specialists declare the pink lemon is another illustration of the occurrence of striking bud variations in this variety of citrus fruit.

Chemist's Suggestion Aids Cancer Research

A PRELIMINARY report on the results of experiments during the last two and one half years with a new lead solution for the treatment of certain types of cancer, which may mark an important advance in cancer research, was recently announced in the *American Journal of Cancer* by Dr. William H. Kraemer of the Tumor Clinic of the Jefferson Hospital, Philadelphia. The announcement must not be considered, in any sense, as a "cure" for cancer—it is merely a development which seems to make a previously-known treatment appear to promise to be more practical at some later date. A cure is far from available at present.

In 1925, Professor W. Blair Bell of the

University of Liverpool, England, announced his discovery that the injection of colloidal lead into the blood stream of cancer patients seemed in some cases to give some relief. However, the injection of lead is extremely dangerous.

More recently, an American chemist, Dr. Hamilton Bradshaw of the duPont Company, becoming interested in the chemistry of this treatment, suggested that the toxic effect of lead might be reduced if small amounts of manganese phosphate were incorporated.

Dr. Kraemer's report sets forth that by adding a one-hundredth part of manganese to each part of lead used in the solution, and injecting the solution intravenously in animals, "no ill effects were encountered."

"As a method of treatment," Dr. Kraemer asserts, "the advantage of lead phosphate with manganese over lead phosphate without manganese is obvious. With the latter about four months is required to introduce the full dose of 600 milligrams, while with the former only six days is required. The toxicity of lead phosphate is injurious to the patient's health, while the absence of toxicity of the new preparation permits its use in all post-operative cases preceding radiation.

"The outstanding feature of the new lead-manganese preparation is that it is well tolerated by the patient, enabling us to introduce intravenously 100 milligrams daily until the total of 600 milligrams is reached."—*A. E. B.*

Aphids Move Abdomens to Frighten Enemies

WHEN aphids, or plant lice, line up on the stem of a plant and bury their beaks in the tissues to suck sap they move their abdomens up and down and from side to side in unison, like a battery of animated bellows. Some observers have suggested that the aphids used their abdomens to pump the juices from the plant, but Dr. Floyd F. Smith, entomologist of the United States Department of Agriculture, believes they move in this manner to shake off or frighten away their enemies.

On the approach of danger or the occurrence of a slight mechanical disturbance, such as jarring, the aphid twitches its abdomen without withdrawing its beak, Doctor Smith says. This is a reaction to danger from small parasitic flies or wasps attempting to lay eggs on or within the aphid's body. When the first aphid twitches, it startles the next one. Thus a wave of twitching moves along the line of insects.

Doctor Smith has observed that this twitching is not essential to sucking, for some species of aphids do not twitch, and yet they seem to feed as much and to propagate as rapidly as others. Delicate muscles within the insect's head enable it to extract the plant sap, he says, and apparently the abdomen does not function as a bellows.

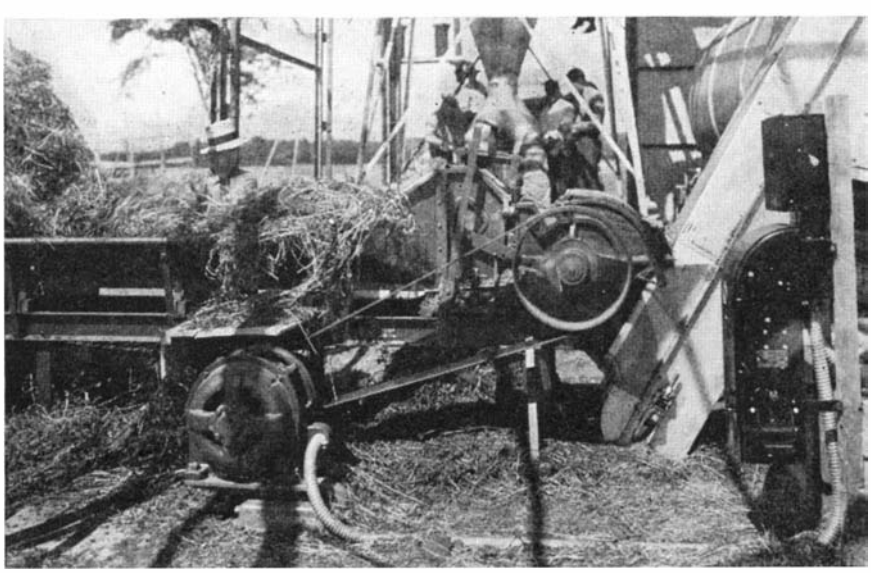
Making Hay Without the Sunshine

ANOTHER of the sun's steady jobs has been taken away, and another agricultural proverb has been proved out of date, at E. A. Ashton's Ashgrove Farms, near Saratoga, New York. Making hay whether the sun shines or not is something that the Ashgrove Farms have been doing profitably since last June with the aid of an artificial dryer and electric motors.

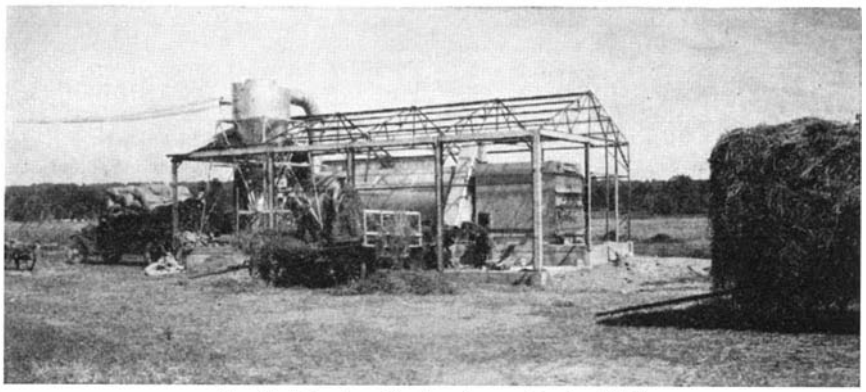
Experiments in the artificial drying of hay have been carried on for some time with electrically-driven machines known as "Ardryers" for curing hay crops regardless of prevailing weather conditions. The "Ardryer" is a product of the Arnold Dryer Company, of Milwaukee. The installation of one of these machines at the Ashgrove Farms is one of the latest and most successful of these applications, and aroused considerable interest among summer visitors in upstate New York.

This has been an exceptionally bad year for forage crops because of the excessive rainfall, but Mr. Ashton has stored in his barns about 600 tons of dried alfalfa and mixed hay of high quality, and it would seem that a fickle sun has been successfully flouted. It has been estimated that about one half of the crop would have been lost, or of poor quality, had sun-curing been relied upon.

The artificially dried hay is highly nutritious because the leaves, which become wet with rain and are easily lost in sun curing, are saved. The crop as a whole is higher in protein and fat values and lower in fiber content. After drying, the hay can be stored



The hay cutter that feeds the Ardrier, which cures hay without sunshine



An Ardrier installation in use in the field

indefinitely without heating, sweating, fermenting, or discoloring. The dried hay retains its natural green color.

The bale of hay also has passed from the picture at the Ashgrove Farms. The hay is first delivered to a cutter, driven by a General Electric 20-horsepower motor, where it is chopped into fine pieces—suitable for later automatic handling but forever out of the province of the baler. The amount of moisture in the crop offers no difficulty. The chopped hay is fed from the cutter to a revolving cylinder, seven feet in diameter and 20 feet long. At one end of this drum is an oil furnace and the hay and hot air are drawn through the cylinder, or dryer, by an exhaust fan located at the outlet end. The dried hay is then delivered to a collector from which it is fed to a blower and blown directly into the mow in the barn. The cylinder of the dryer and the blower are driven by General Electric motors of 25 and 10 horsepower respectively.

Mr. Ashton has estimated that the cost of his summer crop of hay was no greater because of the artificial drying process, the crop itself was of higher quality and feed value, and all the losses usually following a rainy season were eliminated.

Belgium's Nickel Coinage System

WITH the issuance of a 20-franc coin in pure nickel, Belgium now has the most complete nickel coinage system of any country in the world. It has nine different nickel coins, six in pure nickel—in denominations of 50 centimes, 1, 2, 5, 10, and 20 francs—and three of essentially the same copper-nickel alloy as the United States five-cent piece—in denominations of 5, 10, and 25 centimes.

The first 20-franc coin was recently executed by the Hotel des Monnaies, was approved by the Commission Monetaire and placed in circulation through the Banque Nationale.

Approximately 3,000,000,000 pure nickel coins have been issued in 64 denominations by 24 countries.

Smoke Damage in Chicago

SMOKE from burning coal costs the people of Chicago 95 dollars per minute, according to estimates of Joseph Harrington, who served as administrative engineer of the United States Fuel Board in Illinois. In a recent address Mr. Harrington said that burning of smokeless fuel, such as gas, would effect an annual saving of 50,000,000 dollars in that city. His figures exclude cleaning smoke-soiled house furnishings, and do not include injury to health by smoke laden air, he said.—*A. E. B.*

Marine Algae as Fertilizer

THE Governor of Tripolitania has had a chemical investigation made of algae which form large deposits at many parts of the coast of Tripoli, to find out whether they have fertilizer possibilities after having been first used as bedding for cattle. The analysis shows: water, 19.44 percent; nitrogen-bearing materials, 2.4 percent; carbohydrates, 51.86 percent; chlorine as sodium chloride, 14.81 percent; lime, silica, soda, magnesia, alumina, iron, potassium, iodine, phosphate, and sulfate, 11.45 percent. The organic matter contains 3.85 grams of nitrogen per kilogram of algae. It would therefore seem to be possible to utilize the algae as fertilizer.—*A. E. B.*

A "Mike" for the Lapel

ENGINEERS have devised a microphone so small that it can be worn in the lapel of a coat or kept entirely concealed in the breast pocket. Using this miniature transmitter, a speaker can move about the platform as he pleases and continue to project his voice out over the loud speakers of the public address system. With the familiar stationary microphone, he has been obliged to take up a fixed position immediately behind it so that it would pick up his words effectively.

The lapel microphone is connected to its amplifier by a pair of flexible conductors which the speaker trails with him as he moves. All he requires in order to have the freedom of even the largest stage or platform is a sufficient length of wire.

In developing this system for the Western Electric Company, engineers of the Bell Telephone Laboratories took a new type of telephone transmitter which is just coming into use by switchboard operators and placed it in a mounting for mechanical protection. To cut down the rumble of a speaker's chest sounds, they provided a circuit containing an electric filter arranged so as to give a pleasing balance of sounds.

The tiny microphone has already been used on a number of occasions by Sergius P. Grace, well-known lecturer on the scientific marvels of the telephone. Mr. Grace hides the microphone in his breast pocket. The wires connecting it to the amplifier are covered with black silk and he passes them down the inside of his trouser leg. His audience, looking in vain for the microphone which is usually quite conspicuous,

is mystified as to how Mr. Grace's voice comes through the public address system. The mystification increases as he walks about the stage without interfering with the steady amplification of his voice. Ordinarily, at the close of his lecture, Mr. Grace takes the tiny microphone from his pocket and explains.

Automatic Electric Iron

SEVERAL distinctive features have been developed in the construction of a new iron made by the Crosley Radio Corporation and called the Moto-Iron. The ironing

Above: **The Moto-Iron in use, patting out wrinkles.** *Right:* **A close-up of the mechanism of the iron**

pad is vibrated by a small electric motor which pats out the wrinkles in the fabric, in contrast with the crushing effect of other irons. This results in a new, fluffy finish, even on rayons.

Using the Moto-Iron it is possible for the operator to sit in a natural position. Exertion of pressure is not required. The material is always in plain view and manipulation of controls is practically eliminated. As a result, the work is much less tiring. There is said to be no possibility of tearing material or breaking buttons when the Moto-Iron is used.

The new iron is small in size and is very simple and easily operated. It can be placed on any convenient table when ironing, and stored in a closet or cupboard when not in use. It is so light in weight that it can be carried from room to room.

Dairyman Turns Epidemiologist

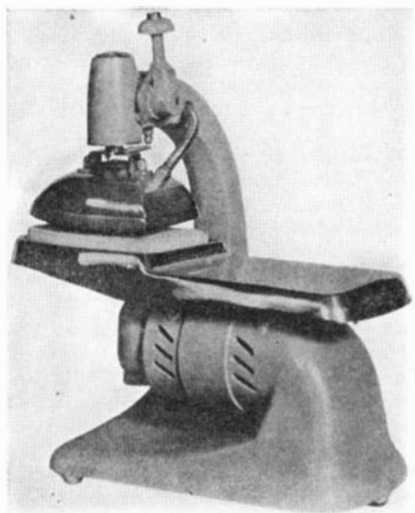
A FAMILY residing at Glenarm, Illinois, made some ice cream for the family and a few invited guests. Cows owned by the family were the source of the milk and cream used. Every member of the party who ate of the ice cream later became ill. None of the few who did not partake of it suffered an attack. Manifestly the ice cream carried the cause of illness.

The herd owner immediately withdrew from the market all of the milk produced by his herd. He took samples of milk from each of the eight cows and carefully labeled each sample. He collected the remainder of a can of pineapple, a part of which had been used for flavoring the ice cream, a sample of the ice cream itself, the freezer, the scoop, and a sample of water from the family supply. All of this material was brought in good condition to the diagnostic laboratories of the Illinois State Department of Public Health for examination.

This voluntary action on the part of the herd owner is highly commendable and indicates a much wider and a much more intelligent appreciation of preventive medicine and the methods of its practical application than is usually believed to be the case.—Abstract from the *Illinois Health Messenger* in *Health News* (Albany, N. Y.).

Overheating Causes Fuel Loss

SCIENTISTS have shown us that overheating the home makes us susceptible to colds and other illnesses, but now the heating engineer has translated overheating into dollars and cents. A recent study of the problem revealed that every degree of heat above 70 in the home represents a



waste of 3 percent in the fuel consumed. In other words, if the indoor temperature is 75 degrees, you are wasting 15 percent of the total fuel being consumed. From 68 to 70 degrees has been established as the most healthful as well as the most economical indoor temperature.—*A. E. B.*

No Depression in the Tungsten Tool Business

ONE industry that showed a gain during 1930 was the manufacture of tungsten carbide tools, which are made in the United States under several different names, according to the United States Bureau of Mines. These tools have shown such great efficiency in various types of work that the demand for them has grown despite the fact that the price for the compound is one dollar per gram—one and one half times the value of gold. Only a comparatively small tip of the precious metal is brazed on a tool.

Another surprising item of the tungsten business is that between 300,000 and 350,000 pounds of tungsten is used annually in alloys which are welded electrically to the edges of oil-well bits, giving them, in some rocks, a life ten or more times as long between dressings as the plain steel bits.

However, as much the greater part of the tungsten ore and concentrates produced in and imported into the United

States is used in the manufacture of high-speed tool steel, the consumption of tungsten, and usually the production, fluctuates with the rise and fall in operations in the steel industry. In the United States one short ton of tungsten concentrates is used for each 13,700 long tons of steel ingots and castings made. Therefore, the decrease of 28 percent in the production of steel in the United States in 1930 was reflected in the tungsten production in 1930.—*A. E. B.*

THE AMATEUR ASTRONOMER

(*Continued from page* 345)

latitudes the southern face of the hut will be raked back at a lower angle—just the thing, for this will provide more room at the bottom to sprawl out long legs and big feet in comfort. A fellow ought to be really comfortable in this kind of observatory.

Next comes Mr. Hindle's third contribution, a brand new test for the Cassegrain (and Gregorian, too). This is being tried out at Mount Wilson and may be used on the 200-inch. We quote verbatim Mr. Hindle's explanation of the discovery, as transmitted to the Royal Astronomical Society and published in the *Monthly Notices* (March, 1931) of that distinguished body, of which he is a member.

"The figuring of the secondary mirrors for compound reflectors has always been considered a difficult problem. The comparatively recent revival of the Cassegrain is undoubtedly due to the 'parallel ray' system of testing adopted by Professor Ritchey, and illustrated and described on page 39 of his work, 'The Modern Reflecting Telescope.' It may be noted that the concave secondary mirror for a Gregorian can equally well be tested by the same method (see Figure 1).

"That test leaves much to be desired. No matter how carefully the mirrors are collimated, the convex does not appear a perfect surface of revolution when examined under the knife-edge, probably because the illuminated pin-hole and the eye cannot simultaneously be on the optical axis. There is a large blind spot in the center of the convex, due to its interposition in the parallel rays returning from the plane mirror. The area visible is that due to point illumination only. The supports for the convex obstruct the view to some extent, in addition to which there are diffraction effects around all obstructions. The plane mirror used must be at least as large as the paraboloid, and requires first a spherical mirror from which it is derived with diminished accuracy. The five reflections are objectionable; to a certain extent they drown that figure of the secondary mirror which we wish to see.

"By the remarkably simple device of substituting a slightly larger *spherical* mirror in place of the *paraboloid*, with a radius of curvature approximately equal to the focal length of the latter (Figure 2), we immediately *dispense with the parallel rays*, and *reduce the number of reflections to three*. The secondary mirror is then seen under the shadow test in no uncertain manner. It can be correctly figured over a larger diameter. The blind spot in the center is much smaller, and the supports for the secondary mirror do not obstruct the view. Diffraction effects are therefore negligible.

"The circles to the left of Figures 1 and 2 show respectively the appearance of the small mirrors from the secondary focus.

"The mirrors are set up at approximately the required distance apart and squarely facing each other by reflection. The exact value of the radius of curvature of the spherical mirror is not of any importance; it is only necessary that its center of curvature and the shorter conjugate focus of the secondary mirror should coincide when testing.

"If the image of the pin-hole is examined with an eyepiece before the secondary mirror is corrected, there is such a considerable difference of focus that two distinct images may be found along the line of aberration, with much dispersion of light. When the secondary is correctly figured to look perfectly flat, all the light is concentrated within the image of the pin-hole, the details of which are plainly visible. The expansion of the image is the same on both sides of focus; in fact, the test is precisely similar to that of a spherical mirror at its center of curvature. It therefore follows that the surface of the secondary mirror *must* be accurate to within a very small fraction of a wavelength.

"It is obviously better to refer secondary mirrors to a spherical mirror, whose accuracy can be tested at any time by visual inspection, rather than to a combination of mirrors derived from the same source, with diminishing accuracy. It is likewise of the utmost importance to be able to produce secondary mirrors without reference to the paraboloidal mirrors with which they have to work.

"The uncorrected secondary mirrors for Cassegrain and Gregorian telescopes show diametrically opposite appearances under the knife-edged test. The former has a protuberant, the latter a depressed intermediate zone, at the average focus. The hyperboloid is therefore more difficult to produce, having a depression in the convex spherical surface, reaching a maximum depth at the intermediate zone, and diminishing to nothing at the edges and center. A corrected convex, if resting inside a concave spherical surface of suitable curvature, would make contact on the edge and center only. Such a figure cannot be produced haphazard, and if the depressed zone is unsymmetrical, an astigmatic image results.

"The Gregorian concave, like the paraboloid, is corrected by excavating the center more deeply, the excavation diminishing to nothing at the edge. It can therefore, more easily than the Cassegrain, be corrected by star tests if workshop tests are unavailable, gradually making the ellipsoid deeper until full correction is attained. This probably explains the predominance of the Gregorian before workshop tests were devised."

Now there ought to be an enhanced interest in the Cassegrain, and a few of the all-but-extinct Gregorian may be attempted too. Mr. Hindle has written for us a compact treatise on these types, and we have made three carbon copies of it to lend out for limited periods to bona fide Cassegrain-Gregorian workers who will swear with one hand on "A. T. M." to return them promptly for the next fellow's use.

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

Coal and Fuel Oil Held Goods of Same Descriptive Properties

THE case of Transcontinental Oil Company, Ohio Oil Company assignee substituted, *versus* Harlan-Wallis Coal Corporation, was recently heard before First Assistant Commissioner Kinnan. The decision follows in part:

"The applicant seeks registration of a mark comprising the words 'Marathon Coal Best in the Long Run,' the mark being used upon coal, in Class 1, raw or partly prepared materials. The opposer claims through its predecessors in business, prior adoption and use of identically the same mark except for the word 'Coal,' used upon 'carbon or water-white burning oils, refined and semi-refined petroleum, kerosene, gasolene, benzin, naptha, and fuel oils,' and sets up ownership of . . ." various certificates of registration.

"The marks being admittedly identical except for the word 'Coal' appearing in the applicant's mark, and the opposer having fairly established use of its mark upon fuel oil continuously since a date prior to the date of the applicant's entrance into the field, there is presented for consideration only the question whether the goods of the respective parties possess the same descriptive properties or belong to the same class within the meaning of section 5 of the Trademark Act.

"The applicant has earnestly pressed the view that the goods of the respective parties do not belong in the same class and that their inclusion in different classes of the official classification should be accepted as conclusive upon this point. While various adjudicated cases relied upon by the Examiner of Interferences and the opposer show the classification of this Office is not controlling, yet the applicant contends those cases are mainly of the character in which the different goods under consideration were in practice used together.

"Recognizing fully the difference in the physical characteristics of the goods of the respective parties, the different method of handling them and in producing them, yet the fact must be recognized that both constitute forms of fuel for heating purposes, both are frequently handled by the same retailers and sold to the same class of customers. . . ."

The First Assistant Commissioner then cited several decisions; among them "the case of Cross *versus* Williams Oil-O-Matic Heating Corporation is also deemed pertinent to the issue raised in the case at bar.

"In that case the court held the notation 'Coal-O-Matic' when used upon machines for automatically feeding coal to furnaces confusingly similar to the notation 'Oil-O-Matic' used upon devices for automatically feeding fuel oil to furnaces. The court made it plain that it considered the goods belong to the same class.

"It is held that the goods of the applicant and those of the opposer possess the same descriptive properties and belong to the same class as these terms are defined in the adjudicated cases made of record in this proceeding. These cases are deemed fully to establish that the Office classification is not controlling upon the question of what goods possess and what do not possess the same descriptive properties.

"The decision of the Examiner of Trademark Interferences sustaining the opposition and adjudging the applicant not entitled to the registration applied for is affirmed."

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.

Tire Trademark Registration Refused

IT was recently held by Assistant Commissioner Moore that The Dayton Rubber Manufacturing Company, of Dayton, Ohio, is not entitled to register, under the Act of 1905, as a trademark for rubber tire casings, a mark described as "an inner band of white, a band of red peripherally outside of the white band and a band of black peripherally outside of the red band."

The ground of the decision is that the alleged mark would not impress the public as other than an ornamental design.

In his decision, the Assistant Commissioner said: "It appears to be well settled that marks which consist merely of the inherent characteristics of the goods, rendering them more distinctive or attractive, are not registrable. It is only when a mark functions in the mind of the public to identify the goods as to their origin or ownership that it constitutes a technical trademark and is registrable."

Then, after referring to and quoting from the decision in The Goodyear Tire and Rubber Company *versus* Firestone Tire and Rubber Company, 240 O.G. 641, 1917 C.D. 49, he said: "I am of the opinion that the applicant's mark would not function as a trademark, but would be regarded by the members of the public as being merely for the purpose of ornamentation."

Hotel Radio a Profit Source

HOTELS which make available to their guests in public and private rooms, by means of a central receiving set, broadcasts of copyrighted musical compositions perform such compositions in public and for profit, within the meaning of the Copyright Act, the United States Circuit Court of Appeals for the Eighth Circuit has just determined.

This ruling was made in the cases of Buck, etc., v. Jewell-LaSalle Realty Co., in which the Supreme Court of the United States, by a decision handed down on April 13, held that the transmission of broadcasts of copyrighted musical compositions by hotels to their guests constituted a "performance" of such compositions within the meaning of the Copyright Act.

The Supreme Court, in answering a question which had been certified to it by the Circuit Court of Appeals in these cases, did not pass upon the question of whether such hotels "perform for profit," the cases as presented to the Supreme Court not calling for a determination of this issue.

Guided by the ruling of the Supreme Court, the Eighth Circuit Court of Appeals has now determined, however, that such performances are public performances and for profit. The lower court, therefore, held that the defendant company, owner and operator of the LaSalle Hotel in Kansas City, Mo., could be liable for infringing the copyright of a musical composition broadcast from a radio broadcasting station and transmitted to the hotel's guests by means of a central receiving set and loud speakers.

"It having been thus determined," the opinion of Judge Booth states, referring to the decision of the Supreme Court answering the certified question, "that the specified acts of the hotel proprietor constituted a performance, we are of the opinion that the record discloses that the performance was a public one and was for profit. The words 'public performance for profit' have received a liberal interpretation."

The court refers to an English case, Messager v. British Broadcasting Co., Ltd., 137 L. T. R. 810 (1927) 2 K. B. 543, in support of its holding that the broadcasting of a musical composition constitutes a public performance.

The decree of the trial court dismissing the bill for copyright infringement as to the Jewell-LaSalle Realty Company was reversed by the Circuit Court of Appeals and the case remanded for further proceedings consistent with its opinion and that of the Supreme Court.

"Grand Rapids" Furniture Ruling

THE Federal Trade Commission has ordered Joseph Greenspan, trading as Grand Rapids Upholstering Company, New York, to cease representing his firm as a manufacturer and to abandon the use of the word "Grand Rapids" as a trade name or in advertising, unless and until the furniture described by this name is actually made at Grand Rapids, Michigan.

Use of the terms "factory" or "manufacturers" to describe any building used as the company's place of business, is prohibited, unless and until the concern actually owns and operates a factory wherein furniture sold by the respondent is made.

The phrases "Manufacturers selling direct to the public—Save the retailers' prof-

it," or similar expressions, are also barred, unless and until the company owns or controls a plant in which its product is made.

The Commission found that the company does not manufacture furniture at Grand Rapids or anywhere else, except so far as it upholsters a part of its stock, namely, living room chairs, in New York.

The respondent is not an agent or representative of manufacturers situated in Grand Rapids, and little or none of the furniture sold by the company is manufactured in Grand Rapids, according to findings of the Commission.

Golf Green Patent Held Valid and Infringed

AN infringement suit for the alleged infringement of the Fairbairn patent, No. 1559520, has been decided by District Judge Simmons in favor of the plaintiffs, Fairbairn and McCart. The patent covers improvements in methods of constructing golf putting-greens and similar surfaces. The court's decision, in part, follows:

"The invention described in the patent in the suit relates to new and useful improvements in method of constructing the surfaces of playing fields, and particularly adapted for the surfaces of putting greens for golf courses. One of the objects of the invention is to provide a surface for putting greens adapted for use on arid land, which surface will be as near as possible in appearance and effect as the densely-growing, closely-cropped grass which makes the ideal putting green surface.

"Another object of the invention is to use material in which a certain amount of surface friction may be had, rendering the surface action of the golf ball identical with the surface action of a grass green; and still another object of the invention is to use a material which is resistant to moisture. Other objects of the invention are to bring about economy of cost, both in construction and maintenance, and to use a material which will withstand heavy play without disturbing or affecting the putting surface and which may be dyed to simulate a grass putting green.

"These objects are claimed to be accomplished by covering a prepared and properly shaped surface with a suitable flocculent mass, and this flocculent mass is compressed by rolling or other compression. The patentee has found that a most desirable surface can be had by use of ground cottonseed hulls, in which the hull portions still retain a certain amount of cotton fiber adhering thereto. . . .

"The only prior art patents which are entitled to any consideration at all are the Smith patent, No. 815649, which discloses a putting mat made of asbestos felt or sponge rubber; the Stedman patent, No. 957387, for an artificial playing-bed, having a rubber surface; and the Flynn patent, No. 1513978, for a putting green surface made of cattle hair, comprising bristly fibers. No one of these three references can be seriously regarded as an anticipation.

"Nor in the absence of analysis and comparison should much weight be given to them, in the face of the presumptive validity of the patent that arises from its grant, the wide commercial success of the patent in practice, and the undoubted tribute paid it by the present and prior infringers. The patent in suit is held valid in all its claims, and infringed by the present defendants."

Door Closer Trademark Registration Canceled

ASSISTANT COMMISSIONER MOORE recently held that The Everedy Company, of Frederick, Maryland, was not entitled to register, under the Act of 1920, the term "Silent," as a trademark for door closers, and that the registration which it had obtained should be canceled, in view of the long prior use by The Yale and Towne Manufacturing Company, of Stamford, Connecticut, of that term in connection with the door closers put out by it.

In his decision the Assistant Commissioner noted the holding of the examiner of interferences that petitioner had shown no injury since it, in common with all other traders, possessed the right to use and continue to use the notation in question in trade, and said: "The holding of the examiner does not appear to be supported by the weight of the authorities" (citing and quoting from decisions).

Then, after quoting Sec. 4 of the Trademark Act of 1920, he said: "Under this section the petitioner may not associate the word 'Silent' with its door closers without being liable to an action for damages.

"In view of the above, it is evident that the continuation of the said registration would be likely to cause confusion in the mind of the public as to the origin or ownership of the door closers described by the term 'Silent' or by like descriptive terms.

"As the registrant was not, at the time that it filed its application for registration, nor when the petition for cancellation was filed, entitled to the exclusive use of the descriptive term 'Silent' in connection with door closers, I am of the opinion that said registration is without authority of law and should be canceled."

Abdominal Belt Vendors Forego False Advertising

A COMPANY selling an abdominal belt by use of which, it was advertised, "the waistline of a prospective purchaser can be reduced by any definite amount," signed a stipulation with the Federal Trade Commission admitting that some 20 representations made in advertising are "incorrect in certain respects and greatly exaggerated and misleading in others."

The belt vendor company agrees to discontinue such representations as follow: That the wearing of the belt produces a kneading or massaging action and causes fat to be dissolved; that excess fat will continually disappear while the belt is being worn; that the reduction of fat is guaranteed to a wearer of the belt; and that the respondents have had experience in the manufacture or sale of such belts for a greater length of time than they have actually engaged in such manufacture or sale.

Can-Opener Trademark

UNDER the Act of 1905, it has been held that the Vaughan Novelty Mfg. Co., of Chicago, Illinois, was entitled to register a trademark for can openers which included the words "Safety Roll" without disclaiming the words.

In the decision, it was stated:

"There is no showing that these words have been used heretofore in connection with can openers and beyond the mere fact that the device has a feed wheel as part of its mechanism, the words are not descriptive in any sense. The word 'Safety' is not used alone but only in connection with the word 'Roll.' It is believed these terms, so far as the record shows, are fanciful when applied to goods of this character."

Power Companies in Japan

STRICTER control and supervision by the Japanese Government over the nation's electric power industry as well as easier financial accommodation for electric enterprises are provided in a recently revised law, according to a report from Consul Leo D. Sturgeon made public by the Department of Commerce.

According to the revised provisions of the law the competent authorities may, in the public interest, create, change or use in common electric power equipment, divert the supply of electricity, and expand or contract the rate of construction work in accordance with the exigencies of a national network of power lines.

Enterprises cannot dissolve, suspend, discontinue, or transfer the whole or part of their works or amalgamate with other works without the permission of the competent minister. Enterprises shall obtain the permission for newly establishing or changing the terms of supply. The minister also has the right to withdraw the whole or part of authority granted to electric enterprises and may even change the directors of a company in such special cases as indicated in the law.

An electric committee is to be established as a consultative organ to the minister for the proper application of the law.

Trademark Confusion Must Be Avoided

IT was recently held by First Assistant Commissioner Kinnan that Francis L. Dieterich, of Newark, New Jersey, is not entitled to register, under the Act of 1920, the notation "Corkseal," as a trademark for gaskets, in view of the prior registration by another, under the same Act, of the term "Korkpak," as a trademark for the same goods.

In his decision, after pointing out that the marks were clearly so similar that, if otherwise registrable under the Act of 1905, the latter could not be registered, and noting applicant's argument that the Act of 1920, in terms, forbids only the registration of a mark which is identical with a known trademark of another and referring to a decision of the Solicitor of the Department of the Interior, construing the 1920 Act, the First Assistant Commissioner said:

"The whole purpose of all the trademark registration acts would appear to be to grant registration of marks which are not confusingly similar and deny registration to a newcomer where confusion is apparent, since it would appear obvious Congress did not intend by its registration enactments to add to confusion in trade."

Books SELECTED BY THE EDITORS

RADIO FREQUENCY ELECTRICAL MEASUREMENTS

By Hugh A. Brown, M. S., E. E., Asst. Prof. Elect. Engr., U. of Ill.

THIS book will be of value in furthering the knowledge of radio-frequency phenomena of those who are equipped with a knowledge of alternating current electricity equivalent to that usually acquired in the fourth year of college preparation for a degree in electrical engineering. The author states in his preface that "knowledge of the elementary principles of radio communication is also assumed. The book is intended to serve as a ready manual for the use of the radio engineer, and the experienced amateur."

Sources for further reference are given throughout the book wherever necessary for a fuller understanding of any particular branch. An appendix deals with certain recent laboratory arrangements and facilities needed in making specific radio-frequency measurements. One part in particular of this section which held our interest is that devoted to the preparation and use of the Piezo-electric quartz crystal.—$4.20 postpaid.—*A. P. P.*

PROJECTING SOUND PICTURES

By Aaron Nadell, Publix Theaters Corp.

A PRACTICAL textbook for projectionists and managers, intended primarily for theater men concerned with the reproduction of sound. It aims to convey a practical and useful outline of the principles underlying the mechanisms and circuits used for that purpose; and upon this basis to build up a clear understanding of the apparatus, and the methods of operating it most successfully.—$2.65 postpaid.

SCIENCE IN ACTION

By Edward R. Weidlein and William A. Hamor, Mellon Inst. Ind. Research

THIS 287-page volume contains a sketch of the value of scientific research in American industries. The authors have marshalled a vast amount of material, all showing the connection between research and production—laboratory work and dollars. The reader will gain a knowledge of research institutions and what goes on in them which would otherwise require a year of travel and investigation. If you happen to know any multimillionaires who do not yet grasp the connection between research and financial returns, this is the book to slip into their hands. The major stress is on applied rather than pure science.—$3.20 postpaid.—*A. G. I.*

THE SCIENCES DEPENDENT

By J. Arthur M. Richey

IN this book a writer, who is a philosopher but who appears to know his science both broadly and well, criticises science mainly because of its mechanistic and materialistic trends. Though not out of sympathy with science he takes many a sly jab at its aims and methods. What he wants is plenty of God added to our present science and then it will be all right. These critical chapters are bright and sparkling, never for a moment dull. They would be provocative only to a reader who lacked a sense of humor and a sense of detachment. You may not agree with the theme of this book but you will find it good reading.—$2.15 postpaid—*A. G. I.*

THE UNIVERSE

By Frank Allen, Ph. D.

THIS is the transcript of a popular lecture delivered at the University of Manitobe, but somewhat enlarged. In scope it covers much of relativity, space, time, matter, energy, and so on and, though limited in length (142 pages), it would seem a good investment. Length is a poor criterion for a book, anyway; too many long ones might be shorter. This is one book the reviewer expects to save—which means it is regarded as rather more worth while than a lot of books one sees.—$2.15 postpaid.—*A. G. I.*

ELEMENTS OF GENERAL CHEMISTRY

By J. A. Babor, Asst. Prof., W. L. Estabrooke, Asst. Prof., and A. Lehrman, Instructor, N. Y. University

FOR those who have had no previous instruction in chemistry, there is sufficient fundamental information in the text to prepare for further study and the treatment of the subject is broad enough to meet the needs of the large number who do not go on in this science. The periodic table is presented early in the text and the applications and conclusions are drawn around it in a way most comprehensible for the student. All fundamentals are covered in the first part and in the second half the principles are applied—the repetition here fulfills pedagogical purposes to advantage—581 pages plentifully illustrated.—$3.95 postpaid.

A LABORATORY MANUAL for the above by the same authors is of similar size—with text on right-hand pages only, thereby furnishing note space opposite corresponding text.—$2.15 postpaid.

A HISTORY OF AIRCRAFT

By F. Alexander Magown & Eric Hodgins

MANY books on aviation have been issued, but none to our mind as complete and well turned out as is this one. The research and "digging" that evidently has been expended here is tremendous. One reasonably familiar with what has been published must admit that a lot of new material has been uncovered and it all has been woven into as chronological an order as clarity will permit. Twenty-five pages of chronology carry up to July 1, 1931; Post and Gatty. Four hundred and sixty-seven pages and extended index.—$5.20 postpaid.

BERNT BALCHEN

By John Lawrence

FOKKER stated in his book that Balchen is one of the greatest pilots. Certainly one can more readily believe his marvelous accomplishments were based on the most rugged experiences after reading this story of a real Viking. Modest to a painful degree, it is a real bit of diplomacy to be able to extract and find out what details this book contains. You will enjoy every word of it and if you agree with this reviewer, you will be glad Bernt Balchen at last has received his just due.—$1.90 postpaid.

AROUND THE WORLD IN EIGHT DAYS

By Post and Gatty

FEW human accomplishments, outside of Lindbergh's, and that was of such short duration, have so fired the imagination and held the attention of the world as did that of the two unheralded adventurers from the Southwest. Here is their own story. Contrary to general un-

derstanding they were both amply experienced in their lines and this story tells of all that they had experienced before their record flight to qualify them for it. As interesting as it is well told—one you must not miss.—$2.65 postpaid.

ADVERTISING AND ITS MECHANICAL PRODUCTION

By C. R. Greer

WHILE the author designates his work as being particularly applicable to advertising, it is as well a complete and ably presented description of general reproduction—type, composition, electrotypes, printing, et cetera throughout the entire course of producing a brochure. It is most comprehensive, well illustrated, and contains everything concerning advertising and printing necessary to an advertising manager, printer, or student. Four hundred and sixty-one pages well illustrated. A reference we highly recommend.—$5.25 postpaid.

ORGANIZED COMMODITY MARKETS

S. S. Huebner, Editor, Prof. Insurance & Commerce, Univ. of Penna.

ONE of the "Annals" of the American Academy of Political and Social Science consisting of 28 monographs each written by an author specially qualified in his subject. The various exchanges are analyzed as to method of operation and field of coverage; this extending also to foreign markets. There has been nothing issued as comprehensive as this book during the last twenty years—which is evidence enough of the need and importance of this issue.—$2.15 postpaid.

AN EARLY AMERICAN HOME

By C. H. Miller

A DELIGHTFULLY whimsical account of the fun and enjoyment a builder of nineteen houses had in designing and erecting the *one* house he finally selected for his own. Much keen investigation and observation is back of this most readable account and the description and drawings are most explicit; in fact anyone could readily carry out a similar project with no difficulty at all. You will get a laugh from every page. A marvelous combination of sense and nonsense.—$3.70 postpaid.

THE USE OF HANDBOOK TABLES AND FORMULAS

By J. M. Amiss and Franklin D. Jones

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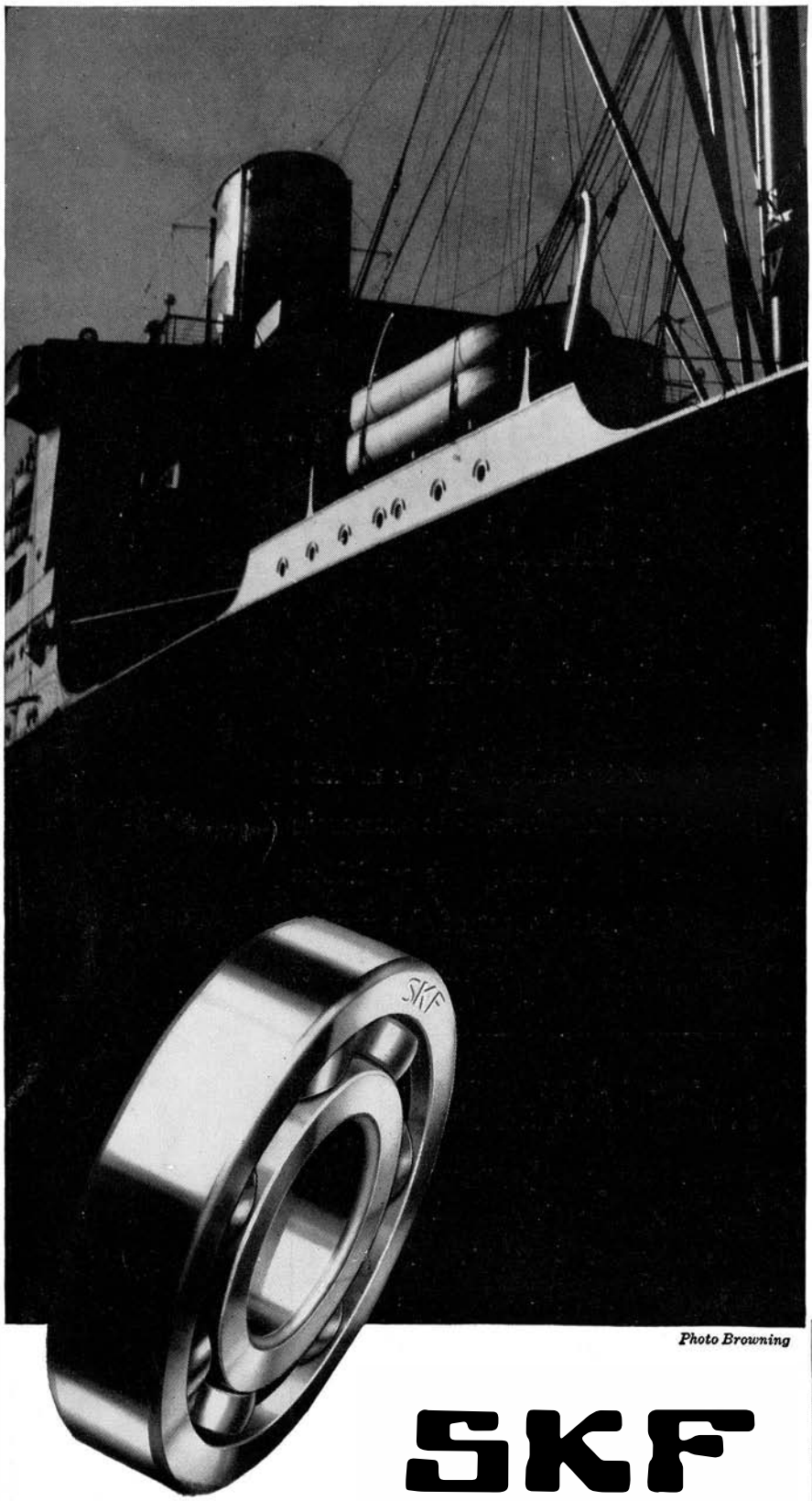

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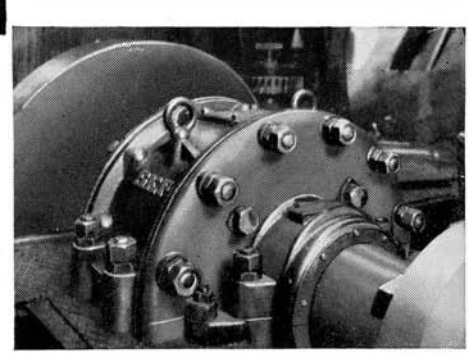

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