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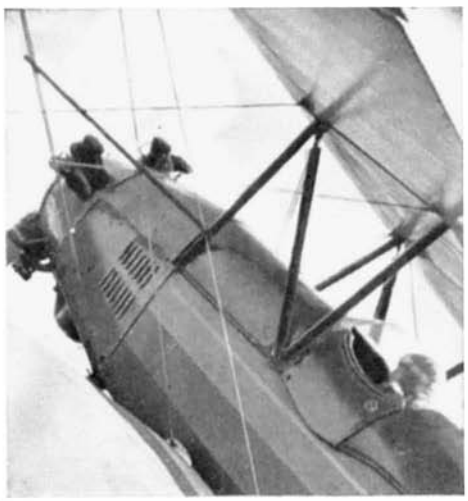

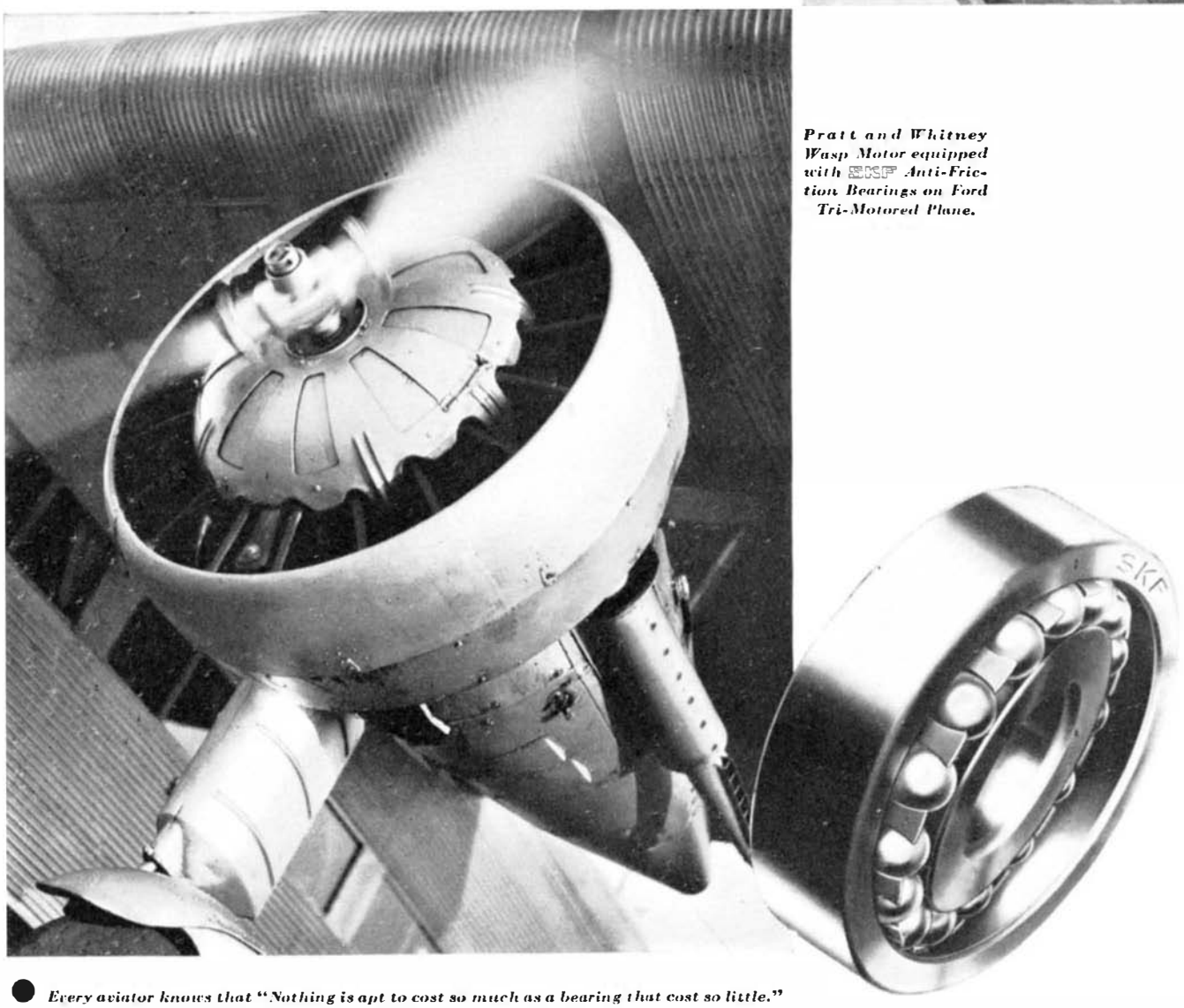

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EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

CONTENTS · AUGUST · 1931

ACROSS THE EDITOR'S DESK

FOR several weeks prior to the general newspaper announcement of a new endurance record set by a Bellanca plane equipped with a Packard Diesel engine, we had been in touch with the engine manufacturers. Although we knew of the preparations being made for the flight, it was necessary to forego publication of anything on the subject until a new record had actually been established. Needless to say, we watched with great interest the first two flights which failed to reach the objective, and were enthusiastic over the results of the third and successful attempt. A wire of congratulations elicited from Mr. Macauley of the Packard company a letter which set forth so many illuminating data on the flights that we publish it in its entirety in the SCIENTIFIC AMERICAN Digest in this issue.

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A scientific pastime that holds in store for those who heed its call a glimpse of a new world unknown to the average person, in part of which immortality appears to hold sway, involves the use of only a microscope and a few drops of water from a stagnant pond. When beginning the study of biology, the writer placed a few wisps of hay in a bowl of water and let nature take its course for a few days. Then a drop of the water was placed on a microscope slide and the 'scope focused on it. An animated figure eight was in the field of vision, and as we watched, it suddenly split into two parts, each of which went its own way. We had been a witness to the reproduction of a *Paramoecium*, an inhabitant of the microscopic world, which reproduces by division. There were other things to be seen as well, and we spent many fascinating hours over the 'scope before other work claimed our attention. The other day we were taken back, in memory, to those earlier days, when we read and accepted an article entitled "Into a Hidden World," in which the author deals in a light yet authoritative manner with "pond life." After you read this article in a coming number, you will probably start to think seriously of getting yourself a microscope and a few drops of water.

●

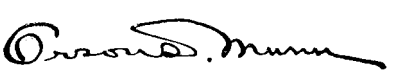
Some of our most illustrious men were products of the little red school-house. Likewise, some of our most famed airplane pilots are products of the not yet abolished, haphazard method of instruction by a pilot who, himself, has had but scant training. But since safety in the air depends to a great extent on the ability of the man at the stick, it is not good logic to believe that poor training will suffice. But what is a good school? And what is a good curriculum of flight training? The Department of Commerce has answered these questions by regulations governing the operation of air schools, and Mr. G. W. Orr, President of Roosevelt Aviation School, discusses in our September issue flight training under these rules.

●

Science, especially that basic science, physics, has now come to an impasse; it seems to be stumped, at least temporarily. It can't get farther along on the road toward discovery of the true, ultimate nature of the final basic concepts of the science —such as time and space and energy and matter— because of something new, the principle of "indeterminacy" and the work of the English scientist Dirac. It begins to look as though there never will be a way to penetrate to the real bottom of things and thus we are left in the position of the old lady who lost her glasses and could see to find them only if she had them! Has science then reached a stalemate, temporary or permanent? Who knows? This and cognate thoughts are discussed by the philosophical physicist, Dr. Paul R. Heyl, of the Bureau of Standards, in our September issue.

●

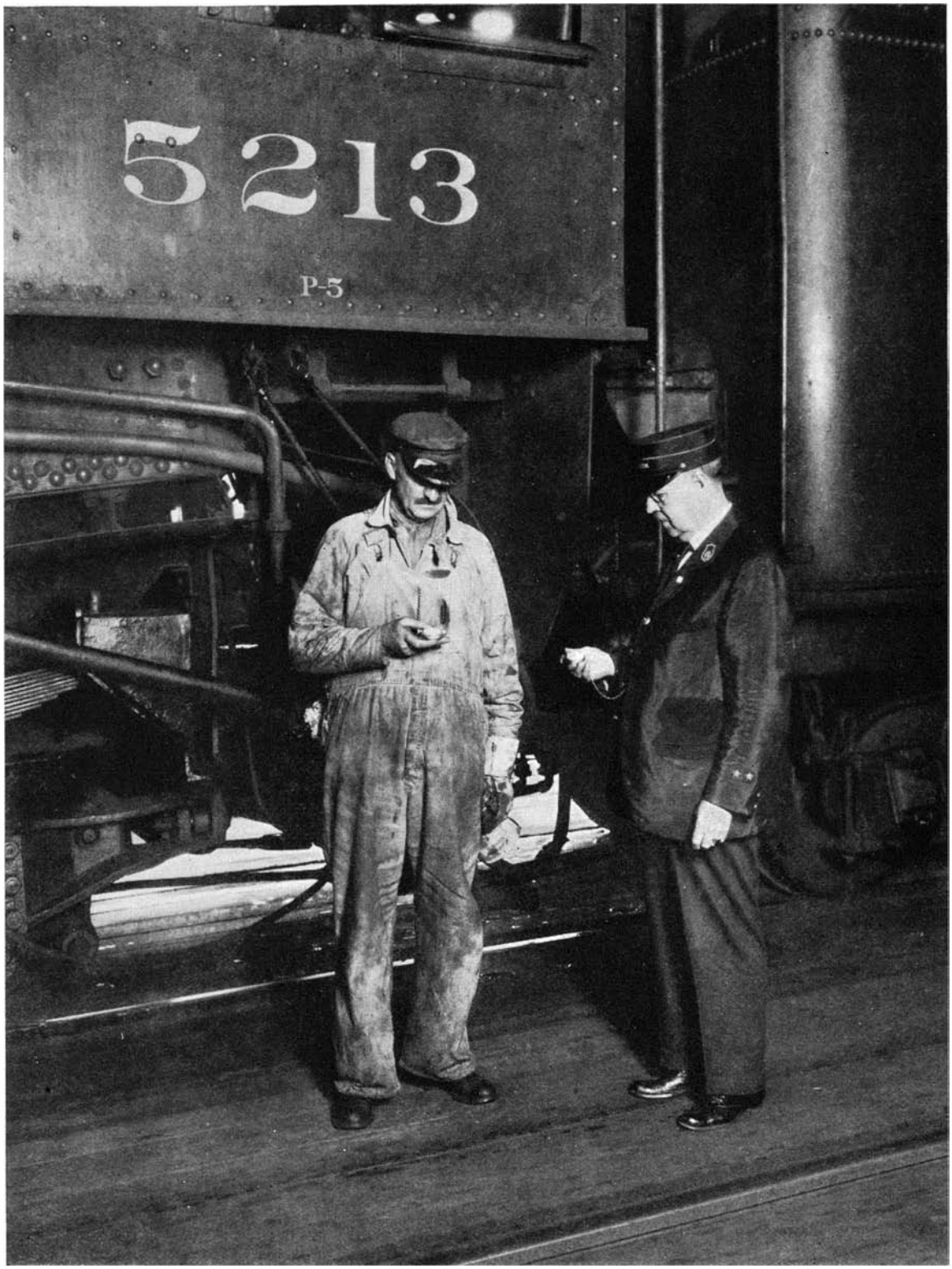
Among other articles soon to appear is one of vital importance to the sportsman and to everyone who is interested in the preservation of our natural scenery and our native birds and animals. Entitled "Wild Life in a Fire," it draws a sad yet true picture of the ravages wrought by unchecked fires as they sear their way through forests, killing everything in their paths and leaving wide swaths of ruined woodland dotted with the bodies of the wild things that have fallen victim to the flames. Forest fires, in the majority of cases, are not unavoidable. They can and must be checked, and it is only by the cooperation of all who enter the woods that we can hope to see the end of this wasteful destruction of one of the most valuable of our natural heritages.



DR. WILLIS R. WHITNEY

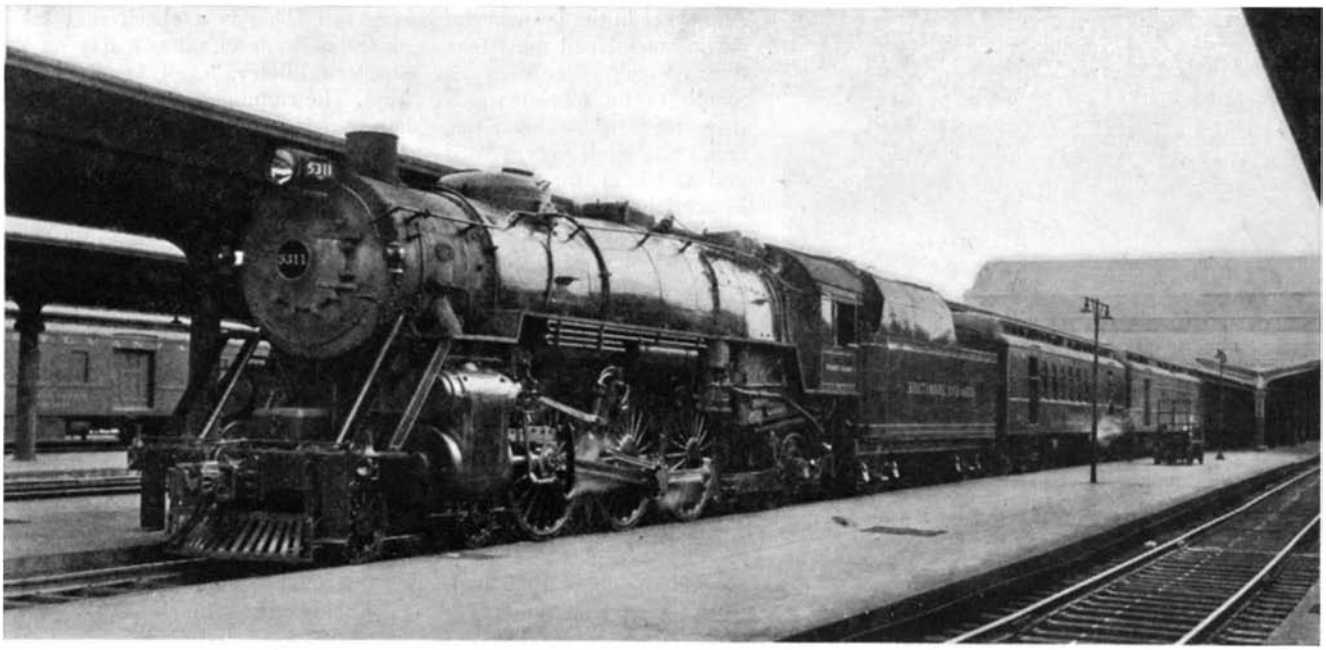
MEN of science are often criticized for taking so little time off—or none at all—to be really human. Dr. Whitney, Vice President and Director of the Research Laboratory of General Electric Company, is a notable exception, as the photograph bears witness. The latch string hangs outside the door of his office at Schenectady, and he is always available to even the least important of his subordinates. As an administrator, he stands high in the estimation of his company; and as a scientist, he has won a string of degrees, holds a permanent place on consulting boards, advisory committees, and boards of directors of several scientific institutions, and has been awarded a number of medals for noteworthy research, the latest of which is the Franklin Medal which was presented by the Franklin Institute.

With him in the photograph is a little dog which was restored to health by radio-created artificial fever and other experiments. When brought to the laboratory, this dog was suffering from an "incurable" mange. In a recent address, Dr. Whitney told how this "radio fever" is being studied by several competent groups of American doctors and research men for its possible value to the medical profession, and suggested that perhaps the time will come when it may be used to supply internal heat to human beings so that the artificial heating of houses will be unnecessary.



CORRECT TIME IS ESSENTIAL TO SAFE RAILROADING

IN no industry or enterprise is time so important a factor as in railroading. There must be as perfect a meeting of time in watches as of minds. The dispatcher, the conductor, and the engineer must have unvarying time; watches must be of known make and they must constantly be tested and adjusted. A comparison is made at the beginning of every long run. Astronomical time filters down through the dispatcher's office to the watches of the crew. To insure efficient railroading all the men's watches must run as uniformly as can be made possible by fine craftsmanship and by inspection.



The "Columbian" drawn by the "President Fillmore" has just received the signal to leave the Washington terminal

TIME AND THE RAILROAD DISPATCHER

By FRANCIS X. MILHOLLAND

Assistant to the Senior Vice-President, Baltimore and Ohio Railroad

TIME, on the railroad, is a benevolent master. The hands of the clock daily control the movements of thousands of trains. Time tables are consulted by millions of people scattered in cities, towns, and hamlets everywhere. The commodities of the nation are moved and delivered on a time basis. From the last stroke of twelve of one year to the last stroke of twelve the next, time is master—and "waits for no man."

It is, perhaps, not too much to say that the whole complex structure of railroad organization would collapse without the aid of the vital coordinating force symbolized in the clock. Suppose that by some meteorological freak, all our watches and clocks should become oddly magnetized and run in crazy fashion. This phenomenon would probably not seriously disrupt the normal processes of most of the industries, but the operation of the railroads would turn into great confusion. Trains would run, for they are guided and guarded these days by elaborate and ingenious signal devices, but they would come into terminals behind schedule, miss connections, disappoint passengers, inconvenience shippers, and generally create havoc in the well-ordered transportation processes of the country.

With so much at stake, it is small wonder that the railroads have developed precision and uniformity in their timepieces to such a degree that people have come to regard the railroad as synonymous with time accuracy. The factory worker looks at his watch, the housewife checks her clock, as the fast limiteds fly past city, town and countryside. The city motorist, driving to work in the morning past the railroad station, glances at the clock tower to check his watch even though he does not catch a train. The railroad agent and ticket clerk receive scores of telephone calls inquiring about the time.

Conductor comparing time with dispatcher's clock before starting

LET us examine the machinery by which this split-second accuracy and rigid uniformity are brought about. On the Baltimore and Ohio Railroad, a special department handles the job—the "Time Service Department." Accuracy is achieved by this department through a system of standard clocks located in the office of every train dispatcher, and in every terminal where train and engine crews are required to register and begin their work. It is the task of certain designated employees of the company to keep the standard clocks accurate. At noon daily, they receive the correct time by wire from the Federal Government. Should the standard clock be as much as ten seconds fast or slow, it is corrected. Card reports are maintained daily showing the variations in seconds and the corrections made, which are forwarded at the end of each month to the General Offices in Baltimore, where a record is kept of each standard timepiece on the entire system.

Uniformity of time over the system is brought about by rules that require men in many branches of the railroad to compare their watches with one of the standard clocks at certain

Official inspectors at various points periodically examine all railroad watches for accuracy

specified times. These men include supervising officers, such as road foremen of engines and trainmasters; members of train crews, such as engineers, firemen, conductors, and flagmen; employees in the Maintenance Department, such as signalmen, supervisors of track, and track foremen. All these men have something to do with the running of trains and each man must have what is known as a standard railroad watch, the product of any one of a designated group of watch manufacturers, well-known for making timepieces of enduring accuracy. To insure the safe operation of trains, each railroad man's watch must tick in unison with every other watch, or as nearly in unison as the fine craftsmanship of the most skilful watchmakers of our day can make possible.

As a further guarantee of uniformity, employees in the branches of service mentioned must take their watches once each month to an official watch inspector for comparison, and twice each year (April and October) for thorough inspection. For this purpose, the Baltimore and Ohio Railroad has 136 official watch inspectors, all of whom are practical jewelers and watchmakers. Their work has been examined and certified by the Horological Institute of America, a body sponsored by the Bureau of Standards of the United States Government. These inspectors are located accessibly in the cities and towns along the line of road and, with their co-operation, inspection service is kept at maximum efficiency.

While the main tracks of the trunk-line railroads of the country are well protected by modern signaling devices, there are still many miles of single track where trains are permitted to run from block to block with time accuracy —and that means watch accuracy—as their principal safeguard. In emergencies, or on the occasion of violent storms, the signal systems of even the most highly developed main lines may be thrown out of order, and here, again, the unfailing watches in the hands of engineer, conductor, and flagman, are the basis of safe operation.

Most of us, at one time or another, have seen the engineer and conductor of a passenger train standing beside the steaming locomotive at a terminal comparing their watches at the start of a long run. This is a check that takes place hundreds of times a day on the quarter million miles of American railways. The running of trains nowadays, however, is more than the mere job of getting them from one terminal to another on time. Regularity and smoothness of operation all the way are also considered important factors in good railroading. This is why we may often see conductors and flagmen looking at their watches as they pass familiar landmarks, such as towers and stations, along the line, even when passing them at high speed, in order to check the regularity of the run and smoothness of the speed maintained.

All illustrations courtesy Baltimore and Ohio Railroad

The dispatcher's office, Baltimore. The telephone plays an important part in this work. On the "train sheet" is recorded the time trains pass telegraph offices

NOW we come to another part of the story. Who guides the engineer along the many steel lanes of the railroad, through the dense centers of traffic in the big cities, in and out of busy railroad terminals—always on time? Unlike the motorist, who not only operates his machine but also has a choice of the roads he wishes to follow, the engineer controls only the speed of his locomotive, not the route. It is not his job to "steer." He must follow orders, which are conveyed to him by the highly efficient devices of the modern railroad signaling system. Silently, day and night along his route, lights flash, semaphore arms move, switches turn, controlled by an invisible hand guiding the trains to their destinations. Trace that guiding force to its origin and you will find the railroad train dispatcher sitting at a table in his office, probably poring over his "train sheet."

A superficial glance at the things required of a train dispatcher will convince you that his job is not a simple one. Upon his shoulders rests the responsibility for moving many trains daily in a precise and orderly manner with safety and promptness. In unforseen emergencies, he must decide quickly what to do to forestall costly blockades and to avoid confusion. It is essential that he possess qualities of steadiness, sobriety, and reliability together with initiative and a capacity for passing rapid, sure judgment on any given situation.

Assigned to each dispatcher's office is a certain portion of the railroad, and all trains entering or leaving that section are subject to his orders. Also subordinate to him are the operators in the towers and telegraph offices located in the territory under his care.

Supplementing the telegraph in dispatching, the telephone has come to be commonly used, so much so that it has long since ceased to be a novelty. With the receiver at his ear, instead of his hand upon the key, the dispatcher keeps in constant touch with operators and towermen.

Anywhere on the circuit, an operator

may attract the attention of the dispatcher on the telephone, by saying, for example: "Dispatcher—B-ville." When the dispatcher desires to talk with an operator at a certain location, he "selects" that station by turning the proper key in a cabinet directly in front of him. A bell rings on the operator's end and he quickly answers. Frequently, the dispatcher is in touch with several stations at one time, which is made necessary when orders are issued to trains at different locations.

In his important and responsible work, the dispatcher functions hand in hand with time. The standard clock in his office is his most valuable ally. He uses it constantly in directing and following the movement of trains. He uses the minutes and seconds in planning the routes of trains. And time is also vital to him in making the quick decisions that are always necessary.

Now, specifically, just what does the train dispatcher do? For one thing, he compiles daily an elaborate train sheet, which is the dispatcher's record of the movement of trains in his territory. Operators in the telegraph offices and towers out on the line keep him informed as to the time of trains passing those points and he carefully notes this information on the train sheet. In the case of freight trains, he must ascertain and record the total number of loaded and empty cars in each train and the total "tonnage." These facts, studied in their relation to each other, enable him to tell which trains to side-track and which to let through—in short, to chart the course of trains through his section.

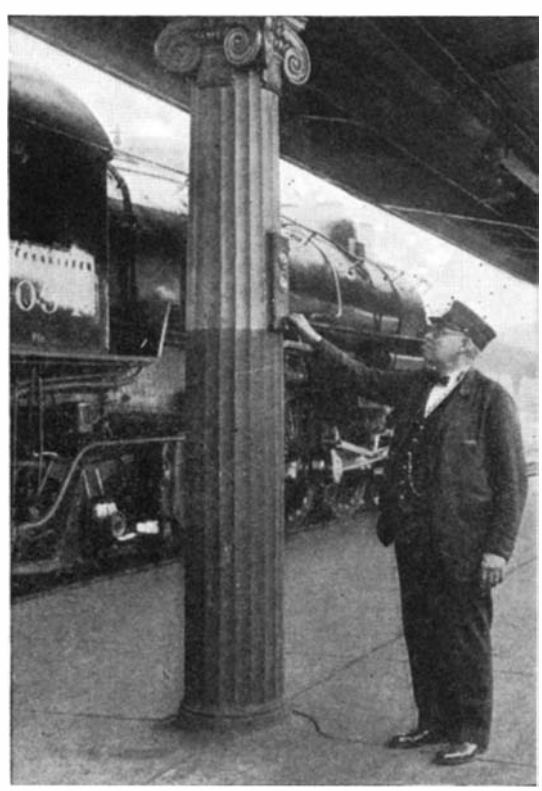
AS AN example, let us take the *Columbian*, Washington-New York passenger limited of the Baltimore and Ohio, which leaves Washington at 4 P.M. daily. First, we look in at the train directors at work in Tower K, the largest interlocking plant in the Washington terminal yards. A standard clock, conspicuously placed, is the first object that catches the eye. Then we notice above the heads of the train directors numerous miniature semaphores. These automatically indicate the proximity of trains approaching the plant. The four circular dials we see at the right are train describers which operate in conjunction with other plants. Just above the clock is a triple row of numbered circles, part of the train starting system at the terminal.

It is this starting system which particularly engages the attention in connection with the departure of the *Columbian*. The conductor, the train director, and the terminal gateman each has a part in this operation. Along the length of the passenger platform beside which the *Columbian* stands ready to leave, are five posts, each equipped with a metal box containing two lights and a key switch. (Other platforms in the terminal are, of course, similarly equipped.) A two-light set is also placed at the platform gate in plain view of the gateman. The numbered circles in Tower K, the platform lights, and the gate lights have separate functions, all contributing to one end—the starting of the train.

The operators in the dispatcher's office at Tower K, Washington terminal, give orders to the levermen who operate the switches and signals, all interlocked

This is how they work: At one minute to four o'clock, the conductor of the train turns the key switch in any one of the platform boxes. This causes one light of a vertical row of the numbered circles in K Tower to burn—the particular row corresponds to the number of the track on which the *Columbian* is standing. Noting this signal from the conductor, the train director, when ready to start the train, pushes a button in his cabinet (shown below the clock in the picture) which does four things: extinguishes the top numbered circle light above the director's head, lights the second numbered circle light in the vertical row, turns on the top light in each of the conductor's platform boxes, and illuminates the top globe in the gateman's light set. The conductor and the gateman are informed by this means that the dispatcher is ready to permit the starting of the train. The gateman closes his gate, makes sure that all passengers are on board, and then turns his key switch, located on the opposite side of the gate-post from that on which the lights are placed. The turn of the gateman's key lights the second light in his own set, the second light in the platform boxes, and the third light in the vertical row in Tower K. Seeing both lights burning in the platform boxes, the conductor glances at his watch and at precisely 4 P.M. waves a hand signal to proceed. From here on the engineer is governed by signal indication.

Now that the train is on its way, let us turn our attention to the dispatcher's office in Camden Station, Baltimore. At about twenty seconds after 4 P.M., the dispatcher at Baltimore receives information from the operator in the Washington terminal that the train has de-



Conductor signaling gateman and train director in Tower K. All co-operate in train starting

Gate showing the twin lights at the left which play an important part in all train departures

parted on time, and notes this on the train sheet. As this train passes each telegraph office or tower, the time of its passing is transmitted to the dispatcher and duly recorded.

Suppose, now, that from other facts on his sheet, the dispatcher finds that a long freight train is moving slowly ahead of the passenger train on the same track. The speeding *Columbian* must not be held up. It is on a limited schedule. The dispatcher then instructs the operator at the proper location to divert the freight train over to another track. These instructions are obeyed, which gives the *Columbian* a clear track. After it has passed, the dispatcher notes the fact on his sheet and instructs the operator to allow the freight train to resume its normal course. This comparatively simple operation is only one of hundreds performed daily.

HOW does the dispatcher know which train shall precede others? In this he is guided largely by definite operating rules which specify the superiority of trains, and it follows that in order to give the passenger train a clear track, the freight train would be diverted or sidetracked at the proper time to enable the passenger train to pass without delay. The same is true of freight trains of different classes. For instance, a freight train which carries stock or perishable shipments is considered fast freight and would be given preference in right of way over a train handling ordinary freight.

What is to be done on single track when two trains are to meet? In this case, the rule of direction named in the timetable defines the method of passing. Where eastward trains have superiority they will occupy the main track and westward trains take the siding. When, for any reason, a scheduled train becomes late, it is the duty of the train dispatcher to fix meeting points at such places as will avoid delay to either train.

In certain places, where heavy grades or other operating conditions affect speed, the time of trains between stations may vary greatly, even when the distances are practically equal. In addition to his knowledge of the physical characteristics of the stretch of track under his supervision the dispatcher must keep in mind the location of the passenger and freight stations; the length of the sidings; the points of their divergence from the main track; and other data of this nature. It takes a thorough knowledge of railroading and years of training to keep a clear head in the maze of detail.

When there are many freight trains moving upon the railroad, the dispatcher's job becomes even more exacting. He must be familiar with the class and capabilities of the engines pulling the trains and, as previously mentioned, must ascertain how many cars, loaded and empty, make up each train, together with the total tonnage. If a freight train consists of 100 loaded cars, for instance, and the gross weight of each car is 50 tons, the total tonnage of that train would be figured at 5000 tons. Passenger trains, of course, have precedence over the freights, and this ever-recurring problem of getting the freight trains out of the way becomes more difficult with each increase in the number of trains to be handled.

If traffic becomes dense the dispatcher is kept busy issuing train orders. These orders are sent to the operators at the towers or offices most conveniently located. When it is necessary for several trains at different locations to receive the same order, the dispatcher transmits it simultaneously to the several offices. After the operators receive the orders they repeat them back. The train dispatcher also follows the repetition closely and does not authorize delivery of the order until it has been correctly repeated. This arrangement eliminates the possibility of error.

ANOTHER important phase in the dispatching of trains is a special time table. To the public, the time table is a booklet of information about the arriving and leaving time of trains. But there is another time table, which is used by employees, having to do with the running of trains. This document shows not only the time each scheduled train is due to arrive and depart from terminals and many intermediate points, but also contains special instructions peculiar to local conditions.

It is the dispatcher's efficiency, aided by the accuracy of the railroad clock, which prevents congestion and avoids trouble-making delays. Together, time and the dispatcher bend their efforts toward the dual task of satisfying both the passenger who likes to arrive on time and the shipper who wants his freight to come through as scheduled.

EASTWARD

Distances from South Chicago	Train Order Stations	WEST SUB-DIVISION TIME-TABLE No. 15-C Effective 12.01 A.M. Central Standard Time Sept. 28, 1930	Length of Passing Sidings in Cars	FIRST CLASS 14	FIRST CLASS 58 Pere Marquette No. 2	SECOND CLASS 98	SECOND CLASS 92	SECOND CLASS 94	THIRD CLASS 82	THIRD CLASS 84
				DAILY Ex. Sunday	DAILY	DAILY	DAILY	DAILY	DAILY Ex. Sunday	DAILY Ex. Sunday
				P. M.	P. M.	A. M.	P. M.	P. M.	A. M.	P. M.
	DN	CHICAGO 19.3		10.15	11.45			6.45		
0.0		SOUTH CHICAGO DEPOT 0.2		11.09	S12.35					
0.0		ROCK ISLAND JUNCT. 0.2		11.10	12.37			8.00	5.15	
0.8	DN	C. R. TOWER 1.5								
1.7	DN	WOLF LAKE YARD OFFICE		11.13	12.39		1.00	9.00	5.22	
120.7		RIPLEY 2.9	142	1.53		10.20	7.05	2.14		7.20
125.5	DN	AVILLA 4.6		2.00		10.45	7.23	2.24		7.45
130.5	DN	Penna GARRETT 5.2		A 2.15		A 11.00	A 7.30	A 3.00		A 8.15
				A. M.	A. M.	A. M.	P. M.	A. M.	P. M.	P. M.
		Time over Sub-Division		3.05	0.13	8.00	6.80	7.00	7.35	6.15
		Average speed per hour		42.3	43.8	15.1	19.8	18.6	9.1	9.7

Passenger trains will not exceed a speed of 65 miles per hour.

Speed as shown in Special Instructions, Rule 5, and such other restrictions as may be in effect, will not be exceeded.

The "working time table" that the public does not see gives such information as train order stations, speeds, superiority of trains, and the length of sidings

OUR POINT OF VIEW

Transportation Control

AT least one president of a large railroad system refuses to be greatly alarmed concerning what is currently known as the plight of the railroads. When we asked him about it recently, he told us that the "problem" of the railroads is principally the depression problem that affects all business and industry just now. He believes that, when general conditions improve, the business of the railroads will improve accordingly.

He told us that motor transportation is taking only about 3 percent of the freight business of the country, and inland waterways only about 2 percent. He recognizes that these modes of transportation have evolved in the natural course of progress and says that any form of control of them is up to the people whose taxes maintain the highways that the trucks use freely and whose government subsidizes the inland waterways. If the people wish to support these two systems of transportation by their taxes—for private gain, of course—that is up to them.

This sounds broad-minded enough but it puts the question squarely up to the people.

Everyone knows well that nothing can ever replace the railroads in the transportation of such freight as coal, for example, except, on particular routes, the inland waterways. But what of general freight, lighter or short haul shipments? Are these to be lost to the railroads? No one blames the shipper for taking advantage of cheaper rates by motor truck or by canal and river, but when the realization comes that each one of us pays taxes to make it possible for that shipper to save money, *that* is a different matter.

Samuel O. Dunn, writing in *The Pullman News* says that in the Ohio River territory, the railways move a ton of freight 100 miles for an average of 88 cents; but by water the cost is $1.25 for the same distance, the shipper paying only 60 cents of this while the public pays the other 65 cents in taxes.

Then let us look at it from a selfish viewpoint; it is manifestly unfair *to us* that this situation should endure. As far as railroads are concerned, our interests have been safeguarded for years by the Interstate Commerce Commission. Is it not possible, then, for the people to create a similar body to watch our interests in connection with other modes of transportation?

The Air Maneuvers

MOST of those who witnessed the Army air maneuvers, beginning with the mobilization in Dayton, Ohio, on May 15 to their completion at Washington on Memorial Day, probably believed that the 672 planes flown represented the most modern equipment in the world. This belief doubtless was strengthened by the fact that there was not a casualty and only two or three minor accidents to planes although the total plane-hours flown was 37,000.

As a matter of fact, the 672 planes were practically all those available in the country; and those used as light bombardment machines were actually comparatively low-priced training planes. If we had carried out fully the five-year program for military planes and equipment, at least 1500 modern and most efficient craft would have been available.

What the air maneuvers did show conclusively was that we have a trained and competent personnel second to none in the world; and that the United States takes first place so far as the operation of large units is concerned. From the maneuvers we learned the strategically important fact that commercial airports may be utilized in time of war for military aircraft. Given proper equipment, therefore, our Army's air force could do most satisfactorily its part of the job of defending the country in wartime.

Rain Makers

IT is again open season for a certain kind of hunter. He is most likely a polished personage with personality, a convincing tongue, and a lot of mysterious apparatus which seems to be of an electrical nature. The hunter is the "scientific" rainmaker; and his game is anybody with more money than knowledge of science who either wants it to rain or doesn't want it to rain on some specific occasion.

Farming communities have been known to pool their spare cash and put up large sums of money to try out rain making devices. Huge guns have been fired toward the heavens and various kinds of electrical machines have buzzed out their call for rain so that parched crops might drink. On the other hand, organizations such as those that operate race tracks, fairs, or other outdoor gatherings have paid the rain controller large sums to prevent rain. Bear in mind that money has a lot to do with this modern magic.

To our knowledge, nothing of any importance has ever been done in the effort to control rain. If some apparent success has been attained, it may be put down as negligible or the result of chance. It is not at all likely that pseudo-scientists with nondescript equipment can or will do what scientists with their specialized knowledge and superior apparatus have tried and failed to do. If someone does find even a partially successful solution to this problem, it will first be tested thoroughly by men of science who know what they are about. In the meantime, gullible ones will perhaps continue to pay their good cash for nothing. Rain insurance would be just as satisfactory—just as good a gamble—and much cheaper.

Death to Children

IN connection with the peace-time use of explosives, two significant facts stand out. The first of these is that during the past four years, one half billion pounds of dynamite and black powder have been transported annually by the railroads of the United States and Canada without the loss of a single life and with but negligible property damage. The second is that about 500 children are killed or injured every year while playing with blasting caps.

The blasting cap is a necessary auxiliary of dynamite, and its very appearance and size make it attractive in the eyes of children. It is a copper shell about a quarter of an inch in diameter and one or two inches long, half filled with fulminate of mercury. Flying particles of copper from this cap, when it is exploded, will imbed themselves in iron a foot away and will blow a hole through one sixteenth inch steel plate.

Blasting caps are so small that they are easily mislaid or lost, especially by careless workers. Thus it is that children find them where blasting work has been going on and, in playing with them, accidentally strike them against something or investigate their contents with disastrous results. Many fingers, the sight of one or both eyes, and even lives are lost as a consequence.

We cannot urge too strongly that extreme care be taken by those authorized to handle these dangerous little "ferrules." They should be kept under lock and key and the loss of even one of them should never occur. Furthermore, parents should explain to their children just what they look like so that the children may avoid them entirely.

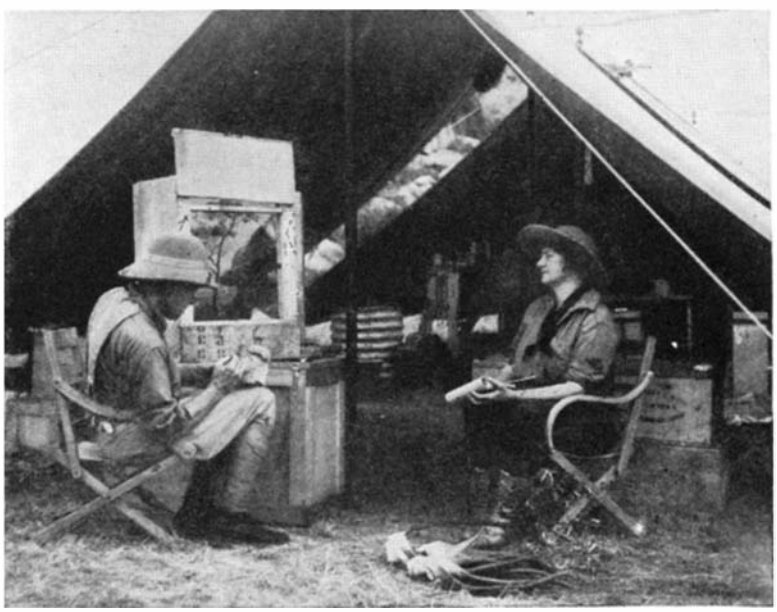
Carl Akeley and George Eastman, expedition sponsor, in Tanganyika

CARL AKELEY'S AFRICA

FIRED with the enthusiasm of a crusader, endowed with the technique of a sculptor and governed by the balance wheel of true artistry, Carl Akeley has left behind him monuments of such imposing grandeur as it has been given to few men to excel.

The great African Hall of the American Museum of Natural History, soon to be opened, and the permanent establishment of the Parc National Albert in the Belgian Congo as a sanctuary for wild life, particularly gorillas, represent the outstanding attainments of one of the greatest naturalists that ever lived. In the former will be found all the dominant forms of the mammalian life of Africa in settings which give a comprehensive idea of the scenery and environment, with a truth and accuracy which only such an exceptional personality could weave into the inanimate setting. In the Parc National Albert will be preserved for all time, because of the beneficence of His Majesty, Albert, King of the Belgians, the beauty and grandeur of the pre-civilization and the wild life Akeley loved to photograph, paint, model, and conserve. Here, too, most appropriately, his body lies at "home," as he used to call this country.

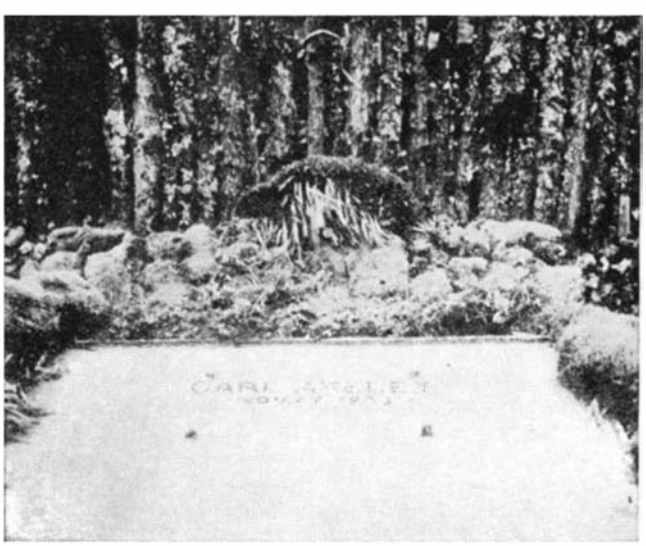
Carl Akeley was undoubtedly the world's greatest taxidermist. He was also a sculptor of high order, and inventor and explorer of note. He first went to Africa in 1905 for the Field Museum and in 1909 for the American Museum of Natural History. In 1924 he married Miss Mary L. Jobe who had already made a name for herself as an explorer. She accompanied her husband to Africa in 1926 as secretary and expedition manager for the Akeley-Eastman-Pomeroy African Hall Expedition of the American Museum of Natural History.



Carl and Mary L. Jobe Akeley in their camp in the Lukenia Hills, Kenya Colony, making a sketch model of a group of rare Klipspringer

Shortly after the arrival of the party in the Belgian Congo, Carl Akeley died on November 17, 1926 and his wife buried him on the slope of Mt. Mikeno. Mrs. Akeley bravely carried on the aims of the expedition for several months.

About a year ago it was our pleasure to review briefly a most fascinating book on Africa entitled "Carl Akeley's Africa: the Story of His Last Expedition" by his wife. Now we have another book entitled "Adventures in the African Jungle" partly written by Mrs. Akeley and partly made up of stories which the great naturalist delighted to recall and relate to friends both old and young. While this book



Carl Akeley's grave is in the Parc National Albert on Mount Mikeno in the gorilla country of Belgian Congo

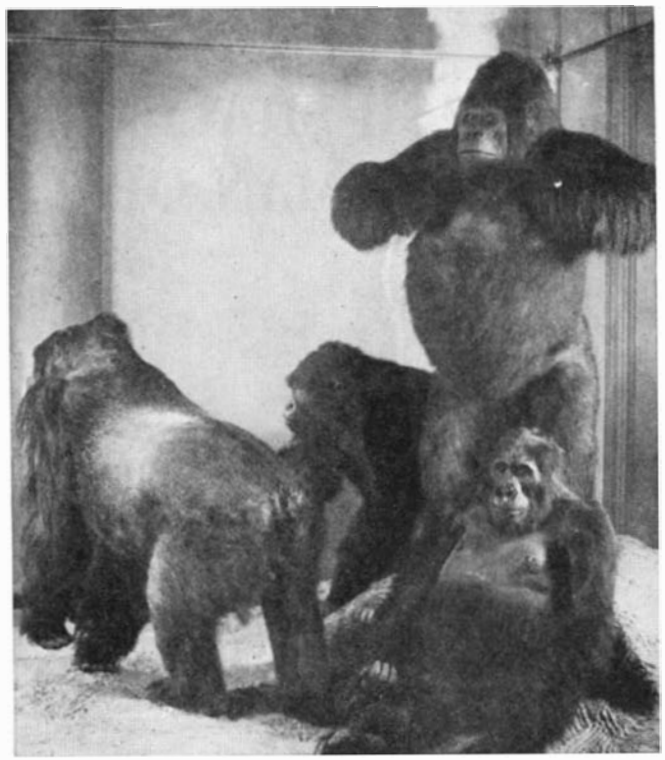
In the Parc National Albert the mountain gorillas feed on wild celery. The forest is a fairyland of moss and ferns

is primarily intended for juvenile reading it is filled with interesting anecdotes and information which render it an ideal book for adult reading as well. Through the courtesy of Mrs. Akeley and the publishers, Messrs. Dodd, Mead & Company, we are able to present a number of illustrations from these two books.

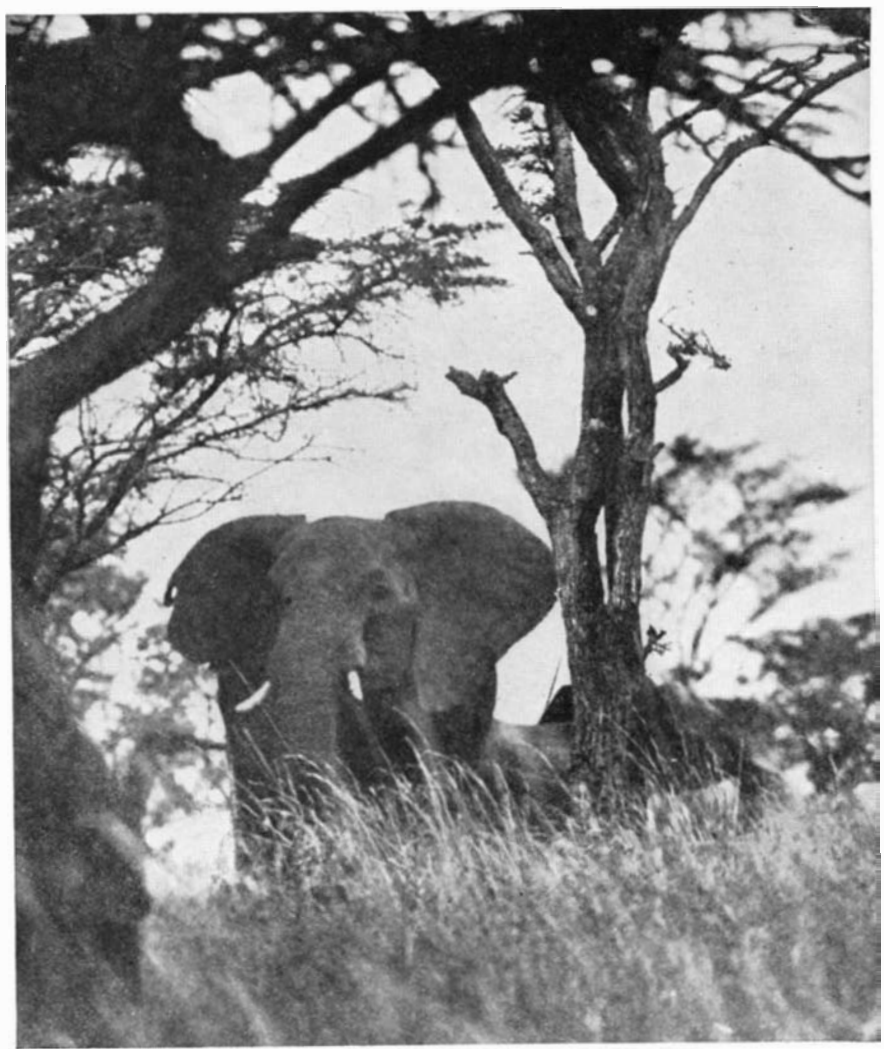
"Carl Akeley's Africa" is an account of the last expedition. It pictures the struggle of the great game herds of Africa against the rush of civilization. Mrs. Akeley says: "During the five weeks which Carl and I spent in the so-called heart of the lion country of western Tanganyika, we saw 146 lions. Not one of them evinced the slightest inclination to be aggressive unless wounded. Without exception they conformed to the creed my husband formulated: *'The lion is a gentleman:* if allowed to go his way unmolested he will keep to his own path without encroaching on yours.'"

That all the large animals are dangerous is contradicted by Mrs. Akeley, who says: "The ends of conservation may further be served by ridding the minds of travelers of the fallacious notion that all large animals are aggressive. Only once during 13 months of hunting in the remote regions of Equatorial Africa was a shot fired by any member of our party in self-defense."

Anyone who reads this book will gain a fresh point of view as regards the personalities of animals as well as of the natives of Africa. The descriptions of the collisions between nature and civilization are well worth while. Who, for example, would think that the very dumb giraffe mowed down telegraph wires until World War combatants in that section had to stop fighting among themselves until they could get rid of the long necked pest?



Mountain gorillas collected in the Congo and mounted by Carl Akeley for the American Museum of Natural History



This cow elephant charged Mr. Akeley and was taken by him at 75 feet just as the elephant started to charge. He was once nearly killed by an angry elephant

During 1921 Akeley made an expedition through the Belgian Congo and visited the mountainous gorilla country lying in the Kivu district in a triangle between three extinct volcanoes, and became so impressed with its possibilities as a sanctuary for all forms of wild life, he at once began an agitation to have this region declared a royal park prohibited to all game hunters. King Albert, by royal decree, created the Parc National Albert in 1925 and this was followed by the reservation of 500,000 acres with a plan of organization and administration.

MRS. Akeley refers to the gorilla country as follows: "On the cool wooded slopes of extinct volcanoes and ranging side by side with the gorilla and at peace with him are herds of elephants and buffalo; here, too, are leopards which sometimes menace the gorilla's young."

Challenging the misconceptions of generations, but fully authenticated by recent studies of accredited scientists, stands an impressive gorilla group in the new African Hall, a tribute not only to a unique method of taxidermy developed by Mr. Akeley, but also to a score of years of prolific activity.

To accomplish such perfection of reproduction and to rest at last in the country and among the animals he loved to preserve and conserve, Carl Akeley surely represents the meeting of science and romance.

WHICH SHALL INHERIT THE EARTH—MAN OR THE INSECTS?

By L. O. HOWARD

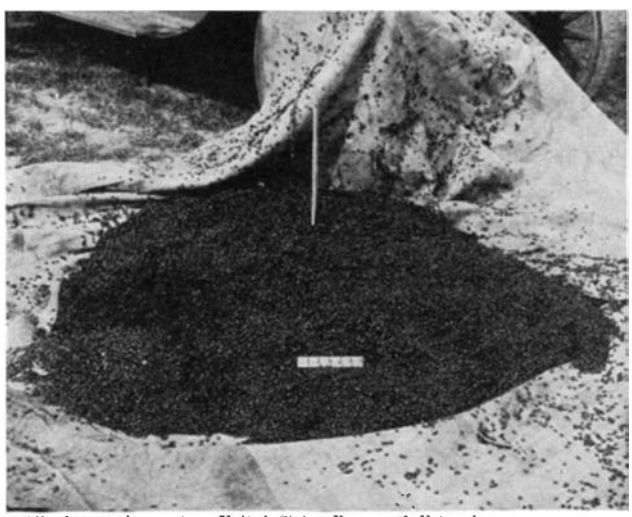
I HAVE raised this question because it has become perfectly evident to me that insect damage is rapidly increasing and because almost no one seems to realize it. I have written and lectured on this topic very considerably, and have urged my colleagues among the entomologists and my friends among the magazine and newspaper writers to display the danger as much as possible.

Probably most people who have read one of these articles have merely shrugged their shoulders and considered it as simply one more attempt at sensationalism. Others may have given the matter some thought, and surely the whole effort has done good. I have no desire to frighten anyone unnecessarily, and I surely believe that the insect menace will be conquered by the human species eventually. But that will not come about until the danger is appreciated, and I am trying to bring about this appreciation as speedily as possible and well before disaster comes.

IT is a fact that insects destroy from one tenth to one fifth of all of our crops. It is a fact that with many crops the present agricultural methods are exactly fitted to encourage insect injuries. It is true that in feeding our increasing millions we are feeding increasing billions of insects. It is true that the labor of one million men each year in the United States is lost through insects, and that the money loss exceeds two billions of dollars annually.

Not only do insects harm humanity by eating the growing crops, but they are supporting themselves and increasing at our expense in countless other ways. They ruin all sorts of stored products—grains, dried food of all kinds, clothing, rugs and carpets, furniture, our dwellings, and even our drugs and medicines. The damage to stored foods is enormous, in mills, on railway trains, on docks and on shipboard. In times of great emergency, like the World War, such damage not only is keenly felt but may result in death by starvation to great numbers.

Then, too, insects damage our livestock and carry disease to both man and his domestic animals. Insect-borne diseases have decimated great populations. Witness the great plague years of Europe, the plague and cholera still existing in oriental countries, the yellow fever epidemics of past times, and the hundred million dollars a year loss at the present time in the United States from malaria. Moreover, of late years it has been discovered that with many of the diseases of useful plants certain insects are the accidental or necessary carriers, so that of the many millions of dollars lost every year by plant disease insects are implicated in at least a large share of the loss.



All photographs courtesy United States Bureau of Entomology

A single day's catch of Japanese beetles from 500 traps. Man's invention of agriculture was a boon to the insects

This tremendous loss from insects has been growing greater year by year. It is true that we have at least temporarily conquered some of the great pests, like the grapevine Phylloxera which threatened the extinction of the wine industry; like the fluted scale which bid fair to ruin the citrus industry; like the cotton boll-weevil which drove cotton planters in this country to despair. But others are constantly appearing, like the Japanese beetle, the Mediterranean fruit fly, and the European corn borer; while the locust plagues in old-time proportions devastate very great areas in certain countries from time to time, driving large populations almost to starvation. Three or four years ago this was the case in certain Central American countries, including the southeastern states of Mexico, and only last year eastern Egypt, Palestine, and Transjordania succeeded in repelling an enormous invasion coming from the east just as did its remote ancestors in the time of the biblical plagues.

How is it that the insect type of life is so successful? How is it that, without intelligence, without conscious organization, without individual bulk or great strength, and without any artificial weapons, insects are able to compete with man who has exterminated or subdued all other

Children in Japan engaged in collecting Japanese beetles which are the victims of parasites, as part of an attack on other beetles by spreading parasitization

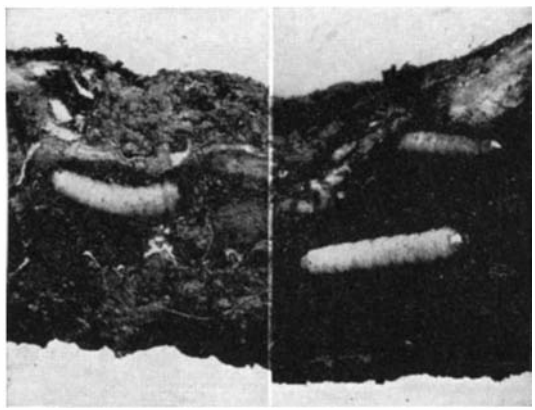
types of life except the organisms which cause disease?

In the first place the insect type is infinitely older. It is a type that had become perfected by evolution and adapted to an enormously varying environment millions upon millions of years before the higher vertebrate type appeared. Here, also, is another point that is overlooked: An insect may have many generations in a year, whereas man has only one generation in many years. Chronologically speaking, therefore, evolution works very much more rapidly with the insects. To take an example: The cotton boll-weevil has been in our southern cotton fields for about 35 years. That means, say, two generations of man, but 136 generations of the weevil; so that in the same period of time evolutionary forces have been working on 68 times as many generations of the insect.

This rapidity of development is accomplished in many ways and is complemented, with many forms, by enormous powers of multiplication. It has been shown, for example, that the whole ponderable mass of humanity now on the globe would be outweighed very many times by the offspring during a single summer of a single cabbage plant-louse, if all these offspring could be provided with enough food and were not killed by their natural enemies.

NATURE, since life began on earth, has tried an infinite number of experiments, and the two that have succeeded transcendently are man at the head of the vertebrate series and insects at the head of the arthropod series. They co-exist today, each at the head of its own phylum, and each has evolved characteristics that make it the potential master of other life. In the possession of what we term intellectuality, man has an enormous advantage that will lead to his eventual domination. But in every other characteristic the insects have the great advantage.

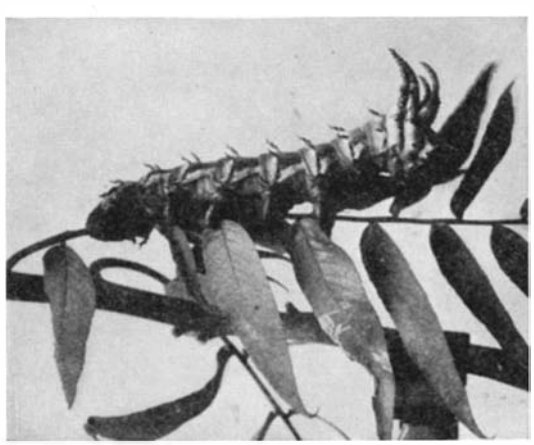
Few people realize the great advantages of the structure of the insect body over those of the structure of the mammalia, perhaps especially man. In the evolution of vertebrates, primitive forms were small, and these animals worked towards self-preservation by the accumulation of strength and bulk —the forms which fed on vegetation increasing in bulk, as a protection against the smaller flesh-feeders, and the flesh-feeders increasing in strength in order to overpower the larger plant feeders. This resulted in gigantic, highly specialized forms. But, of course, with the changing of conditions these animals were not able to adapt themselves, and died out very largely, and only the smaller vertebrates have persisted. With insects, the shortness of the life cycle and the rapid cessation of growth of the individual prevented the development of great size, and the evolution of insects has proceeded in the opposite way—they have been growing smaller and smaller and more highly specialized.



The peach borer in its galleries at the crown of the peach tree, where it does heavy damage

With the vertebrates, the skeleton is inside; with the insects, the skeleton is outside, and this has been a great source of help in evolution. A Russian author (Chetverikov) has worked out the superior strength of the limb of an insect, and he has done this as an engineering problem. He arrived at the conclusion that the vertebrate limb, other things being equal, is three times weaker than the insect limb. The exterior skeleton affords an endless opportunity for the development of external characters, giving rise to the extraordinary variety of insects as they exist today. In addition, the substance of which the insect skeleton is composed is of great advantage. It is chitin, a peculiar substance that looks like horn. It is an albuminoid, and differs from horn in important particulars. It burns without shriveling, and is attacked neither by alkaline solutions nor by dilute acid. It contains no sulfur, as does horn, and does not grow brittle with age, like the bones of vertebrates. It covers and protects the insect's entire body. With man, the muscles are exposed to the slightest injury, since they are attached to the inner bone. But with the insects they are covered and protected by the chitinous skeleton, and they function better than the muscles of man, since they have numerous attachments to ridges on the inner side of the chitinous covering. The insect skeleton is hard to break; it bends, and it is lighter and stronger than bone.

Much of the insect skeleton is composed of waste material, which is thus used to a very good advantage instead of being expelled from the body. The chitin chemically is a complex of nitrogenous sugar groups, while the bony skeleton of man is composed largely of proteids and inorganic materials, chiefly lime and phosphorus. Now it happens that the starches and other substances that make the chitinous skeleton of insects abound in nature, while man's diet must be carefully selected so as to include the substances needed in the growth of bone.



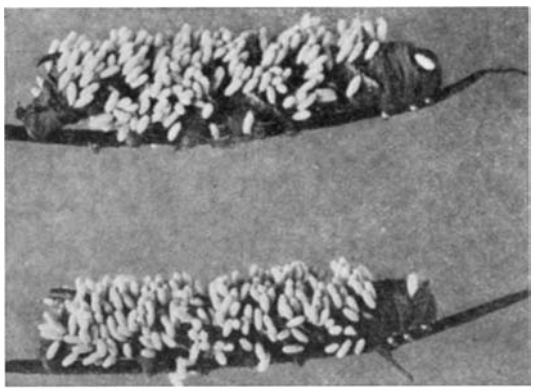
The largest of all our native caterpillars, popularly called the "hickory-horned devil"

ASIDE from the skeleton and its appendages, all the rest of the anatomy seems to adapt insects better for a mundane existence. The anatomical arrangements for carrying on the vital functions of circulation, respiration, and digestion are notable in contrast to ours. And the muscles of insects function much more efficiently than do those of the vertebrate animals. A man would be able to jump an eighth of a mile if he could leap as many times his own length as do certain insects. Instead of being concentrated, as are our lungs, the breathing tubes penetrate to every part of the body, carrying oxygen to every part of the organism, and the obstruction of a tracheal branch is, therefore, not a very serious matter to an insect. As to circulation, there is no real heart; there is a dorsal vessel extending the whole length of the body. There are no small arteries or veins, the blood circulating free in the body cavity. A slight wound, even to the dorsal vessel itself, never causes death from bleeding. The nerve centers of an insect are distributed throughout the whole length of its body instead of being concentrated in its head.

With all these anatomical and physiological advantages, it is not strange that insects seem to be less susceptible to disease than are the higher animals. It is true they sometimes have their internal parasitic diseases, caused by

micro-organisms and toxins, that may carry them off in great numbers. Of this a notable example is the silkworm disease known as pebrine, which at one time threatened the extinction of the domestic silkworm of commerce. But we have been unable to utilize any of these insect diseases in our warfare against the creatures.

Notable among insects' advantages and supplementary to their small size, rapid multiplication, and rapidity of motion, is their extraordinary power of concealment. This has developed in the course of ages of evolution, and this evolution has depended upon a multitude of factors. They have been brought into such close resemblance to their general environment and to specific features of their environment that they are often concealed in a most perfect manner. Protective resemblance has worked with other animals, as has been especially pointed out by the late Abbot H. Thayer, who was both an artist and a naturalist, but it is with insects that we see the most extraordinary things in the way of protective coloration, and far more in the way of protective structure. We have only to think of the walking-sticks and the leaf-insects and those extraordinary Indian butterflies which when their wings are folded resemble dead leaves. Equally striking instances occur almost unnoticed all around us; for example, the so-called measuring worms which hold themselves at a proper angle from the twigs upon which they have been crawling, and from their color and position resemble twigs themselves. There are leaf-hoppers that resemble the thorns of the plants on which they live. Nowhere in nature do we find anything to compare in number or in perfection with the phenomena of this sort that occur among the insects.



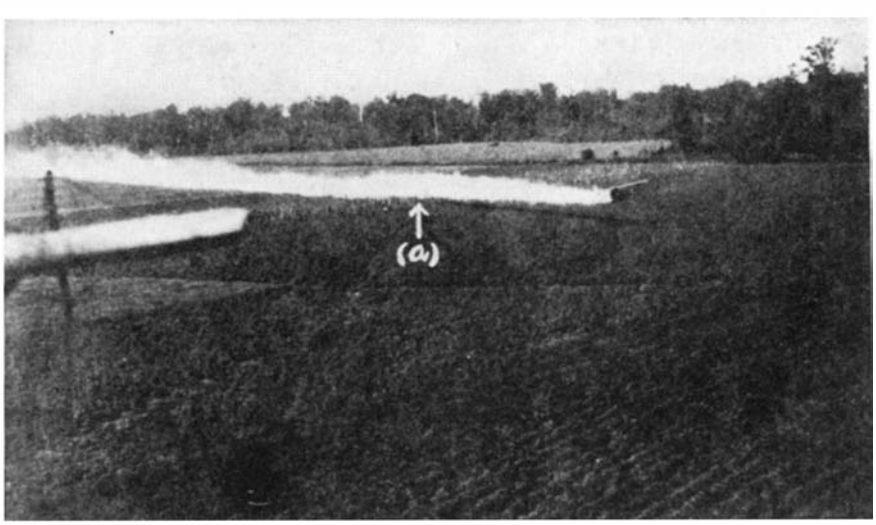
Man's allies. Cocoons of a parasite attached to a tomato worm which will eventually die

HERE then is a very ancient type of life that for many millions of years gradually perfected a structure and a physiology so perfect that it has endured for many millions more. It has passed through changes and cataclysms that have wiped out many other types. Now suddenly (geologically speaking) within half a million years an entirely different type—the erect mammal called man—has increased and spread and calls the earth his own. Although, as compared with the insect type, he is a poor creature, he has evolved a wonderful mind and has rapidly come to control and to use to his advantage nearly all the other kinds of life. But he has measurably overlooked the insects. The insects, however, have not overlooked him, but have utilized every single new chance he has given them for enormous multiplication. The progress of mankind from barbarism to civilization and so to world control has been accompanied by an always increasing number of insect plagues. He has always fed (not cherished) insects, and now he feeds them on a perfectly gigantic scale, and the frightful loss from insect damage is the greatest of all wastes.

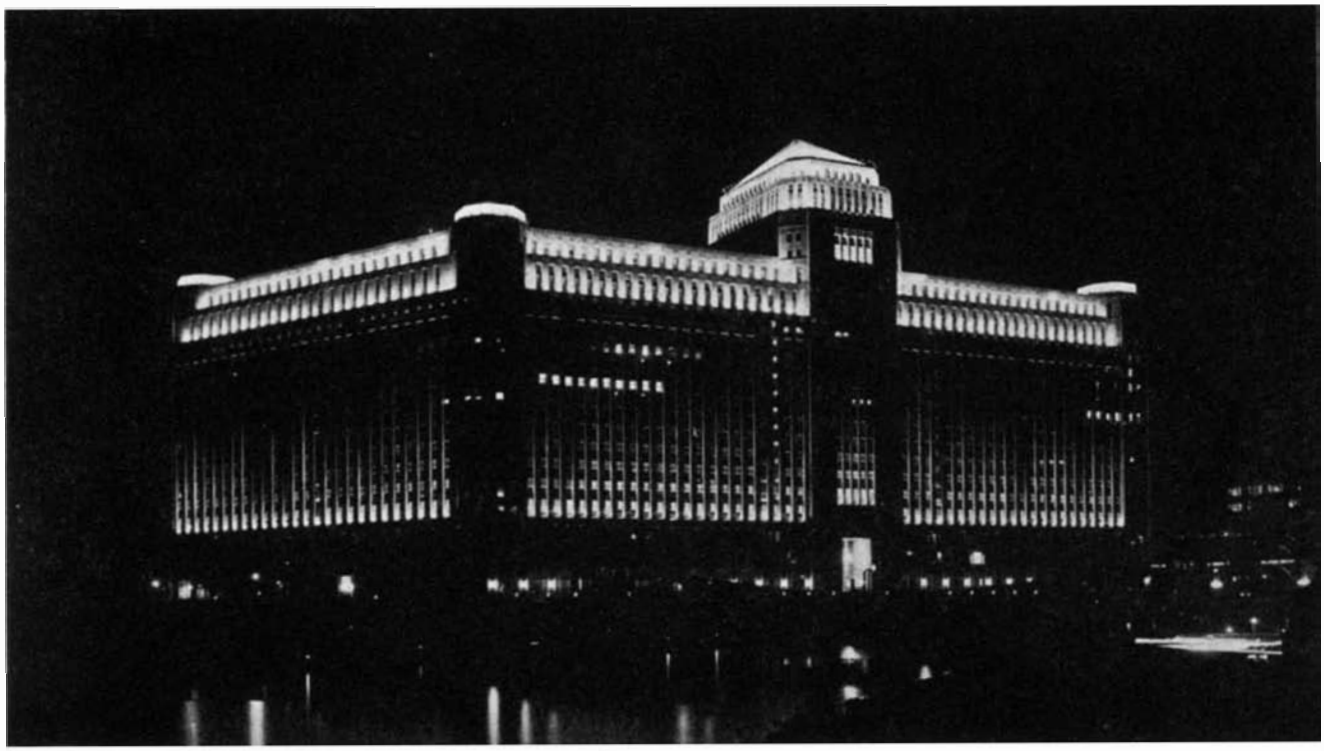
It is not so long ago that seemingly wise prophets were predicting starvation from over-population within a comparatively few years. I think, in fact, that one author selected the year 1933. But the attitude of the knowing ones has changed. Authorities like Sir John Russell of the Rothamsted Experiment Station in England and Dr. A. F. Woods, Director of Scientific Work of the United States Department of Agriculture, in recent addresses went quite to the other extreme and inferentially predicted an ample food supply for hundreds of years to come. This change of attitude has been brought about by discoveries in the scientific investigation of the problems of agriculture. Plenty of food, therefore, is apparently in sight, to the minds of these men who apparently have either not considered the injurious insect side or have taken it for granted that the economic entomologists and other scientific men will solve all such problems.

Accepting, as we should (considering their very high standing as investigators and thinkers), the optimistic statements of these later prophets, we cannot ignore the continuing increase of the insect hordes. We cannot overlook the fact that they seize every chance that we give them, and that in our efforts to grow food quickly and on a larger scale we usually give them a chance to increase beyond bounds.

FROM all this we cannot avoid the conclusion that humanity must at once give great attention to the insect problem. We have begun to do this, perhaps especially in the United States where the danger under present conditions is more acute than in some other countries, like those of Europe, and there are now with us many hundreds of well trained men working under the state and under the federal government. But these men, for the most part, are working for the quickest relief and on emergency projects, and we need thousands where there are hundreds today. We need them at work not only on the great emergency problems but also upon the basic problems. We must know everything possible about insects. Entomologists must do this, and then, based upon the knowledge thus gained, we will often have to do things very differently. Agricultural engineers, the broad students of farm management, the agronomists, so-called, will be able to develop in many cases new methods of crop culture which will avoid the insect danger, and then, with able minds calling in the help of chemists and physicists, we may in many cases be able to launch mass attacks that will be effective. In the meantime, plant physiologists, including the plant breeders, will be developing resistant crops.



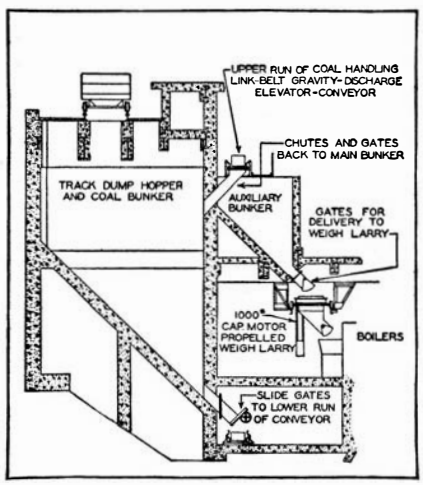
Dusting by airplane for the cotton boll-weevil. The white streak is the long trail of poison dust which is discharged from the airplane as it passes along



The Merchandise Mart is only 18 stories, but there are 4,000,000 square feet of floor space accommodating 30,000 persons

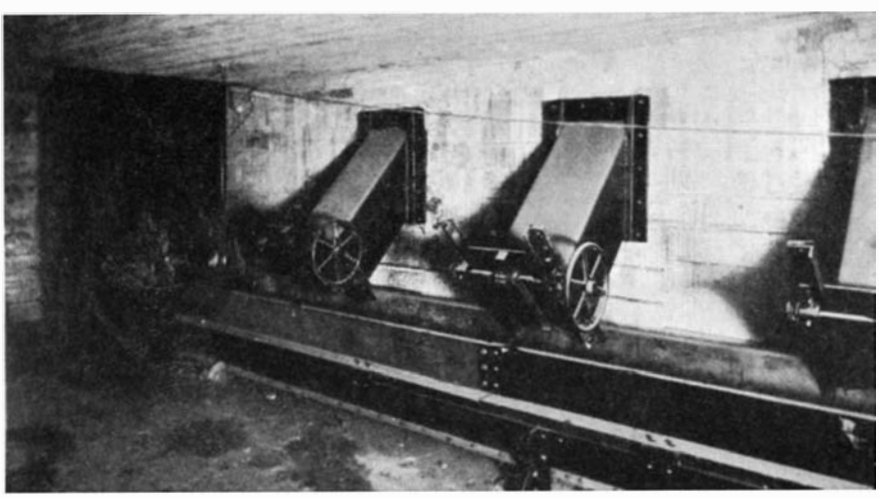
A $35,000,000 BUSINESS HOME

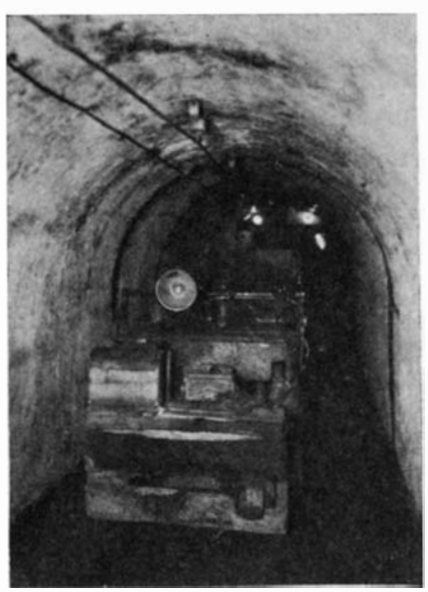
CHICAGO has recently added to her collection of "largest" enterprises an immense building called "The Merchandise Mart" which accommodates 30,000 workers housed in 91.8 acres of floor space. The cost was approximately 35,000,000 dollars. The distinction of being the largest building in the world is transitory, for a larger structure is now being constructed by the Port of New York Authority as an inland freight terminal. While The Merchandise Mart is only 18 stories in height with a six-story tower, there



Courtesy Link Belt Company

Below: **Gravity discharge elevator-conveyor in boiler room.** ***Right:*** **Diagram showing coal handling equipment and the coal bunkers**





The Chicago tunnel system handling a car of ashes, saving carting

are 4,000,000 square feet of floor space. One floor of this building contains an area equal to the total floor space available in a 10-story building of the average Chicago skyscraper ground dimensions. It occupies a ground area 724 feet long and 324 feet wide. The underlying idea is to have a structure so vast that merchants can do much of their buying in a central mart. We illustrate some of the mechanical features, and the connection with the Chicago tunnel described in our September, 1930 issue.

WORLDS FROM A CATASTROPHE

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

NATURE has been kind in presenting us with a few relatively simple problems in which some of the great processes can be studied almost free from complications caused by the others. A classic instance is found in the motions of the planets, which are so far apart in practically empty space that we may safely venture the radical simplification of treating them as mere material points moving under gravitational forces alone. Even when so simplified it takes years of work to calculate the motions of a pair of bodies such as Jupiter and Saturn, and the mathematical methods (involving the use of infinite series) are such that, though we can be sure that these results will predict the motions with great precision for hundreds of revolutions to come, we cannot be quite sure what changes will happen after they have made millions of circuits of their orbits.

But, along with these "easy" problems and sometimes as a part of them, Nature sets us riddles that remain unanswered. One of these is: How did our planetary system get there? It is obviously no accidental conglomeration of bodies; the planets all go around the sun in the same direction and almost in the same plane, most of them in nearly circular orbits; the largest planets are near the middle in order of distance from the sun, while the innermost and outermost are small; most of them are in rapid rotation and the rotation is in nearly the same direction as the orbital motions, except for Uranus where it is at right angles to it; and six of the nine large planets are the centers of satellite systems which reproduce the solar system in miniature with interesting but not radical variations in plan. Here we have traces—nay definite evidence—that some orderly process forms the whole. But have we enough on which to work backward and make out the process clearly?

The old hypothesis of a slowly contracting, flattened nebula which left behind as it shrank rings of matter which somehow coalesced into the planets, perished late in the last century from incapacity to explain why the planets, which altogether make up but 1/700 of the mass of the system, have more than 98 percent of the momentum of rotation or angular momentum. In an isolated system the sum total of this angular momentum is fixed in amount—internal processes can transfer from one part to another but can neither create nor destroy it—and no one has ever been able to explain how, without external influence, almost the whole angular momentum could have got into so tiny a part of the material.

Courtesy Mount Wilson Observatory

A spiral nebula with arms suggesting the "filament" of Professor Russell's discussion. This is *not* a solar system in formation—these never have been discovered—but a whole island universe of suns. It serves only as a rough analogy

This led Professors Chamberlin and Moulton of Chicago, about 30 years ago to revive and support by reasonable and convincing argument the theory that the planets owe their existence to a catastrophe. Long ago, three or four thousand million years ago as we have now good reason to believe, our sun was an isolated star, till some other wandering star passed near it and was drawn in by their mutual attraction so that the two bodies passed in a hyperbolic orbit within a few million miles of one another. The enormous tidal forces caused the ejection of vast masses of the solar material. Some of these fell back, others may have flown off into space, but a good part was set into motion sidewise by the attraction of the now receding star and condensed into a system of planets all moving around the sun in the same general direction.

In this generalized form the hypothesis is accepted by practically all students of the subject. Nothing short of an encounter with a visitor from outside appears to be capable of putting the angular momentum into the motions of the planets which we actually find there—at least no rational alternative has yet been suggested.

But the details of the process are very puzzling and there is lively disagreement about them. Chamberlin and Moulton concluded that the material ejected from the sun came in huge eruptive bursts like those from a volcano and that these "bolts" cooled down to form swarms of small solid bodies or "planetesimals."

COMPACT swarms of these bodies gradually consolidated into the nuclei of the planets and grew by slow accretion till they had swept up almost all the smaller bodies and reached their present size.

An alternative form of the hypothesis, suggested later by Sir James Jeans and Dr. Jeffreys, concludes on dynamical grounds that the material escaping from the sun flowed out of it under the tidal pull of the passing star, rather than escaping by paroxysms, and formed at first a long and nearly continuous ribbon or filament. Shortly afterward this broke up crosswise into parts, somewhat as a thin falling stream of water breaks into drops. The middle and thickest part of the filament forms the largest masses—Jupiter and Saturn; the thin ends the smallest—Mercury and Pluto. The attraction of the receding star set these masses in lateral motion as they separated, so that they did not fall back into the sun but formed planets.

On both of these hypotheses it is difficult to account for the rapid rotation of the planets. The infall of each planetesimal on a nucleus would tend to produce rotation, but the numbers

striking it on one side and on the other would be nearly equal and their efforts would merely annul one another, so that the rotation of the final mass should be slow unless the circumstances of infall were highly specialized. It is harder still to see how the material of the filament of matter pulled out from the sun by tidal action could be at the same time set into rotation fast enough to account for the fact that Saturn makes some 57 revolutions and Jupiter more than 60 while the sun turns around once. Many of the asteroids are turning still more rapidly. Eros rotates 112 times as fast as the sun. In this last case the rapid rotation as well as the irregular form of the planet may be due to a later encounter between two asteroids, as was mentioned last month, but nothing of the sort can be assumed for the great planets.

DR. JEFFREYS has recently suggested that this difficulty may be met by supposing that the planet-forming star actually collided with the sun, making neither a clean central hit nor a glancing graze but something between. During the actual impact, which must have lasted less than an hour owing to the enormous orbital velocity, the material of both star and sun in the zone of actual contact would have been stirred up with extreme violence, and if one mass slid by the other the intervening layers would have been dragged along and set into rotatory motion. They would have streamed out after the star as it receded, and formed a turbulently eddying ribbon or filament of matter which would "be unstable in a complicated way," and break up within a few hours into separate masses.

All the ejected material would be intensely hot, coming as it did from the deep interior of the sun and having been still further heated by the friction of one mass upon the other. Jeffreys considers that its temperature at the moment of ejection may have been as great as 10,000,000°. Once exposed to space it would cool very rapidly, at first mostly by radiation but also by expansion, so that when it settled down into more or less independent masses these would be very much larger than at first —larger than the sun itself if it were not for the loss of heat by radiation and low density.

In such a mass the more refractory constituents would condense, forming raindrops, not of water but of molten metal or rock, and these would fall toward the center and collect into a liquid planet, while the lighter gases would remain as a far-extending atmosphere. A small planet would not have gravitational attraction enough to keep this atmosphere or at least its lighter constituents from diffusing away into space, while Jupiter and Saturn must have retained a great deal of it, accounting for the low density as Moulton long ago suggested. Jeffreys concludes that drops of molten matter would begin to form in about a day for the earth and a week for Jupiter, and that the collection of these into liquid planets "probably took a few years for Jupiter and some days for the earth." It should be emphasized that all these theories are closely related. They differ regarding the details of the process rather than their general nature, and there is no necessary antagonism between any of them. The "ribbon" of matter torn loose by an actual collision has much similarity to that postulated by the theory of tidal action without collision, and in both cases there would doubtless have been formed immense numbers of small bodies like the planetesimals. These, by collision with the planets, caused their orbits to become less elongated and gradually to approach a circular form.

Moreover, none of the three hypotheses is completely satisfactory. All of them have difficulty in accounting for the satellite systems, especially for the beautiful miniature solar systems which center on Jupiter and Saturn. It has been suggested that they had their origin in condensation in a planetesimal cloud, or were ejected from the masses condensed from the tidal filament when next these came close to the sun and under its powerful tidal influence; or were born during the break-up of the turbulent ribbon ejected by an actual collision. But in no case have the details of the process been satisfactorily worked out.

Another difficulty common to the three theories is this: If the newly formed planets were of approximately their present masses and carried nearly the same amounts of angular momentum as they do now, it follows from elementary principles of theory that the perihelion distance of each one must from the beginning of its really independent existence have been at least half of its present mean distance. Otherwise the orbit would have been a hyperbola and the planet would have been lost in the depths of space. This means that Uranus must from the first have been always as far from the sun as Saturn now is and Jupiter farther than Mars even is now. How these great masses could have been removed so far from the sun shortly after the original encounter is difficult to imagine. It is easy to show that the shortest time in which a body can be taken from the sun to any given distance, without moving it at such a speed that the sun's attraction would be unable ever to bring it back again, is 7½ percent of the period of a planet rotating in a circular orbit at this distance. To get Neptune out to half its present distance must therefore have taken more than four years, while Jupiter would require about four months.

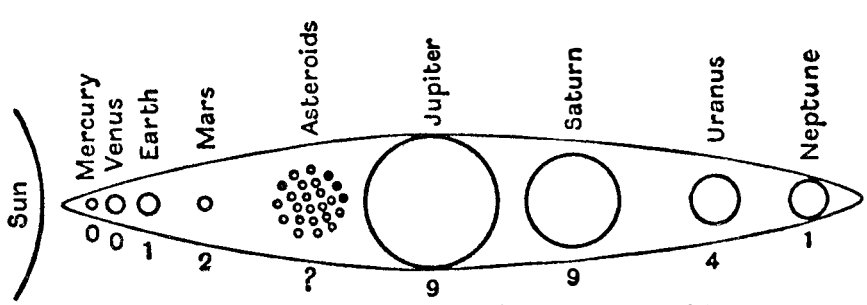
THESE are roughly the lengths of time which the passing star would have taken to recede to the same distances, and this suggests that the planets may represent masses which started to trail after the star and only gave up the chase after some time. In this case the elementary calculations just described are no longer applicable, and the far more intricate ones which tell what could actually be expected do not appear to have been made. After the star had once gone its way it is very hard to see how the planets could have been shifted much farther from the sun.

It may well be that the surviving planets represent but parts of the matter originally thrown out, which, by a favorable combination of circumstances, were dragged to a considerable distance and set moving laterally, while the amount which fell back into the sun or followed the star into the unknown was much greater.

There is a great deal still to be found out before we have a really satisfactory theory of the origin of our planetary system, but real progress appears to have been made and our present cosmogonists, though differing vigorously on details, are by no means to be compared with Browning's poet-philosopher who boasted,

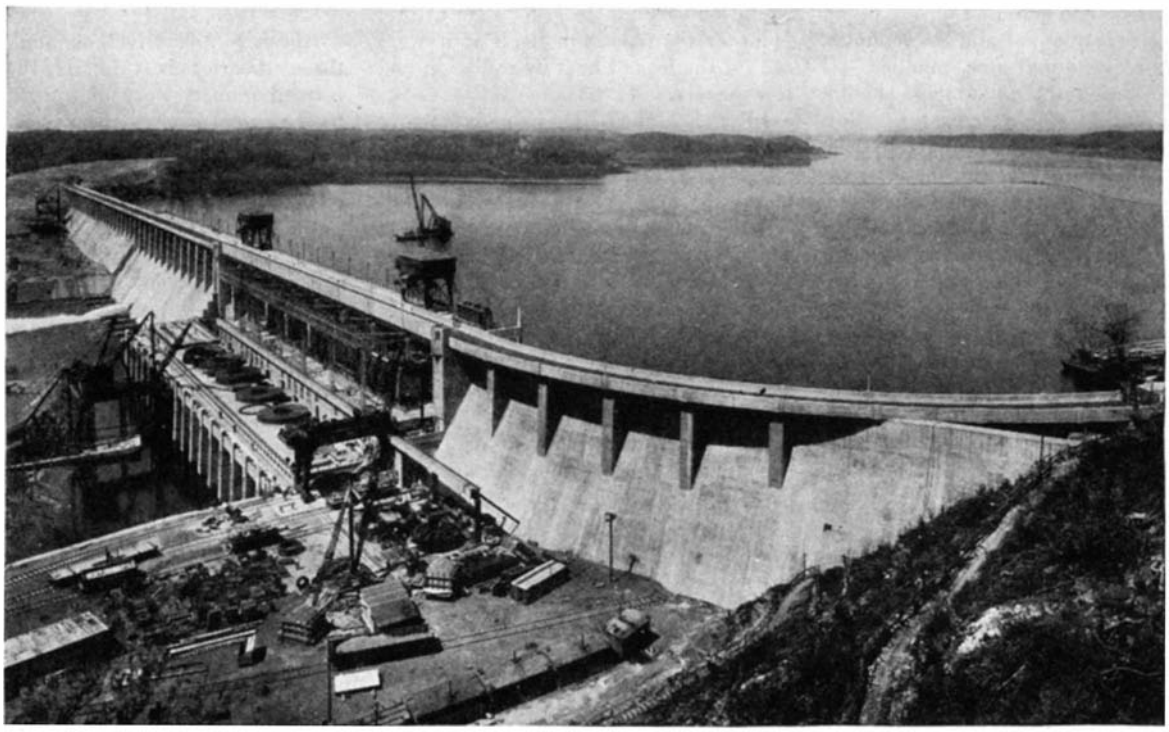
"And I have written three books on the soul
Proving absurd all written hitherto,
And putting us to ignorance again."

—*Princeton University Observatory.*



From Jeans, "The Universe Around Us," by permission of the Macmillan Company, publishers

The distribution of size among the planets—small ones near the sun, then large ones, then smaller ones again—suggests that the filament may have been cigar shaped before it condensed into the "independent masses" described in the text

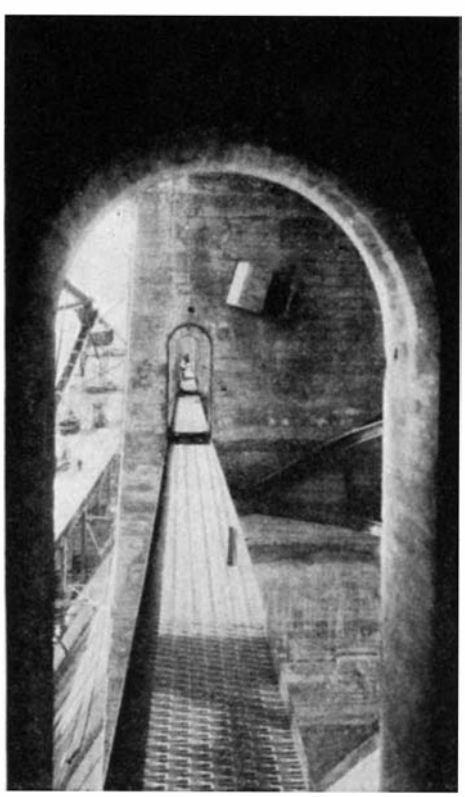


The Bagnell Dam not only impounds 87 billion cubic feet of water—sufficient to generate about 425 million kilowatt-hours of electricity annually —but also serves as a bridge over the Osage River

HYDRO-ELECTRIC POWER IN THE OZARKS

By A. J. SEABURG

Engineer, Hydraulic Division, Stone & Webster Engineering Corporation



An inspection walkway more than 500 feet long extends along the downstream side of the 12 Tainter gates in the dam

FROM a drab, sluggish stream, winding across the western central part of Missouri, the Osage River has been transformed in a single year into a sparkling blue lake 129 miles long and with 1300 miles of attractive shore line. This transformation has been brought about by the construction of a great concrete dam, known as the Bagnell Dam which is part of the 129,000 kilowatt power development for the Union Electric Light and Power Company and which is now being completed by the Stone & Webster Engineering Corporation.

Located in approximately the center of the state, the dam is about equally distant from Kansas City and St. Louis. The lake, held closely within the confines of the rocky bluffs of the old river channel, winds among the foothills of the northern edge of the Ozark plateau and on the map somewhat resembles in shape a great sprawling Chinese dragon.

The Osage River brings the drainage from 14,000 square miles of gently rolling country to the reservoir which has a storage capacity of 87 billion cubic feet of water. In the spring of the year floods sometimes come with the rush of 110,000 cubic feet per second but at other times the river flow dwindles to only a few hundred cubic feet per second. This irregular flow is smoothed out by the large capacity of the reservoir so that the power which the river can deliver in an average year will be about 425 million kilowatt hours. This ordinarily will be used to fulfill system peak load requirements and during periods of plentiful river flow the plant may be operated as a base load plant.

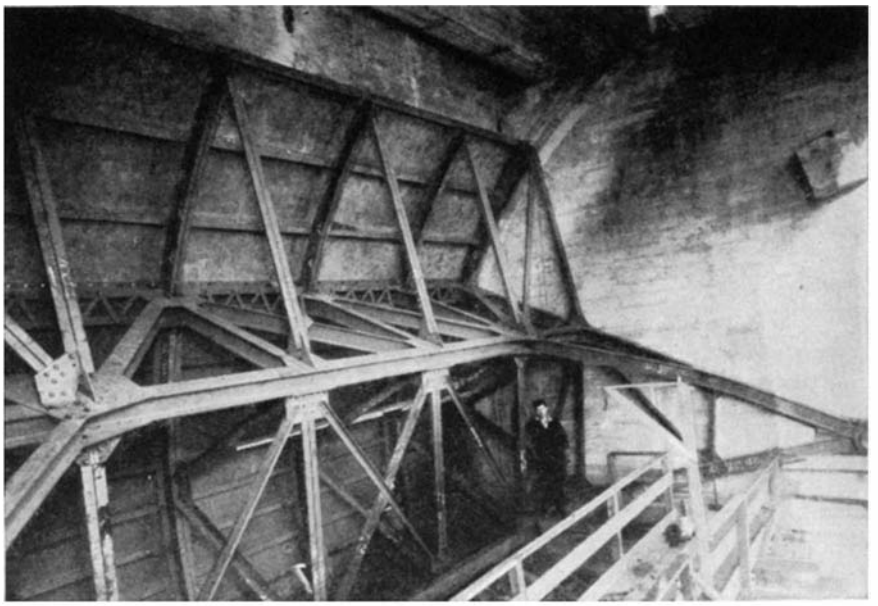
THE development consists of a solid concrete dam of gravity section and a power station built integral with the dam. The dam is approximately one half mile long and has a maximum height of 148 feet from bedrock to the floor of the bridge over the top of the dam.

The power station section, which is located in the old river channel, is 511 feet long. At the left of the power house, looking downstream, is a short retaining section and at the right is a spillway which is 520 feet long. From the spillway to the right bank is the main retaining section. The dam is surmounted by a roadway which serves as the river crossing of United States Highway No.

54 which formerly crossed the river on a ferry. An inspection tunnel is built into the dam above the ordinary level of the water downstream for most of the length of the dam.

The spillway section is equipped with 12 Tainter gates, each 34 feet wide by 22 feet high, weighing 54,000 pounds. These gates will be used to discharge flood waters over the concrete portion of the spillway and to regulate the reservoir water levels. When they are all raised they will permit 156,000 cubic feet of water per second to flow over the dam.

The power house, which is built as part of the dam, consists of a headworks or intake section, an electrical bay, and the main operating room. In addition, space is provided at the east end of the power house for the assembling and dismantling of equipment, machine shops, offices, and other auxiliary service equipment. Provision is made for eight main water-wheel units and two auxiliary units. The steel head gate for each main unit is 27 feet high by 27 feet wide and weighs 137,000 pounds.



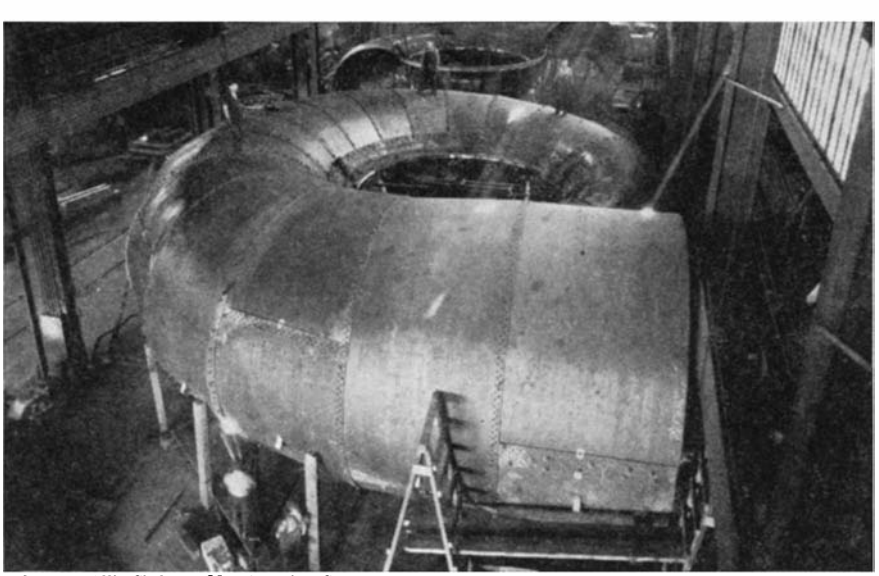
The flood level of the reservoir is regulated by 12 Tainter gates which, when closed, rest on the crest of the concrete spillways. Gantry cranes raise them

THE electrical bay is located between the headworks section and the operating room and contains the electrical apparatus with the exception of the main transformers, the high tension disconnecting switches, the lightning arresters, and carrier current coupling condensers, which are located on the roof.

The operating room is located adjacent to the electrical bay and is of particular interest in that the superstructure ordinarily provided over the generating units has been omitted and the usual operating and turbine rooms have been combined into one room. The omission of the superstructure effects a material saving and is made possible by the use of umbrella type generators in which the main bearing is not located on top but beneath the rotating part of the generator. Each main unit is provided with a metal cover which projects just above the roof of the operating floor. The entire cover is removed when complete dismantling of the unit is required and a small circular hatch in the cover permits general maintenance work on the generators.

The six main water-wheel units are the vertical shaft, Francis type, and have a rated capacity of 33,500 horsepower under the normal head of 90 feet and revolve at 112.5 revolutions per minute. Each water wheel is direct-connected to an umbrella type generator, rated 23,888 kva., at 0.9 power factor, 13,800 volts, three phase, 60 cycles.

The two gantry cranes which travel the length of the power house and spillways and operate both the head gates and the spillway gates



Courtesy Allis-Chalmers Manufacturing Company

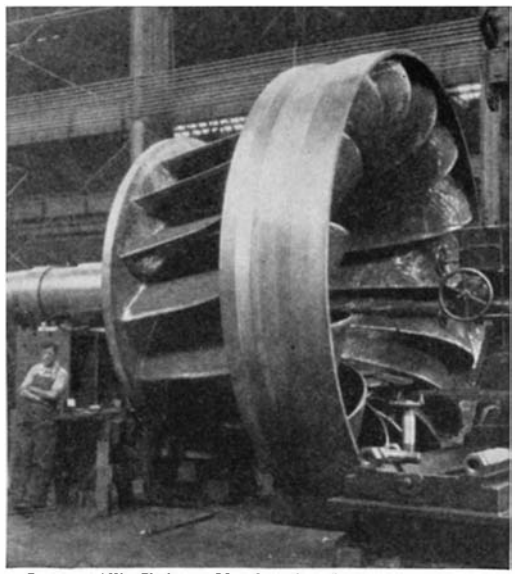
Shop-assembly of one of the scroll cases. It is 19 feet in diameter at its larger end and will deliver 4000 cubic feet of water per second to the water wheel

The power output is transmitted at 132,000 volts by means of three-phase transmission lines. One extends to the Page Avenue substation in St. Louis, a distance of 136 miles over right-of-way which was purchased sufficiently wide to permit the construction of another single circuit line in the future. A double circuit line 120 miles long is built to Rivermines and is connected at that point to a smaller line from the large steam power station in St. Louis known as Cahokia. Rivermines is a central distribution point for the lead district.

The problem which confronted the engineers was to build the plant and deliver power to St. Louis in the short space of two years and four months.

This involved the control of the river; the excavation of 920,000 cubic yards of earth and rock; the placing of 551,000 cubic yards of concrete; the construction of two transmission lines, the shortest one 120 miles long; and the preparation of 95 square miles of reservoir area which in surveys alone included the staking out of more than 2500 miles of line.

A railroad four and a half miles long with a bridge across the Osage River was extended from Bagnell to the site of the work. A village was established on the bluff above the river to accommodate 1200 men and 73 families. The living quarters consisted of bunk-houses to accommodate 28 men each; 10-room foremen's bunk-houses having individual rooms for each man; and family cottages. A central mess hall was equipped to care for 960 men at one time with provision for extension to an ultimate capacity of over 2000. A club house, hospital, school, and miscellaneous service buildings completed the village which was equipped with water and sewerage systems and protected by police and fire departments. The maximum number of men employed at one time was about 4400 who were working at the dam site, on the transmission lines and in various parts of the 95 square mile reservoir.



Courtesy Allis-Chalmers Manufacturing Company

One of the six 33,500-horsepower water wheels being prepared for the new project

THE first consideration in the construction program was the excavation of the overlying alluvial material and gravel above the foundation rock. The general program of construction was to cofferdam the spillway and west abutment areas, which are located on the flood plain of the river at the west side of the valley, and to complete the excavation for this part of the work. The west abutment and spillway were then completely concreted except for notches and sluiceways, the bottoms of which were located at the normal river level to provide for later river diversion.

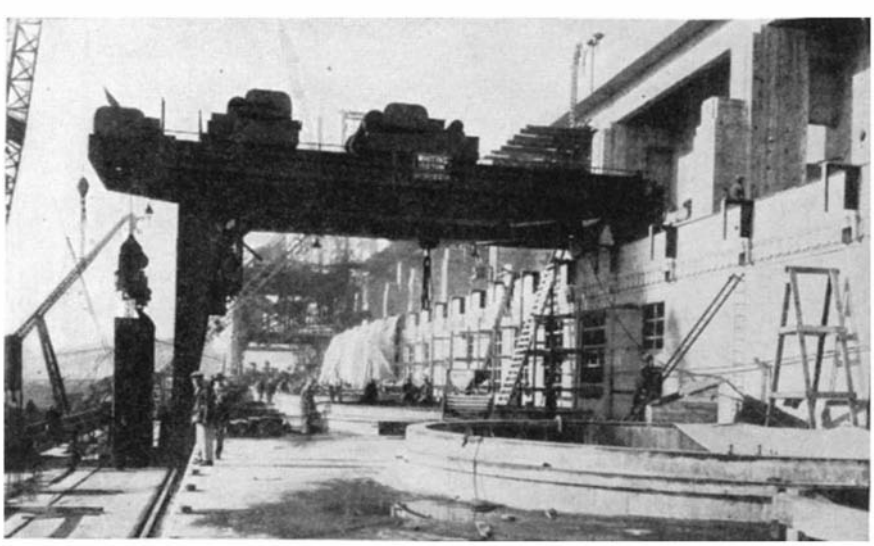
The excavation for a diversion channel having been carried on simultaneously with the work on the west abutment and spillway portions of the dam, the river was diverted through the temporary notches and sluiceways in the spillway when the concrete in these parts of the structure was completed to sufficient height. The main power station cofferdam, which extended across the original channel of the river, was then closed and unwatered and the erection of the permanent power-house structure begun. With this plan of operation, work could go on without interruption even though a river flow as high as 90,000 cubic feet per second should occur. With the dam complete, the filling of the reservoir could proceed by dropping 80-ton sliding gates in front of the sluiceways through which the river was passing, leaving open only those required to keep a minimum flow in the river below until such times as the reservoir should be full and pass over the spillways or through the passages to the turbines.

Before the filling of the reservoir could proceed, a great deal of work in connection with it had to be accomplished. It was necessary to clear the flooded area of 30,000 acres of trees, 900 miles of fences, and all other floatable material to the satisfaction of the United States Army engineers representing the Federal Power Commission. Before this could be done the high water shore line of the reservoir had to be determined and staked out in order to locate definitely the limits to be cleared. In making these surveys more than 2500 miles of survey lines were run. One town of about 450 inhabitants, a county seat, was below reservoir level and was entirely demolished. Scattered over the 61,000 acres to be flooded was a total of 2850 graves, located in 32 cemeteries and 74 isolated spots. The bodies were removed and reinterred in cemeteries located on higher ground.

IN building the dam, the 551,000 cubic yards of concrete were placed in less than a year. It was all mixed in a battery of four 66-cubic foot concrete mixers which turned out a maximum of 113,000 cubic yards in one month, which is believed to be a record unequaled for work of this kind. In one day when 5082 cubic yards were poured, it was necessary to operate on somewhat less than a 2½ minute schedule continuously during 24 hours, but all mixers were automatically locked to insure a full two minute mixing period after all material had been introduced.

The work on the reservoir and at the dam went forward with such good speed that it was possible to drop the "bear trap" gates across the sluiceways in February of this year in time to store the spring floods. The first wheel went into operation in June and the plant which is now nearing completion will be finished well ahead of the scheduled time.

Mr. Louis H. Egan, President of the Union Electric Light and Power Company and Mr. A. L. Snyder, General Manager of the Osage Project, were in executive charge for the Union Electric Light and Power Company. Stone & Webster Engineering Corporation were the designers and builders.



A gantry crane capable of lifting 150 tons can be placed over any generator to assist in repairs or, if necessary, to remove both generator and water wheel

●

As a fitting sequel to the article on the telephone in this issue, we have scheduled for a coming issue an article on international radio-telephony.—The Editor.

TO STOP SOIL EROSION LOSSES

SEVERAL years ago the Department of Agriculture began an intensive campaign against soil erosion that promises to save farmers of the country millions of dollars each year. That campaign is now taking definite form in the erosion prevention work of the first regional erosion stations that have been established in widely separated areas, according to Dr. Henry G. Knight, Chief of the Bureau of Chemistry and Soils, who recently returned from an inspection trip to the middle west, northwest, and Pacific Coast states.

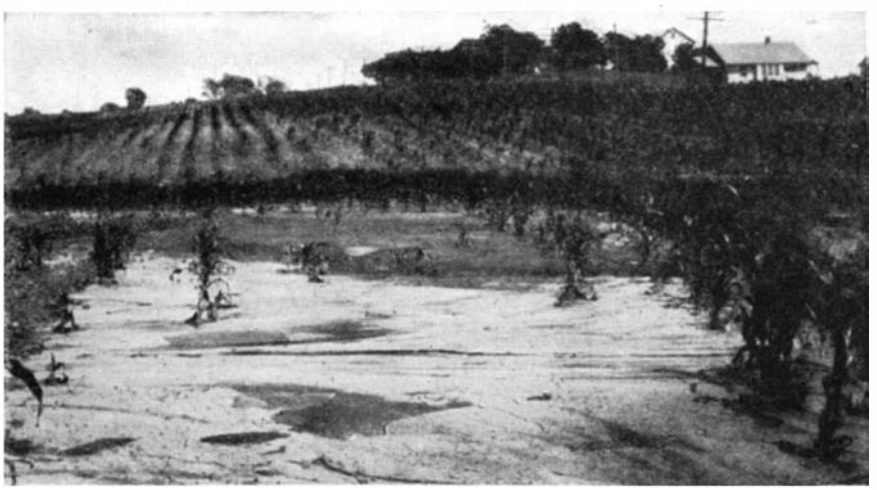
The Seventieth Congress appropriated 160,000 dollars for use by the Department of Agriculture in experiments looking to the prevention of the enormous losses of soil and soil fertility in the United States due to rainwash and gullying. The Forest Service and the Bureau of Public Roads are co-operating with the Bureau of Chemistry and Soils in the campaign against erosion. These losses total approximately 200,000,000 dollars annually, according to latest estimates.

MOST of the funds which have become available for erosion work have gone into the establishment of regional erosion stations. The first seven of these stations have been located in the red-land regions of Oklahoma and Texas; the gray lands of northern Missouri and southern Iowa; the black lands of central Texas; the light-colored sandy lands of southwest Arkansas, northeastern Louisiana, and east-central Texas; the southern piedmont lands of Virginia, North Carolina, South Carolina, and Georgia; the northern piedmont lands of New Jersey and Pennsylvania; and the dark prairie lands of west-central Kansas.

These stations are established on farms where erosion is a serious regional problem, and are for studying methods of erosion control and of holding on the land more of the rainwater.

Doctor Knight visited the erosion stations at Bethany, Missouri, and at Pullman, Washington, where the necessary equipment has been installed and where sheet erosion or run-off is being measured on experimental plots. Plans for field operations are under way at the station recently established in Page County, Iowa. He found that the farmers are keenly interested in the practical work of the stations, particularly in the terracing of cultivated fields, long a successful erosion-prevention measure in parts of the South but which is new to the western and middle western farmers.

A terrace nearly completed in North Carolina. Following the contours of a field, terraces such as this prevent the downhill rush of soil-washing rainwater

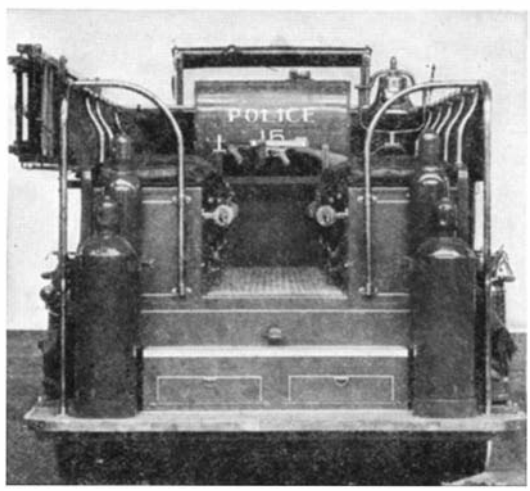


Sheet erosion on a Missouri farm. It has washed the productive top soil from about 50 percent of this farm. Terracing would put a stop to this great loss

Photographs courtesy United States Department of Agriculture

Land erosion of this sort, often seen in the South, can be stopped only by the construction of strong barriers or by the growth of hardy vines and bushes

Above: Emergency Squad No. 2 leaving quarters in charge of a sergeant. The full crew numbers eight. *Right:* Rear of truck showing equipment, including machine gun. Lockers carry tons of equipment



MEETING THE EMERGENCIES OF A GREAT CITY

By ALBERT A. HOPKINS

AN emergency may be defined as "a sudden condition calling for immediate action." The average person is so poorly equipped to cope with an emergency, principally because of lack of training, that policemen and firemen have always been valuable aids in emergencies, big and little. The New York Police Department has a most interesting division which is devoted exclusively to emergency work. In 1925 a truck was purchased and provided with certain emergency appliances and was manned by a sergeant and a picked crew. The usefulness of the idea became so patent to all that there are now 19 elaborate trucks which cost Father Knickerbocker 14,000 dollars each. This service was largely developed through the instrumentality of Police Commissioner Edward P. Mulrooney and Chief Inspector John J. O'Brien.

The squads are located at strategic points in all five of New York's boroughs. During the summer, emergency squads are assigned to both Coney Island and Rockaway Beach, New York's great pleasure resorts. These specialized policemen are carefully selected for this exacting service. The entire personnel consists of one inspector, one deputy inspector, seven lieutenants, 62 sergeants, and 405 patrolmen. Day and night these men await calls through the switchboard that has the most famous telephone number in the world, "Spring 7-3100." A lieutenant on desk duty in the Emergency Service Division is responsible for the proper and efficient handling of all calls.

Special courses are given in the Police Academy, in an annex to Police Headquarters, so that every man is instructed in first aid, steam boiler troubles, the method of disassembling locks of cells, passenger and freight elevator failures, and traction emergencies (street railway, elevated, and subway). They are also instructed in the hazards encountered with high-tension electric wires and poisonous gases. On the roof of the annex is a gas chamber for demonstration and instruction purposes. This chamber can be filled with lachrymating gases, sulfur, or ammonia fumes and the use of gas masks is here taught. Preference is given to mechanics in the selection of applicants. Practically all the duties previously performed by the Police Reserves have been taken over by this division, releasing thousands of men for police duties. The squads co-operate with the Fire Department in maintaining fire lines and otherwise assisting at fires. In certain districts squads respond to even a first alarm.

BEFORE giving an idea of the calls made upon this division, it might be well to call attention to the truck and the splendid equipment carried thereon. The trucks themselves are of the highest order of workmanship and are driven by a 57-horsepower motor. An inhalator is carried on each side of the driver's seat which accommodates the sergeant and the chauffeur. In the center of the car is a runway flanked by lockers and seats for the squad. Two hundred and fifty-seven units make up the equipment of each truck. Included are 1500 feet of rope, ladders of all kinds, life gun case and canister, cutting torches, jacks, life belts, belly bands for horses, gas masks, acetylene and oxygen tanks, boat hooks, stretchers, axes, sledge hammers, crowbars, grappling hooks and grappling irons, block and fall, shovels, wedges, tools of all kinds, surgical kit, and many other pieces of gear too numerous to mention. There are also the machine gun, two rifles, two shot guns, 2100 rounds of ammunition, tear gas and smoke bombs, and bullet-proof vests.

You may well ask why a humanitarian outfit on wheels like this should be equipped for war. It is all a part of their job. They may be dragging a pond for a drowned boy and an hour later be called to keep order at a communistic meeting or to disperse a crowd. Usually the appearance of the huge green car with its grim-faced policemen

(all in uniform) and two shrieking sirens strikes terror in the hearts of the wrongdoers or those who would like to do wrong. Riots can never assume very large proportions when such truck loads of law-enforcement officers can be transported at top speed from a nearby station house.

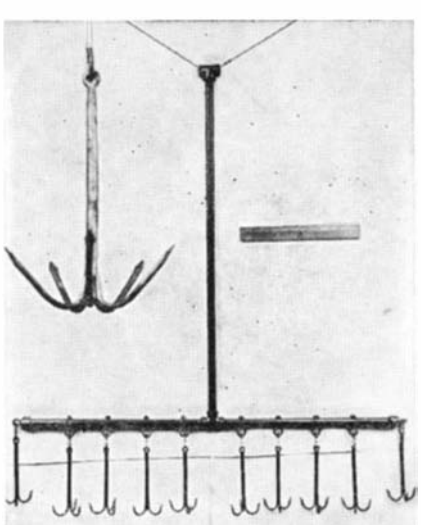
DURING the period of April 1 to December 31, 1930, the various squads answered 2585 calls of every description, from removing a marooned cat from the top of a tree to rescuing persons from gas filled chambers, but the big majority of all these cases might well be termed "errands of mercy." In all, 533 human beings were saved from the effects of gas and drowning, during this period, that otherwise would be now before the "throne of the Almighty," as one of the lieutenants pithily remarked.

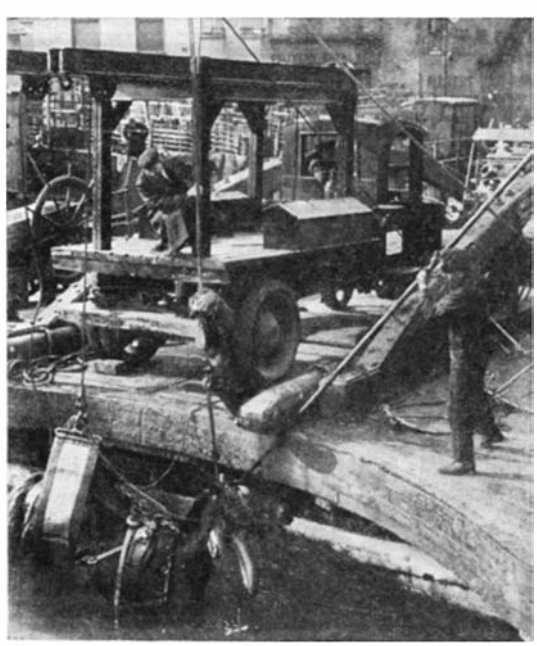
Instructions are given in the use of the inhalator, two being carried on every truck. The gases involved are ammonia, carbon-monoxide, chlorine gas, illuminating gas, cyanogen-chloride gas, sulfur-dioxide gas, and smoke fumes. Accidents to vehicles on the roads, from excavations, and from the water totalled 241 cases in the time mentioned. Wrecked airplanes came in for attention in four instances. Overturned boats were righted, persons were rescued from cave-ins and collapsed buildings, and many were released from stalled elevators. Then there was an assortment of explosions to be dealt with and dangerous signs and fallen trees to be removed or roped up. Ten animals were released from trees, 25 horses removed from rivers, excavations, and places where horses should not be; even two escaped steers were captured. It is no fun to be caught in a vault or locked in an empty building on a cold night, but the emergency service cares for all. Even the government requisitions the service to destroy stills. This is not a type of service, however, which is relished and it is hoped that some time Uncle Sam may buy a few torches and some acetylene.

One of the lieutenants tells us an interesting story. He had been in the Bronx to help direct the grappling for the bodies of three drowned boys. He returned just as an alarm came in that a brokerage house was being held up in Broad Street. He had just time to swing on to the broad step of "No. 2" as it started its dash downtown.

A member of the squad was assigned to cover an adjacent courtyard. He saw a man climb out a window of the eighth floor and start down a fire escape stairway. The man was carrying a revolver. When he reached the third floor the rifleman took aim and cried "Halt!" The crook was about to take a pot shot at the officer when *crack* went the rifle and the bullet took effect in the criminal's head.

We are indebted to Inspector Daniel A. Kerr and Lieut. M. J. Murphy for valuable assistance in securing pictures and other material for this article.





Above: **Candidates for duty in the Emergency Service Division receiving instructions from a member of the Marine Division on the proper way of grappling for bodies.** ***Left:*** **Grappling irons and grappling hooks are vicious looking instruments. The mushroom grappling iron is used for automobiles, et cetera, while the gigantic fish hooks are for human bodies.** ***Upper Right:*** **Pent house of Police Academy converted into a laboratory for demonstrating tear gas bombs and the use of gas masks.** ***Right:*** **Horse overboard; police put on dungarees, haul him out, and then notify the A. S. P. C. A.**

THE BIG NOISE BEHIND THE 'MIKE'*

WHEN out of the night and your loudspeaker comes the screaming whistle of fire apparatus, the rumble of distant thunder, the roar of the wind, the crackling of a fire, the chirp of a canary, the blare of a taxi horn, the heavy drum of a cloudburst, or the sound of waves gently breaking on a sandy beach, you know the genius of N. Ray Kelly, sound technician for the National Broadcasting Company, is at work.

Mr. Kelly has invented and developed many machines for the reproduction of sound effects, and a visit to his penthouse laboratory will soon have you believing that you have been in the yards of a great railroad or that you have just weathered a blustering storm.

Ray Kelly, chief sound effects engineer of the National Broadcasting Company, and a few of the unique instruments which he has designed for producing various sounds for broadcasting

The newest of a long list of sound-effect instruments is a simple wooden box, approximately three feet square. It contains a conglomeration of apparatus calculated to reproduce accurately the noises coincident with modern railroad operation. It is called the "one man railroad" and, if all goes well, Kelly expects to have his latest "gadget" on the air during railroad programs within a very short time.

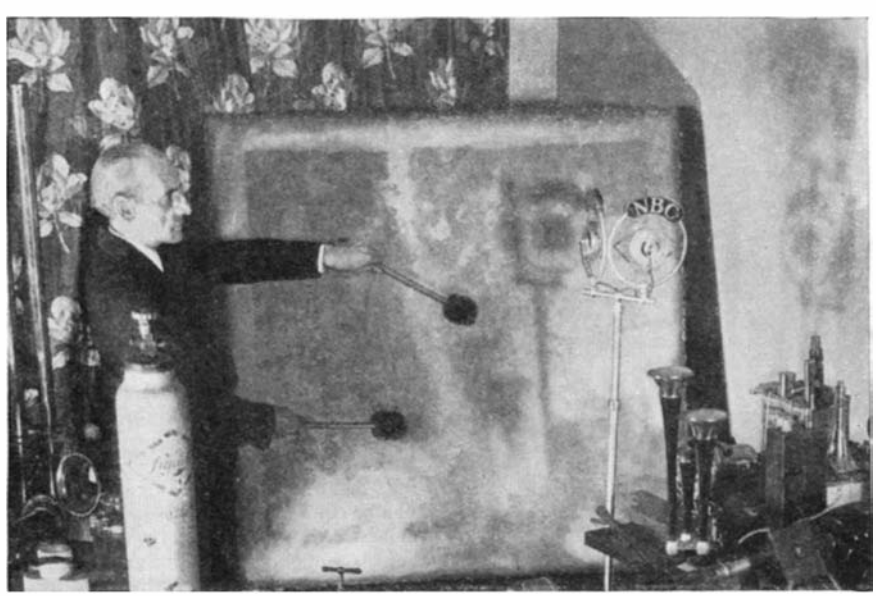
There are scores of sound effect devices in use on NBC programs, most of them invented by Kelly. But this versatile engineer admits that the "one man railroad" intrigues him most of all. It is his brain child, the favorite of a large and successful family.

To capture accurately the chugs, the puffs, the hiss of steam exhausts, the clickety-click of rail heads, the shriek of whistles, the grinding of brakes, the clank of driving rods and other associated rail racket, Kelly spent hours at the Sunnyside, Long Island, yards of the Pennsylvania Railroad. The business of developing realistic sound effects for a nation-wide and critical audience is no haphazard job for this conscientious craftsman. Work, study, and experiment are necessary to success in this very interesting vocation.

While at the Long Island yards Kelly listened raptly to "booster" engines, Pullman cars, gondolas, and other rolling stock. He stored away a knowledge of the conglomerate noises, he memorized the shriek of brakes and the scream of whistles, he timed the puffs of the locomotives and studied the clank of shifting switches. Not one detail of sound escaped his listening ears.

But the "one man railroad" is only one of his developments. He points with pride to sound apparatus that clutters his lofty workshop. With a wave of the hand he will indicate an entire "garage" on a wooden board two feet square, to which are nailed a great variety of automobile horns, including the hair-raising fire department siren. By pressing a few buttons he can reproduce a fleet of taxis, the mad rush of fire apparatus, or the blaring horns of a New York theater-hour traffic tie-up.

The bewildered visitor scarcely has time to make the acquaintance of the "garage" before Kelly blandly comments "Gosh, it sounds like a thunder storm outside," and sure enough, whango! goes the roar and rumble of celestial artillery. The visitor has just come in from the sunny, snow-covered streets and the seeming anomolous weather is explained only when Kelly shows him the big "thunder drum," a four-foot frame across which, see illustration below,



The reverberating roar of a thunder storm crashes from the loudspeaker. In the studio, the sound comes from a tightly stretched square of heavy parchment

*Photographs and text courtesy *Good News*, R. C. A. Radiotron Co., Inc.

heavy parchment is tightly stretched.

Kelly next pulls a cord running through the skin-covered bottom of a pail, giving a very terrifying imitation of a lion's roar; whistles blow in realistic imitation of a dozen different birds; a threshing machine bangs and rattles as a bit of intricate machinery and a baby's rattle are agitated.

Sometimes Kelly conducts his visitor to a vacant studio, arranges a microphone and escorts his guest into the glass windowed monitor room. Returning to the studio microphone, Kelly crumples some stiff paper before the open end of the "mike" and the visitor is surprised to feel himself transported to the side of a crackling fire.

Still standing before the microphone Kelly taps his head with a padded stick and the onlooker is ready to swear he has heard a dog thumping his tail. In fact many people do swear it. We hear rifle or pistol shots. But it is only Kelly striking a padded board with a flat stick, as he explains quite seriously that shell explosions and the actual use of machine guns might completely wreck expensive studio equipment.

The creaking of a porch swing is reproduced by gently rocking back and forth in an old rusty swivel chair placed before the "mike." Animals are heard crashing through the underbrush when Kelly squeezes the straws of a household broom, and the sound of steady rain is produced when excelsior is rubbed against the microphone frame. A torrential downpour is effected by pouring salt on wax paper held before the "mike."

"Many sound effects are obtained by sheer accident," Kelly explains. And to carry out this statement he cites that particular occasion when an announcer stood absent-mindedly rubbing his fingers across the teeth of his pocket comb and developed the mournful notes of a tree toad.

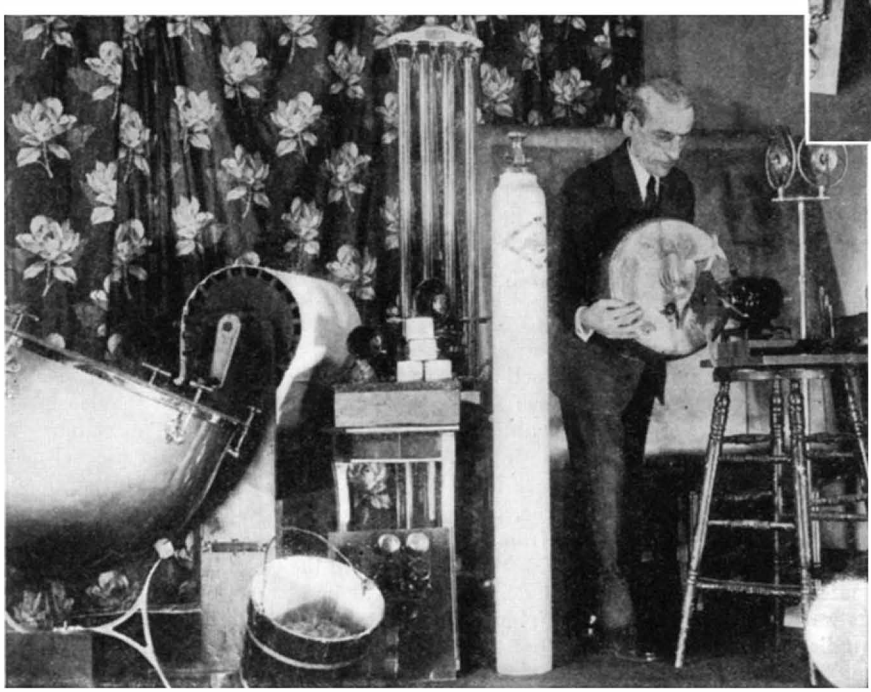
The gentle washing of lazy waves along the ocean front is reproduced by a circular wheel with an eight-inch hollow rim covered by copper screening, inside of which rolls a handful of hard-dried peas.

The wind machine is probably the best known device. It consists of a canvas sheet laid over a paddle wheel winch. As the winch handle is turned the paddles beat against the canvas. At high speed the sound is like that of a howling gale; at low speed, perhaps a gentle summer breeze. Winds of all degrees of velocity are reproduced on this machine and storms have been created that have put nature to shame.

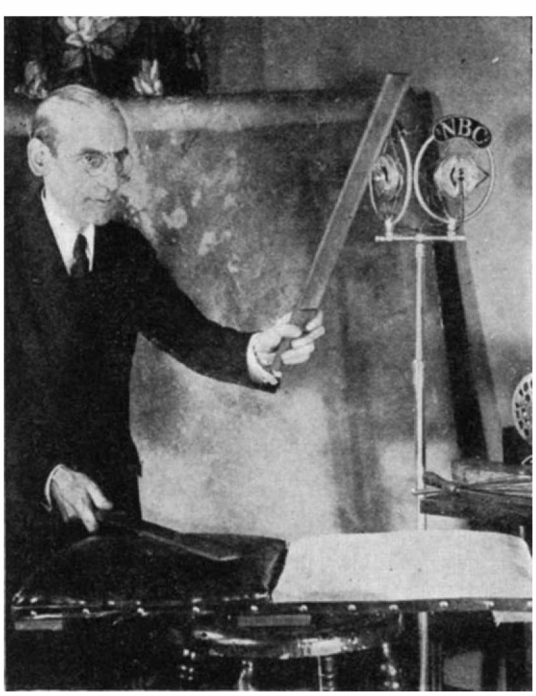
KELLY has a broken-down automobile in the NBC laboratory. It is not a real one. It is merely a battered wash boiler filled with assorted junk and equipped with a small electric motor, to the shaft of which are attached several pieces of leather strap. As the motor runs, the boiler is shaken by hand and the leather straps beat against the debris. It really sounds like an antique "horseless carriage" trying to come down the street.

Many modern programs must have their airplanes. Consequently, another use of straps is to reproduce the hum of airplane engines. An electric motor whirls leather straps against drum heads at varying speeds ranging from the slow sputter of warming motors to the high-pitched drone of the take-off.

Ray Kelly declines to estimate the amount of sound effect apparatus operated by NBC, explaining that the tendency is continually to improve the devices and lay aside equipment which has become obsolete.



Above: **A locomotive pulls out of a station; a drum and compressed air tank furnish the sound.** *Left:* **Straps whirled by a motor strike a drum and simulate an airplane**



Rifles crack and pistols bark, but the sound comes from leather pads struck with paddles

THE EARTH BENEATH*

By ERNEST A. HODGSON

The Dominion Observatory, Ottawa
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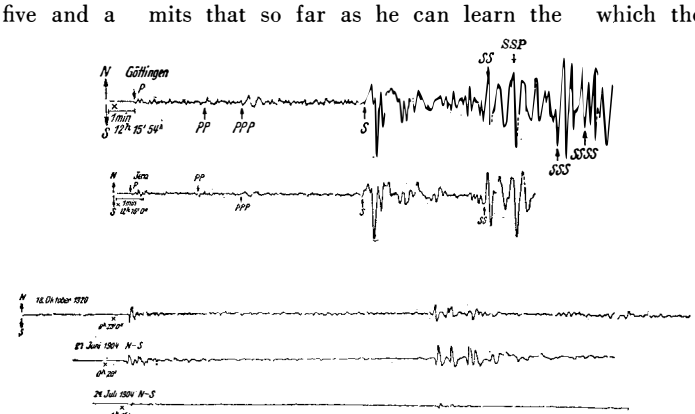
ASTRONOMY first taught us something of our earth as a whole. That science was partly responsible for, and greatly assisted the voyage of Columbus which demonstrated that one could cross the Atlantic without, at least, falling *off*. The idea that the earth is spherical is now general except in Zion City, Illinois. Astronomy measures for us the radius of our planet, finding it to be about 4000 miles, the circumference being nearly 25,000 miles. Astronomy mothered geodesy which has demonstrated that the earth is a spheroid.

The shape and size of the earth being known, mathematical physics, also an offspring of astronomy, informs us that the average density of the earth is 5.6 (in c.g.s. units). It weighs, therefore, volume for volume, five and six-tenths times as much as water. This statement may be taken as a convenient cross-over to geology. Physics and allied sciences are able to tell us only *average* values for conditions within the earth; the average density, the elasticity as a whole, the mean value of gravity; the details are notably lacking. The geologist is concerned with surficial details. Informed that the earth, as a whole, weighs a little more than five and a half times as much as an equal volume of water, he states that the granite, marble, limestone, dolomite, and so on, which form the bulk of our surface rocks weigh only about half as much, volume for volume, as the earth as a whole and that therefore there must be much denser material below. The questions throng: how far down do the surface rocks extend? what distribution of densities exists within the earth? in what physical state do the materials exist—solid, liquid, or gas? We are curious to investigate what lies within "the earth beneath."

THE miner has the terse expression, "Beyond the pick it is dark." If this be so, how far may we penetrate below the surface? The deepest mine in the world is the Saint John del Rey, in Brazil. This gold mine was begun in 1834. In 1924, it had reached a depth of 6726 feet. The bottom of this mine is not, however, the point nearest the center of the earth to which man has penetrated. The Calumet and Hecla mines in Michigan, though only about 6000 feet deep, reach a horizon 4600 feet below sea level, said to be the point nearest the center of the earth on which man has been able to tread. The South American mines being in the mountains, their greater depth of shaft does not penetrate so far below sea level. The number of deep mines or deep bores is small; their cost is enormous. To what depth have you personally inspected the interior of the earth?

If physics deals with generalities, geology studies details—but practically only surface details, as we have said. True, time has broken and uptilted parts of the earth's crust, exposing at the surface that which must once have lain at considerable depth. True, also, volcanoes bring up materials from below, though from what depths these materials come is not so well defined as we could wish. The geologist, having studied the earth's surface features, admits that so far as he can learn the average density of the surface crust is only about half as great as that of the earth as a whole. We leave him as he argues from the known to the unknown; from the observed to the conjectured; from the fact that near the surface the temperature increases about 1° Fahrenheit for each 90 feet in depth, to the possibility that at a depth of 40 miles the temperature may be about 2300° Fahrenheit or the "white heat of the blacksmith's forge"; from measures of the elasticity and compressibility of rocks under high pressures in the laboratory to conjectures as to their properties at great depths within the earth. We turn to seismology for the decisive tests of any theory as to the structure of the earth.



After Gutenberg, in Borntrager's "Handbuch der Geophysik"

Figure 1: **Typical seismograms of distant quakes. First come the longitudinal or "P" waves. Later the "S" or transverse waves begin to arrive. The "S" waves have greater amplitude**

For some, an earthquake is a rare phenomenon of passing, if for the moment absorbing, interest; for others it is a dreaded nightmare of horror. To the engineer, it is a factor in his problems of design; to the insurance agent and the financier alike it is a risk; to the newspaper man it means business; to the geologist it is a tectonic agent; to the seismologist it is all of these and more.

OUR subject requires us to consider the earthquake as a release of energy—the agent which despatches a signal to be registered on the seismograph set up at each of a network of stations distributed over the globe. The signals are there recorded after having traversed the earth for various distances and along various paths, after having penetrated to various depths. The nature of the records indicates the paths by which the signals reached the instrument, the properties of the materials through which they passed. They are thus worthy of the greatest care in our choice of the network of stations, our design of instruments and vaults, our maintenance of continuous recording and accurate timing, our thoughtful study.

Our first problem may be stated thus: At what depth do earthquakes release their signals? Some undoubtedly occur on the surface, though, presumably, the causal movements extend deep into the earth. Others leave no traces of permanent shift at the surface. The added fact that they are sensibly felt over wide areas indicates that they originate far below. We can arrive at a conclusion with regard to depth of focus, as it is called, along different lines of reasoning. Dutton used as a means of determining depth a consideration of the rate at which the in-

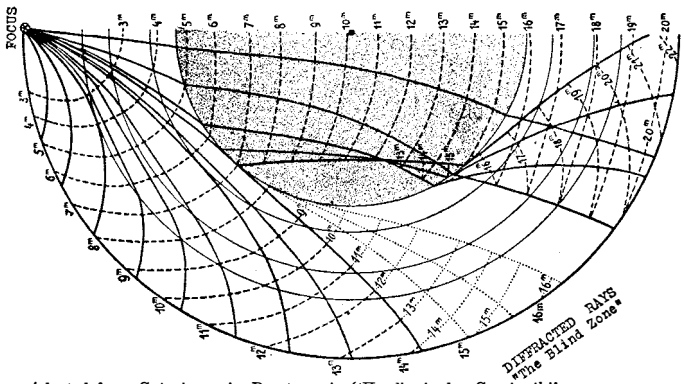
*Reproduced by courtesy of the *Journal of the Royal Astronomical Society of Canada*, Toronto

tensity falls off as the disturbance spreads out in all directions from the focus and makes its effects apparent at the surface. He concludes that the maximum depth of focus is of the order of 20 miles. Walker, working with Galitzin's measures of the angle at which the seismic rays emerge from the earth at the different stations in the vicinity of the focus, deduces that the depth of focus is of the order of one-fifth the earth's radius—800 miles! Omori, making use of the duration of the preliminary tremors of earthquake records, deduces that the mean depth of earthquakes in the Kwanto province of Japan is of the order of 21 miles. Gutenberg studied the curve showing the time of arrival of the first tremors and determined for an earthquake in the Schwabian Alps a depth of 34 miles.

A recent paper by Wadati deals very thoroughly with the various methods. He finds that the Japanese earthquakes fall into two groups, which he terms respectively shallow and deep. "The deep earthquakes take place at the depth of more than 300 kilometers (186 miles), while the shallow ones at about 40 kilometers (25 miles)." Gutenberg, in a recent publication, tabulates the values of depth of focus as determined by nine different seismologists for 16 different earthquakes. With the single exception of Wadati's deep earthquakes, the determinations all lie at depths of 28 miles or less. Seismologists generally agree that the data for determining the depth of focus are not as precise as could be desired but that earthquakes probably originate, in general, at depths of 25 miles or less.

THE uncertainty with regard to the depth of focus is due largely to our uncertainty as to the velocity of propagation of the seismic waves in the uppermost layer of the earth's crust. To determine this velocity we must have an earthquake of which we know, accurately, the time of occurrence and the depth of focus. We can be sure of this last requirement only where the depth is zero, that is where the focus is at the surface. On February 18, 1911, a disturbance was registered which was traced to the Pamirs, in central Turkestan. Investigation showed that a great slide had occurred in which from 7 to 10 billion metric tons of rock had fallen a distance of from 400 to 800 yards. The tremors, registered on the seismographs at Ottawa and generally throughout the world, were believed to have been the result of the rock fall. The exact time of the fall could not be determined. Moreover it is now questioned whether the fall was the cause or the result of the earthquake. Such a question could be raised in the case of practically any such earthquake. We fall back upon the velocity of earth tremors generated by an explosion.

The velocity of seismic waves has been studied in the case of a great explosion at Oppau, in the works of the Badische Analin und Sodafabrik in the Bavarian Palatinate on September 21, 1921. The tremors were registered at five seismograph stations ranging in distance from 68 miles to 227 miles. The chord from Oppau to De Bilt—the farthest station—dips only about two miles below the surface at the middle of the arc. We may thus consider the waves as being well within the upper layer of the earth. The exact time of the explosion is known within one second. The records give the velocity of propagation of the most rapid tremors as 5.4 kilometers (3.35 miles) per second.



Adapted from Gutenberg, in Borntrager's "Handbuch der Geophysik"

Figure 2: **How science knows the earth's core is iron: the "blind spot," coupled with the laws of refraction, shows it**

But one swallow does not make a summer. It was desirable to check the value of the velocity by means of other explosion records, especially as the velocity as determined for waves generated by earthquakes of presumably shallow focus was found to be 7.1 kilometers (4.4 miles) per second. Accordingly, in May, 1924, four explosions, the first two of ten metric tons each, of melinite, the second two of five metric tons each, were exploded at La Courtine, in central France. The explosions being predetermined, arrangements were made to have precise timing and fast-speed chronographs, so that the records obtained were spread out sufficiently to be readily legible. The tremors were registered at three stations ranging in distance from three and a half to fifteen and a half miles. The mean value of the determined velocity for the most rapid tremors was found to be 5.5 kilometers (3.4 miles) per second, confirming substantially the results obtained from the records of the Oppau explosion.

This raises a further point. We have referred only to the velocities of the first movement as registered on the seismograph. The fact that high-speed chronographs were used at La Courtine to spread out the record implies that there were other onsets of value. There were.

Waves propagated in an elastic body (that is to say, a substance which has the power of recovering its shape if it is not strained beyond certain limits—and the earth is such a body) are of two kinds. The first is known as a longitudinal or dilatational type and the waves so propagated are called P-waves, since they are the primary or first registered. The other type is called transverse or distortional, the waves being termed S-waves, because they are the secondary registration, in point of time. The P-wave and the S-wave each travel through the earth from the focus to the station, by paths which may be for the present described as being somewhat concave upward, or as sagging below the chordal line joining the focus and the station. The velocity of each depends on the elastic properties of the earth, being greater, in each case, if the elasticity of the material along the path increases, but slowing down for an increase in density. The S-wave has the added important characteristic that *it cannot be propagated through a liquid.*

THE velocity of the first, fast tremor, found to be 5.4 kilometers (3.35 miles) per second in the case of the Oppau explosion, and 5.5 kilometers (3.4 miles) per second, on the average, at La Courtine, was that of the longitudinal vibrations—the so-called P-wave. The velocity of the S-wave was found to be 3.1 kilometers (1.9 miles) per second at Oppau and 2.8 kilometers (1.7 miles) per second in the mean at La Courtine—again a fair agreement. We thus have a measure of the velocity of propagation of the two types of waves in the uppermost layers of the earth's crust, based on observations of five separate explosions, registered at three or more stations in each case. Obviously we wish to add to our observational data of this nature.

To quote from our legal friends, "time is to be the essence" of our experiments. The nearest of the La Courtine stations was three and a half miles from the blast. The first tremor, marking the time of arrival of the P-wave, registered about one second after the explosion. The S-wave required about two seconds to travel the same distance. The difference in time of arrival was thus about one second in the case of the nearest station, and about four seconds

in the case of the farthest. To render the onset of the S-wave legible it was necessary to record the tremors at a higher speed than that generally used for earthquakes. Obviously, if the distance is increased to several hundreds or thousands of miles the difference in time arrival will be increased and, moreover, slight inaccuracies in the determination of the exact instant of arrival of either phase will not greatly affect the velocity determination.

In order to convey some idea of the manner in which the two types of waves make their appearance on a seismogram, the two groups of records of Figure 1 are shown. The arrival of P and S is indicated for the two seismograms of the first group. These are records registered at Jena and Göttingen, respectively—two German stations about 80 miles apart—of an earthquake which occurred at Kansu, China, about 4600 miles from the recording stations. One minute of record line is indicated at the beginning of the record and successive minutes can be seen on the original records as breaks in the line, a few of which are preserved even in the reproduction. The difference in time of arrival of S and P is here about 8 minutes and 50 seconds. To obtain a record such as this a line recording speed of from half an inch to an inch and a half per minute would ordinarily be employed, depending on the seismograph used and the purpose of the registration. Where S and P arrive within a second or so of each other, as in the case of a blast or explosion, it is customary to have a line recording speed of six or seven inches per second. Such a short-distance, but spread out, record would resemble those registered at Göttingen and Jena for the Kansu quake except that the serrations would be more numerous.

THE second group of records is also interesting. It shows the seismograms registered at Jena for three earthquakes, each of which originated in Kamchatka—about 5300 miles distant—in October, 1920, June, 1924, and July, 1924, respectively. This shows how strikingly alike are the records of the same instrument for earthquakes originating at the same epicenter.

We know from long experience that if an earthquake takes place as a sharp, well-defined, single shock, it will be registered at stations which are more than 700 miles and less than 7000 distant in such a manner that the arrival times of P and S can be definitely determined, the difference computed, and the distance from station to epicenter (that point on the surface vertically above the focus) read off from an empirical table or its graph to within 25 or 50 miles. Furthermore, we can, if the stations are equipped with proper apparatus for recording absolute time, determine the time at the epicenter so accurately that the values derived from the records of stations at distances within the above limits will agree within a few seconds. Moreover, the distances from each of three or more stations being known, for any given earthquake, the position of the epicenter can be determined with a surprising degree of accuracy. And, finally, this work has been done, with ever increasing accuracy, by various agencies since 1899, supplementing previous catalogs of felt earthquakes and giving us an analysis of the relative seismicity of the different parts of the earth's surface, which is very good indeed. This analysis is being continuously strengthened to-day by the efforts of over 200 stations, regularly operating seismographs and publishing data. Our time-distance curves are subject to but minor corrections for distances between 700 miles and 7000 miles. We know our seismic areas. The seismic history of many of these areas is already long-continued enough to be of value in various lines of investigation. From this hard-won, but firmly consolidated position we step forward into the front-line trenches, the active sector of seismological research.

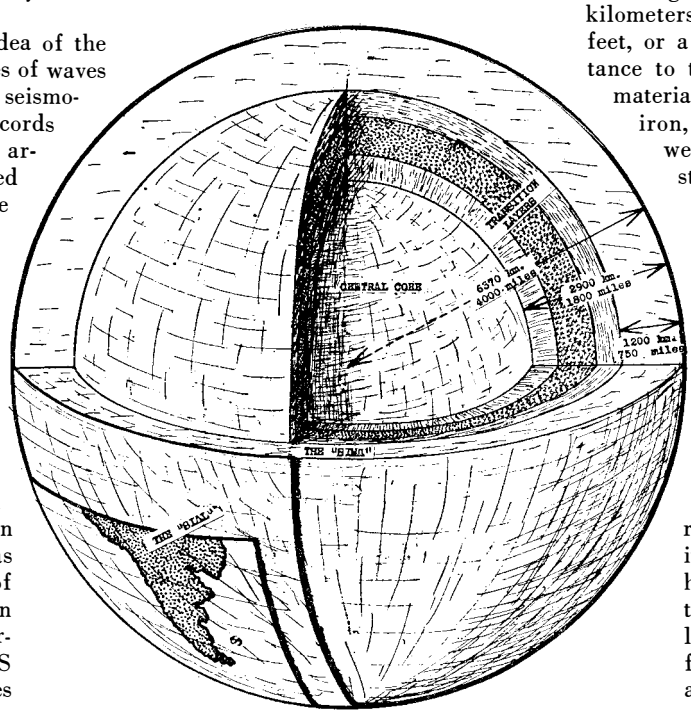


Figure 3: **The structure of the earth, exhibiting the series of concentric layers described later in the article**

All seismologists agree that the earth has a spherically layered structure, consisting of a central core surrounded by a series of shells of different thickness, each with its own distinct properties. The spherical surfaces separating the various shells are probably fairly well defined, that is to say the transition is relatively sudden. They are referred to as surfaces of discontinuity, or simply as discontinuities.

LET us consider first the central core. The surface of discontinuity surrounding it is believed to lie about 2900 kilometers (1800 miles) beneath our feet, or a little less than half the distance to the center of the earth. The material of the core is believed to be iron, with probably some nickel as well. If our earth is made of the stuff of which other worlds are made (and that seems a reasonable assumption), and if the meteors which occasionally fall to the earth are to be regarded as samples of that material, then we may infer a mixture of iron and nickel for the central core. Here we have a large part of the extra density demanded by the physicist to make up for the light surface rocks and average up the density of the earth to the 5.6 which he demands. The existence of the core is rather well established. The P-waves are refracted into its surface in such a manner that they fail to reach stations which are between 7000 miles and 10,000 miles of the epicenter, leaving the so-called blind zone as shown in Figure 2.

In what state is the iron of the core—solid, liquid, or gas? The question is still an open one. The fact that the S-wave will not be transmitted through a liquid or a gas suggests that we apply that criterion. This is not as easy as might be supposed. Some seismologists believe the S-wave has been identified after transmission through the core. Most are agreed, however, that it has not been positively identified, and some are frankly of the opinion that the central core is liquid or gas. It is supposed to be dense, under high pressure of course, but not an elastic solid. The velocity of the P-wave is high for the layer just outside the central core—about 13 kilometers (8 miles) per second. Within the core it drops suddenly to 8.5 kilometers (5.3 miles) per second. Does the density suddenly increase as you pass into the core, or does the elasticity become markedly less? Always we are left with questions, unanswered as yet but not unanswerable. Of such is the kingdom of research. Without them we should develop an orthodoxy of science which would be fatal.

The surface of discontinuity at the central core is, as has been noted, well-

defined. It is indicated by the "blind zone" and also by the sudden drop in velocity which, in turn, indicates either a sudden increase in density or a rapid falling off in elasticity or a combination of these. The fact that there is a sudden drop in velocity is deduced mathematically from the observational data of earthquake records—the so-called time-distance or travel-time curves. There is no other such well-marked sudden change of velocity with increase in depth as that which occurs at the entrance to the core. The other changes are less abrupt and are, in general, *increases* in velocity. The other discontinuities are thus not so well established, in fact or in position, as is that at about half way down the earth's radius.

ASCENDING from the 2900 kilometer level we traverse, in turn, three layers of slightly different properties, the two discontinuities separating them being so ill-defined that we are not sure where—or even whether—they are. The discontinuity which surrounds the triple layer is at a depth of 1200 kilometers (750 miles). The material composing these three layers is supposed to be silicon impregnated with iron. The iron content is supposed to increase for points successively nearer the core, and to be very small at the outer boundary at the 1200 kilometers discontinuity. The three ill-defined layers, taken together, constitute what is known as the transition layer. The transition layer and the core, taken together, are sometimes known as the "nife" (Ni=nickel; Fe=ferrum=iron).

The next discontinuity is much better marked; its excellence is certain; there is some uncertainty as to its position. It may chance to be different in different parts of the world. Much remains to be done in its investigation. The break is usually held to be at a depth of 60 kilometers (37 miles). It marks the upper boundary of the shell of silicon and magnesium usually designated as the "sima" (the name indicating the constituents). The increase in velocity with depth within this layer is so uniform that it is not believed to suffer any internal discontinuities. The density inevitably increases somewhat with depth due to the superimposed weight; the elasticity must thus gradually increase downward at a fairly uniform rate in the sima, and at a less regular rate in the transitional layer of the nife, until finally we get the great reversal, the fall in velocity, at the central core. Let us come back toward the surface and nearer home. What is the constitution of the upper 60 kilometers (37 miles) of the earth's crust?

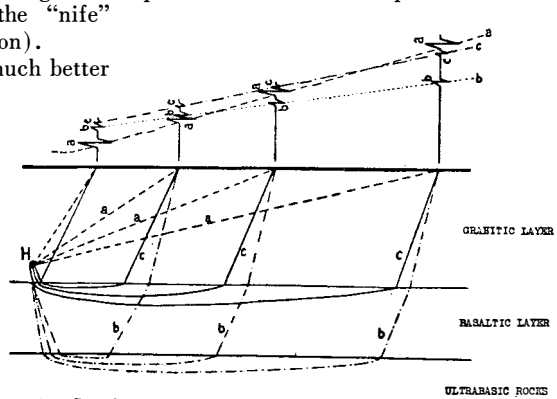
Jeffreys believes that there are three layers, separated by discontinuities at depths of 12 kilometers (7.5 miles) and 37 kilometers (23 miles). These he terms, in order descending, the granitic layer, the basaltic layer, and the ultrabasic layer, thus indicating the probable nature of their constituent rocks. The three taken together are known as the "sial" (Si=silicon; Al=aluminum).

To sum up, then: Beginning at the surface and continuing downward we have, in order—a layer of granitic rock 12 kilometers (7.5 miles) in thickness; 25 kilometers (15.5 miles) thickness of basalt; a 23 kilometer (14 miles) layer of ultrabasic rocks; 1140 kilometers (700 miles) of silicon-magnesium—the sima; a transition layer of silicon impregnated with iron, of a total thickness of 1700 kilometers (1060 miles); and, finally, a great nickel-iron core of radius 3470 kilometers (2150 miles). The best marked discontinuities are those at 60 kilometers and at 2900 kilometers.

Figure 3 shows in schematic form the various layers.

The discontinuities about which we should most like to know more are those at 12 kilometers, 37 kilometers, and 60 kilometers. We shall learn more about them only through a study of earthquake waves and waves generated by explosions. If you look over the edge and into a cup, diagonally so as to just miss seeing a coin placed in the bottom of the cup at the side nearest, and then pour water into the cup, the coin becomes visible, due to the bending of the light ray as it passes from the water into the air—a phenomenon of refraction. The echo is a familiar example, in sound, of the phenomenon of reflection. Earthquake waves are refracted in passing from material of given density and elasticity into a second with different properties, that is, in crossing a discontinuity. They are reflected on reaching the surface or at the inner side of the great discontinuity at 2900 kilometers depth. Seismologists name the various phases appearing on their records according to the paths they have probably taken. For example $\overline{S_cP_c}$ $\overline{P_cS}$ represents a wave which began as a transverse vibration, traversed the discontinuity at the core ($_c$); went on as a P-wave but was totally reflected at the inner face of the 2900 kilometer discontinuity; proceeded as P; again traversed the core and completed its journey to the seismograph as a transverse wave. Figure 2 shows some of the waves going directly through the core, refracted but not reflected. These are designated the P^1 waves. Where reflection takes place, bars above the letters bracket each leg of the path, as indicated in the extended symbol above.

Near the surface we have a multiplicity of refractions. Figure 4 shows some of the paths which have been suggested as possible.



After Gutenberg

Figure 4: **Diagram of the paths of propagation of the longitudinal waves from H, through the upper layers of the earth by several routes**

IT will be seen that we have a very large number of wave arrivals on our seismogram—at least that we may expect many. As a matter of fact some arrive with such small energy content that they register but faintly. This, nevertheless, affords a further check on the theory, as that theory attempts to predict which waves should register thus. The proposed structure may thus be checked in many ways by means of longitudinal and transverse internal or body waves of earthquakes. We have not mentioned that there are also two types, at least, of surface waves. These also serve to throw light on the study of the outer earth shells. Time fails for us to enter on a discussion of what is known as seismic prospecting, by means of which commercial interests probe the upper 4000 feet or so of the earth's crust in the search for oils and minerals. They delineate many of the details of the upper layers, but, from a purely scientific standpoint, the most interesting result is the large mass of data showing the relation of the wave velocity and the type of material traversed.

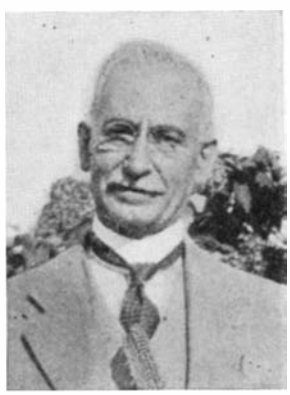
We have outlined, then, the present theory of the structure of the interior of the earth and indicated the means by which it is to be checked and improved through a study of seismic waves. If a later modification of the theory should give travel-time curves more nearly in accord with later and more accurate data, the modification will be adopted. The present theory is (in the language of the automobile prospectus) the latest model, which we take pleasure in exhibiting at this time. We hope it will find its way into the hands of many and that they may enjoy the fullest service in its use. It may be traded in as soon as suggested improvements have been found worthy of adoption. All may rest assured that *when better theories of the internal structure of the earth are built, seismology will build them.*

STAYING THE HAND OF TIME

By MILTON WRIGHT

THREE thousand six hundred years ago the Emperor Thothmes III, to perpetuate his glory, set up two tall shafts of stone in front of the Temple of the Sun at Heliopolis, carving into the face of them such remarks about himself as these:

"Thothmes III, gracious god, lord of the two countries, giving eternal life, the powerful and glorious bull in Thebes, the Sun's offspring, Thothmes III."



Dr. Constantian

For more than a thousand years those obelisks stood there. Then came the invader, Cambyses, the Persian. He overthrew the carved shafts and plundered the temples. Five hundred years those pillars lay in the sand, partially buried. The desert sand blew against them, cutting away the rock. Moisture from the soil formed crystals of salt in the pores of the stone and year by year forced off particles, impairing the legibility of the hieroglyphs.

Five centuries more passed, and again came the invaders, this time the Romans. Here were real trophies, relics of antiquity, so the masters of the world transported the obelisks to the Harbor of Alexandria to celebrate their conquest of Egypt. There they remained for 2000 years more.

IN 1869, Khedive Ishmail of Egypt offered one of the obelisks to the American Consul, who, in turn, presented it to the City of New York. It was brought to New York and set up in Central Park in 1881. "Cleopatra's Needle" should stand here for ages as it had done across the sea.

But America is not Egypt. There is moisture in the air here that eats its way into any stone and wears it away. Within two years after its erection pieces of rock began to fall from the obelisk. In two more years, a thorough examination showed, there were a great many shells or flakes of large size, besides a multitude of small ones. One flake measured 12 by 18 inches, with a thickness of four inches at the base.

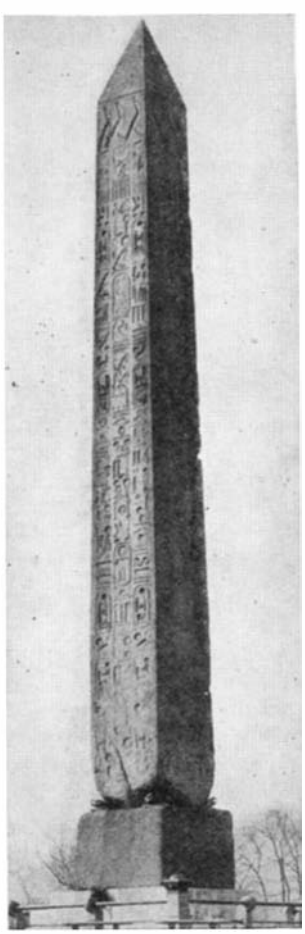
Something had to be done, and done quickly, or there soon would be nothing left of Thothmes' autobiography. All these flakes were mapped and numbered, and then a solid body of hot, melted paraffin wax was applied to fill all voids and prevent any accidental movement.

A few months ago the obelisk was examined carefully by experts. After 45 years no indication could be found of any additional crack or flake or of the enlarging of an existing one. The preservative had stopped completely the rapid disintegration of the oldest monument in America. The hand of time had been stayed.

But what of other structures in America? Do they, too, not wear away in time? And would not the same treatment applied to the Obelisk preserve them?

They do deteriorate, and the same treatment is applied to prevent it. Certain sections of the Cathedral of St. John the Divine, the New York City Hall, the palatial residence of F. W. Woolworth, Fraunces Tavern, the Graduate School at Princeton, Plymouth Rock, and innumerable other piles of stone or brick have been treated by the same process. And nearly all of this work that has been done in the last 20 years has been done under the direction of one man—Dr. Raphael Constantian, doctor of monuments.

Dr. Constantian, a native of Armenia, began his career as a Doctor of Medicine, having obtained his degree at Edinburgh. Upon his graduation he went to Constantinople, but Constantinople just then was no place for Armenians. It was in August, 1896, that he arrived, just in time for the massacres in the reign of Abdul the Damned that shocked the conscience of the world. Young Constantian was thrown into prison, at length being escorted to a French ship by the British Consul and sent to America. He began to practice medicine in the Bronx, but New York was full of young doctors, and, to put it mildly, the Edinburgh-trained Armenian was not making his fortune. Then began a series of chance happenings which changed the significance of his title of M.D. and started him on one of the most unusual and interesting professions in the world.



"Cleopatra's Needle," Central Park, N. Y.

"I HAD gone down to the Bible House to meet a friend of mine, the editor of the *Christian Herald*," he told us. "As I arrived another man was just leaving, and I was introduced to him. It was Edward M. Caffall, son of Robert Caffall, inventor of the paraffin waterproofing process. I asked:

"'Can I do anything for you?'

"'You certainly can,' he replied. Then he told me about the process his father had originated and about his own desire to make a going business of it. He had no money and neither had I, but in half an hour we had arrived at an understanding. In three months I had organized a company, and in eight months we paid a dividend. If I had been 30 seconds later in calling on my editor friend, however, I never would have met Caffall. This was in 1909."

"But how did Caffall's father come to originate the process?" we asked.

"Robert Caffall was Queen Victoria's gardener," he replied, "but was a man who was interested in many things. Paraffin wax was a new product in 1868. He had a piece of it that came from the United States and he heated a brick and waterproofed it with the wax. Then he waterproofed a hop kiln, and then a church.

"But Caffall was interested in bigger things than waterproofing buildings. He came to Amer-

ica with the idea of cutting a canal across Florida, but in spite of his urging the Florida Legislature refused to appropriate the necessary funds. From time to time he waterproofed buildings but it was only incidental with him. One of his jobs was Cleopatra's Needle. After he died, his sons occasionally did some waterproofing work, but had never made a really successful business of it."

"How did you get your first job?" we inquired.

"Chance had a lot to do with it," he replied. "I had gone down to the Customs House on a matter involving taxes and was looking for the proper office to enter, when a young man passing through the hall, asked:

"'Can I help you?' They were the same words I had used upon meeting Mr. Caffall, although the significance of them did not strike me at the time. We got into conversation and the stranger became interested in the waterproofing idea. He was Cornelius Wickersham, son of George W. Wickersham, who was then Attorney General, and he was just starting out to practice law. He became our counsel.

"'I know an architect named Cass Gilbert,' said my new friend. 'How would you like to meet him?' Cass Gilbert was one of the foremost architects in the country; there was nobody whose acquaintance I would rather have made, so we went to Gilbert's office. The card of my new attorney was an open sesame, and in almost no time we were telling the great architect all about it.

"'NOW this is a coincidence,' he said. 'I have planned the Ives Memorial Library at New Haven, a red brick structure with marble trim, and only recently Mr. Watrous said to me with emphasis, "Remember, Mr. Gilbert, no salts on this building." I assured him there would be no salts, but, frankly, I didn't know how to prevent them. Now, will your process prevent those salts?'

"The salts to which he referred are alkaline salts dissolved by rain water and left by evaporation. You have often seen them on a brick wall. They are an evidence of dampness. Not only are they unsightly, but they break down the surface of the wall. They are precisely the thing our waterproofing process would prevent, and so we assured Mr. Gilbert. We came away with a 2500-dollar contract. Incidentally, years later, the success of that job led to our treating the Peabody Museum at Yale. One job followed another and gradually the business developed."

"Is the process the same as it was in the beginning?"

"Essentially it is, although we have developed it considerably. For example, we have developed the idea of heating slowly to get a deep penetration—we can force the wax all the way through to the other side, if we want to—and we have developed, also, a special cleansing process to get rid of every evidence of waterproofing."

"What evidence?"

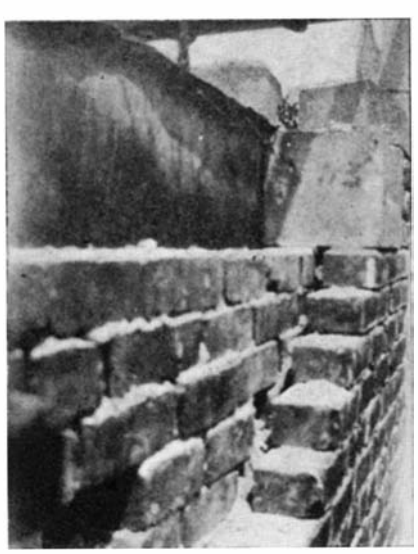
"Wax softens and catches dirt. This darkens the building. By saponifying the surface and dissolving this surface wax away, with the aid of steel brushes, we restore the stone or brick to its original color."

"Just what does the entire process consist of?"

"First the surface must be put in first class condition. Every soft brick must come out. If there is a crack in a brick it must be cut out. Neat, tight joints must be made. Because of changes in temperature, you know, the face of soft brick will fall off in time. In one school building on Long Island we had to replace 7000 to 8000 bricks—practically rebuild the whole wall. The building had been erected in wartime and a lot of bad bricks had been used. Some of the bricks you could carve with a penknife.

"STONE, especially laminated schist with a lot of mica, breaks down easily. Bad stones must be replaced. Then every joint must be tested to see if it is hollow, and if it is, it must be cut out.

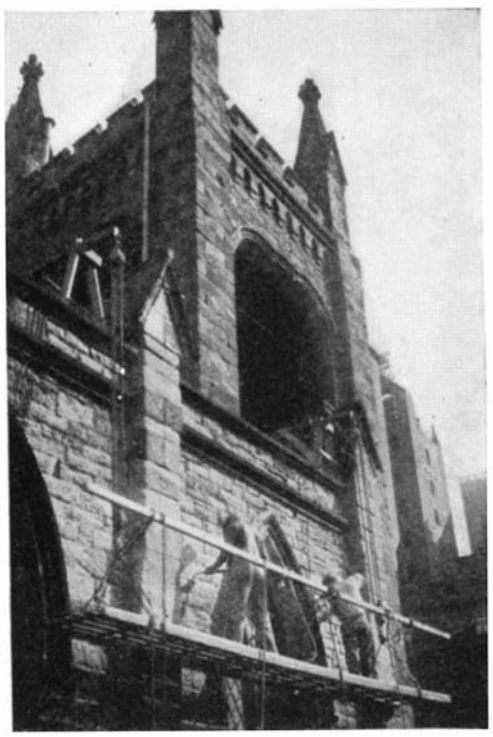
"The wall thus properly prepared, we heat the wall a square yard at a time, using charcoal stoves, and while the wall is hot and dry the wax compound is heated to a liquid and applied with a brush. It works its way in by capillary attraction to the end of the hole and hardens gradually as the wall cools. Much depends on the skill of the workman, and he must use care and apply his heat and his liquid wax slowly."



If the wall is bad, new bricks must be inserted before waterproofing

"But why is heat necessary?"

"Practically every masonry wall exposed to the weather contains a considerable amount of moisture, and it has been found that the walls of many buildings have not dried after long periods of years. As it is quite impossible to secure penetration of a water repellant mixture into a damp body, heat is employed to eliminate the moisture from the wall, thereby also securing a deep penetration of the wax compound."



The crumbling sandstone was cut away where necessary, the stones waterproofed

"Isn't the deterioration of a building a sign that either the architect or the builder is at fault?"

"Not at all; the penetration of water into building materials is a natural process that can be prevented only by rendering the surface permanently waterproof."

"Well, would you recommend that all stone or brick buildings be waterproofed?"

"No, I wouldn't go so far as that. I do say, though, that the vulnerable parts of the outside of a building should be taken care of. The most vulnerable are the parapets; they get the effect of the weather from the top as well as the two sides and they are the first to suffer. Sometimes architects specify waterproofing for the sides which face prevailing storms—in New York these are the north and east."

"And how long does waterproofing last?"

"We guarantee it for ten years, but unless there are unusual conditions of some kind, it should last as long as the building."

AND NOW, IT'S SEAWEED

Kelp from the Pacific Coast May Supply Elements Which Are Now Lacking in Our Diet

By HELEN R. CRANE and EMORY W. THURSTON

SEAWEED has had its ups and downs, dietetically speaking. If, at the present moment it appears to be entering upon the period of its greatest upward curve of popularity this is not because of any newly acquired needs in man, but merely that his attention has been once more attracted to his food.

Today man has turned over the details of his everlasting search for food to business houses. These organizations are not generally interested in diet as such, but only in their particular viewpoint of it and, therefore, long-suffering man, in his preoccupation, has foisted upon him a regimen poorly adapted to his requirements. His meals lack balance and in consequence he suffers from deficiency diseases.

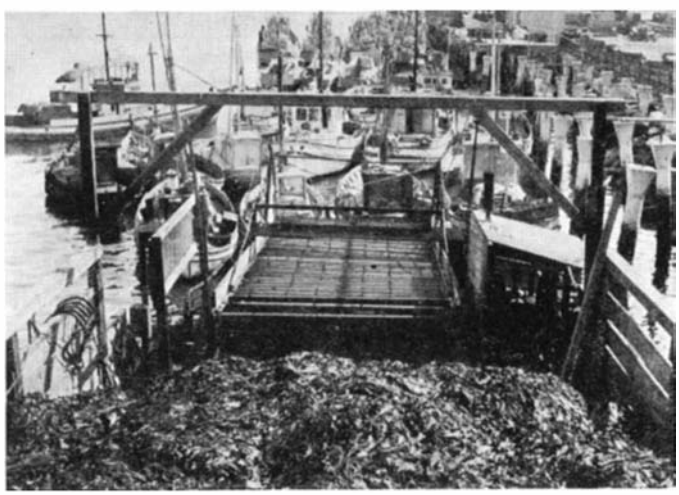
Primitive man ate his whole prey, not just the sirloin steaks. He managed his own larder, and economic pressure as well as instinct bade him discriminate against no part of the animal he brought in. In this way it came about that his diet was likely to be well balanced. Especially was this true if he lived near the sea.

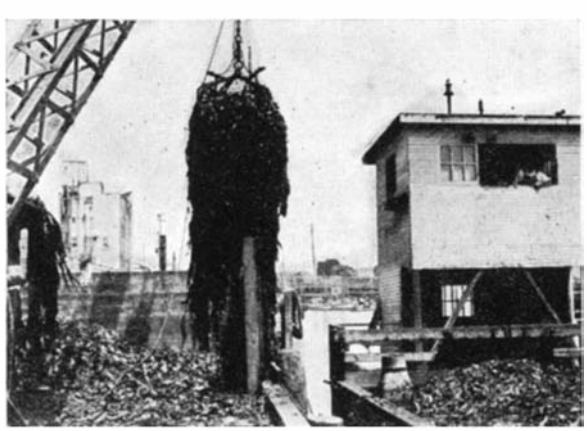
SHORE dwellers seem always to have used various algæ to supplement their diet, in the same manner that the California Indians did. When the white men came to their country these Indians were living in a stone age civilization. Their skeletons show them to have been remarkably free from deficiency diseases and an examination of hundreds of skulls excavated by the curator of the State Museum discloses not more than two or three decayed teeth. Moreover there is no evidence that goiter was ever known among them.

Modern scientists became interested some time ago in the fact that there was a noticeable absence of the deficiency diseases everywhere in the world where sea plants are used for food—Japan, China, Ireland, and all along the northern seas. Interesting himself in a study of this subject, one of the prominent experts on live-stock feeding went to Europe. He was looking for an answer to the problems facing stock-men in certain sections of the United States—diseases, still-births, difficulty in raising the young—and he wanted to study conditions over there.

He learned among other things that the peasants of some of the countries bordering on the seas were in the habit of gathering the sea mosses, drying them in the sun, and then adding them to the cattle's feed. Wherever that was done he observed strong, healthy live-stock. It was a practice worth following up.

Still with no thought of human dietary needs he returned from Europe and began a search for seaweed that could be fed to animals. The Atlantic coast offered nothing that was practical but on the Pacific coast he found some beds of kelp which had been used during the World War by the Government as a source of potash, iodine, and acetone. They were *Macrocystis pyrifera* "groves" and they extended 200 miles along the coast of southern California.





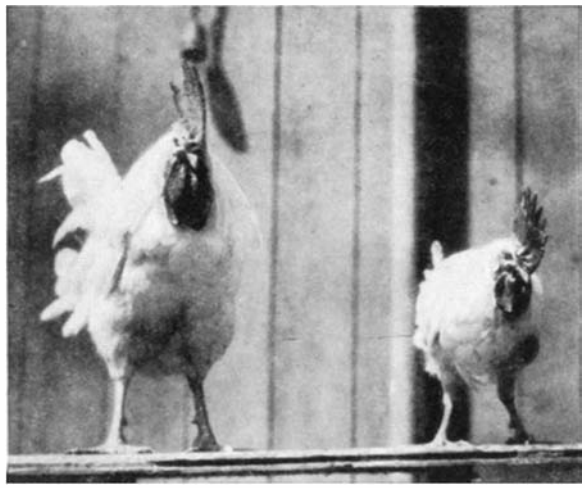
Above: **Bargeload of kelp just being docked. The serrated mowing-machine cutter bar and elevator are shown raised out of the water.** ***Below:*** **Unloading wet kelp from a barge**

EXHAUSTIVE experiments followed. Well known chemists were called in and a means of dehydrating the plant was devised—a means that would preserve elements, vitamins and chlorophyl. When concentrates had been prepared they were given to selected herds of cattle that had been experiencing all kinds of illnesses—that is, the concentrates were added to their daily rations. Within two months their difficulties had practically disappeared.

Experiments followed on other herds, with the same results. The outcome has been that many tons of the product are supplied every week to live-stock breeders in all parts of the country.

Now comes the story of kelp's serious introduction into the human dietary of this country. As mentioned before, there probably never was a time when it did not serve as human food, but 20th Century civilization has led people far from some of their old food habits. Having introduced kelp to the live-stock with satisfactory results, its promoters began to think of using it for humans, and so a series of white rats from the laboratories of the California State University was called upon to test its efficacy.

After two years' careful work with rats, men and women in widely separated areas were selected to test the seaweed, now ground into a fine powder and not unpleasant to the taste. They were individuals suffering from all kinds of diseases. They took the kelp regularly for several months and while there were instances where no apparent results were experienced, benefit in most cases was notable. Every one of the patients who had been suffering from deficiency diseases was benefited to a degree almost unbelievable unless one understands the composition of *Macrocystis pyrifera*.



Two roosters, same age, raised on same diet except that one received a ten percent addition of kelp

Analyses of kelp were made by Government chemists from the Department of Agriculture, as well as by chemists in several of the leading universities. The presence of 32 of the chemical elements has already been demonstrated in it and Professor George W. Cavanaugh, head of the Department of Agricultural Chemistry of Cornell, who has spent the past six months studying the plant and its value as a food, states that he is of the opinion that he may find many more of the known elements in it. He also expects to find them in sea water, by the way. The elements appear to exist in the plant tissues in a complex colloidal combination with chlorophyl and the precious vitamins A, B, D, E, and probably F and G.

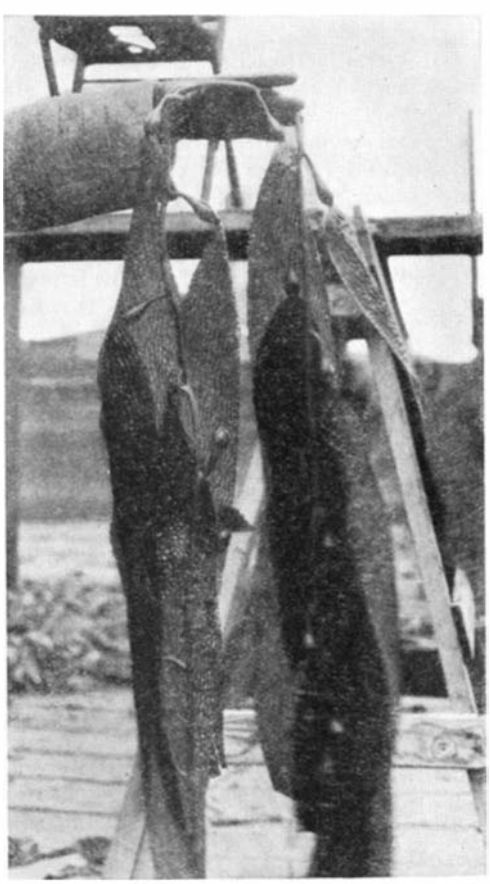
Biologists are fairly well agreed that, in most circumstances, the animal cell cannot accept inorganic minerals and convert them into organic ones that form the basis of protoplasm, but this function can be performed by the plant kingdom. It is in the tiny laboratories, the chloroplasts, that the actinic rays of the sun accomplish the miracle of the photosynthesis—there that the inorganic becomes organic and that the protoplasm of the animal world is built.

Now, a plant is only as rich in minerals as the medium in which it grows, and many areas of the earth have for thousands of years been starving their plants. Ever since the day of the first rainfall, the earth has been undergoing a process of leaching. It is not difficult to imagine the floor of the ocean as being uniform in its chemical character before parts of it were elevated above the surface. Sea water is still uniform in quality except where it is locally modified by fresh water intake, or by some other local influence. When the land first appeared it was rich in minerals and could support a giant flora and animal world, but gradually, as the epochs passed and every rainfall washed more and more of the elements out of the land and back down into the sea, the forms perforce diminished. It would appear likewise that, while some of the forms of the sea have diminished for one reason or another, many of them have maintained their pristine proportions, and today the largest forms in the animal and vegetable kingdoms are to be found there. The *Macrocystis pyrifera* is one of the largest plants in existence.

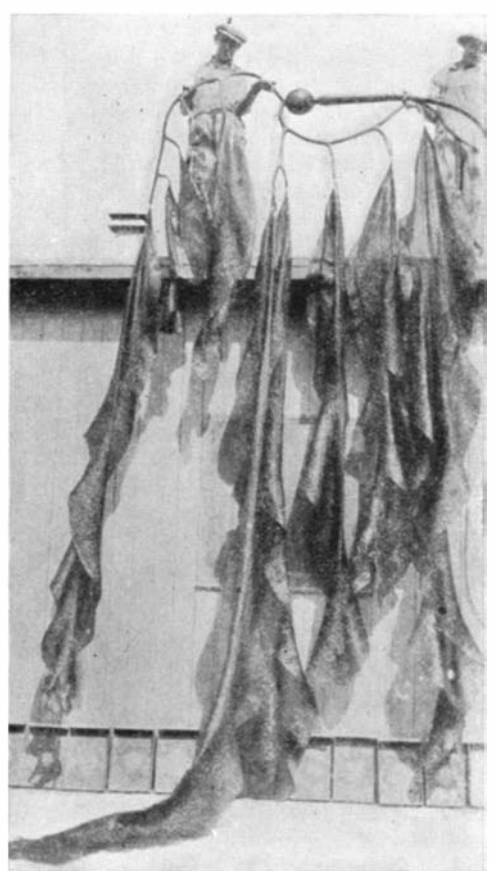
The Macrocystis groves lie about 30 miles offshore, far enough from the harbors to escape contamination. Strong currents, so essential to their being, wash them about vigorously while the sun plays upon them approximately ten months of the year. A rocky ocean floor is their choice of a home site. They have no roots, but fasten themselves to the rocks with huge holdfasts sometimes two feet in diameter. Then they start upward toward the sun. Their average length is between 50 and 60 feet, and because of their rapid growth they can be cut every year, the tops being mowed somewhat as one mows a lawn.

Man is again coming to the realization that back in the sea, his original cupboard—the cupboard that served so well in the earliest days of his ancestors' being—lies some of the food he still needs; that a few of his physical requirements have not changed so much after all since his "amœba" days: in other words, that protoplasm is protoplasm, and is still the first consideration of mortal existence.

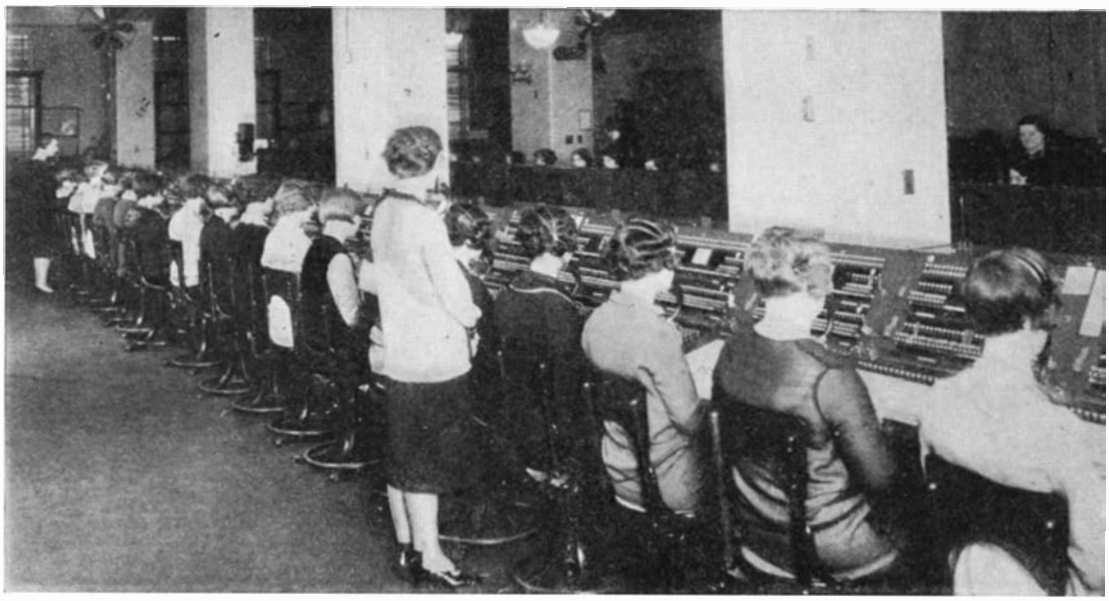
Is seaweed to become a part of the national diet?



Kelp leaves with the little "floaters" which keep the plant upright in water



Fronds of giant kelp. The two men who are holding them give a scale of size



Panel type dial tandem office in New York City, designed for handling calls from manual offices and suburban toll traffic in areas where a large proportion of the central offices are of the dial system

PROGRESS AND THE TELEPHONE

By F. D. McHUGH

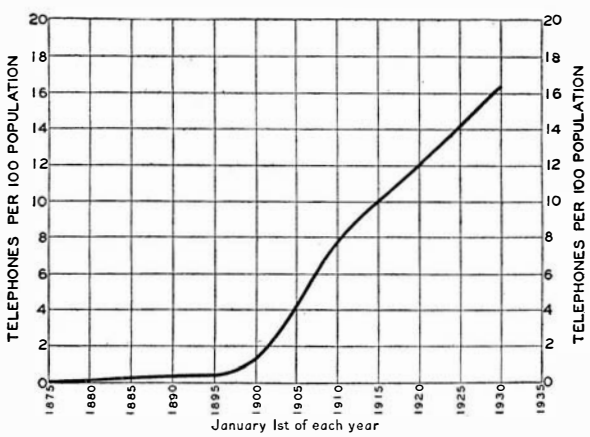
HAD man not learned to communicate his thoughts, ideas, and knowledge to others of his kind, his superiority over the lower animals would be slight indeed; his reasoning power by which his superiority is usually measured would count for little. In the measure to which it has been utilized, therefore, the telephone has had a tremendous influence in shaping our modern day civilization, in speeding up business, and assisting our progress. If that influence has not been exactly cultural, it has at least been of so highly practical a nature as to contribute to the raising of our standards of living; it has helped to promote the progress that has given us greater advantages culturally than we ever possessed before the age of the telephone.

Since man first began to utter intelligible sounds, he has felt the need of methods of sending his messages to distant points and of disseminating widely his ideas for the edification or information of others. He has progressed through the communication eras of drum, fire, smoke, and courier methods to the telegraph, the telephone, and the promise of a television method. Coming after the telegraph, the telephone has surpassed it; and television, when it is made commercially practicable, would appear to be an adjunct rather than a competitor of voice communication.

Telephony, then, with both wire and radio mediums at its command, represents our most efficient means of fast communication and the degree to which it is used in various countries should be, to a certain extent, a fair index of national character. This does not mean that, in having over 20 million telephones—57 percent of all those in the world—the United States possesses a spirit of progress more clearly designed to assure leadership in commerce than does that of other countries; some of our critics say that we haven't yet found that formula. It does mean, however, that Americans have learned the tremendous importance of time-saving and its bearing on progress.

The telephone has indeed become America's greatest time saver. It has come to be almost as important to us as speech itself; and the company which operates it in the United States is one of the greatest corporations in the world. In 1930, the year of the world's worst depression, the assets of the Bell System increased to more than five billion dollars. Almost as bewildering are the figures which show that, for the year ending December 31, 1930, the gross income of the telephone system amounted to 1,103,939,805 dollars. This puts the Bell System at the top of the world's list of larger organizations, private, state, or corporate. The German State Railways, the second on that list, is, however, larger in point of total assets.

The report of the parent company, the American Telephone and Telegraph Company, shows a net income for 1930 of 165,544,707 dollars after depreciation, interest, federal taxes, and so forth, had been deducted. This represents $10.44 a share on an average of 15,856,696 shares outstanding during the year, and $9.22 a share on 17,956,512 shares actually outstanding at the close of the year. In passing, it might be remarked that a large percentage of these shares are held by small investors and an organization of this nature is therefore superior in one vital respect to the so-called Communistic system which is attempting to function in Russia:



The significant rise year by year in the number of telephones in use in the United States since 1875

it actually works for the benefit of the greatest number.

The average number of shares held by a stockholder, of whom there are 580,000, is 31, and no single holding amounts to as much as 1 percent of the total capital stock. Concerning this fact, the company states its policy thus: "The fact that the ownership is so widespread and diffused imposes an unusual obligation on the management to see to it that the savings of these hundreds of thousands of people are secure and remain so." This policy quite naturally imposes, in turn, the further obligation to see to it that at all times the service is adequate, dependable, and satisfactory to the user; or, in other words, to meet both obligations the service given must be the best possible at the lowest cost consistent with financial safety.

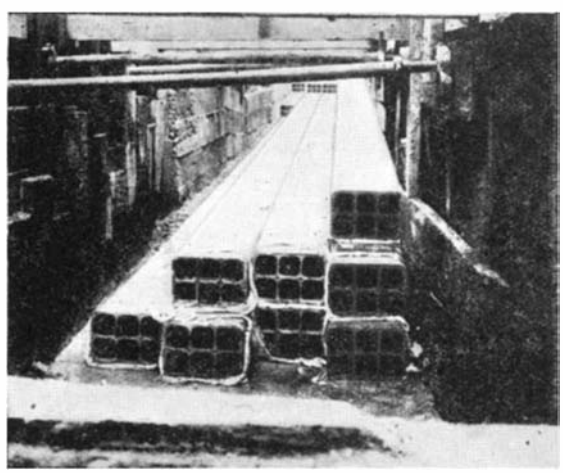
WALTER S. GIFFORD, president of the company, said in his annual report that "the depression which affected business in general in 1930, inevitably affected the telephone business, but not in a way or to an extent to disturb the fundamental objective of the Bell System. It has been able to improve and to extend telephone service. . . . Confident of the continued economic growth of the country and the even more rapid growth of the telephone business, more than 15 million dollars—which is somewhat in excess of any previous year—was spent for development and research for future improvements."

What this monster corporation that can spend such a sum on research alone, is, can be told in a few words. It is a company composed of 24 closely associated Bell Telephone Operating Companies which own and operate 15,649,000 telephones covering the entire area of the United States, and the telephone lines used for toll service within their territories. These companies also have operating agreements providing for interconnection of lines with several thousand independent companies that own 4,404,000 telephones in this country. Besides this "single unit system" operation of 20 million telephones, there are 101,000 telephones not connected with the Bell System.

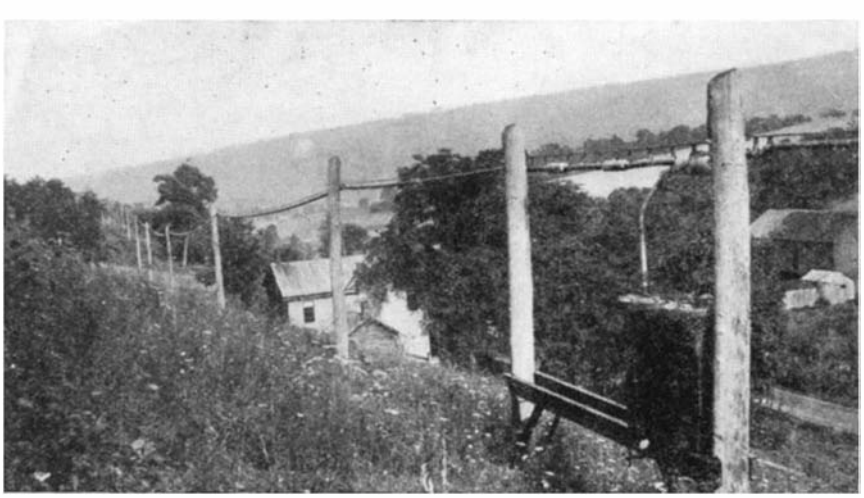
Some of the 24 Bell Operating Companies are subdivided into smaller autonomous operating units. For long distance calls between the territories of different operating companies, service is supplied by the Long Lines Department of the American Telephone and Telegraph Company, in close co-operation, however, with the associated companies.

In the general departments of the A. T. & T. Co., which includes the Bell Telephone Laboratories, there are 7500 scientists, engineers, business experts, and assistants whose duty it is to improve equipment, and develop new methods and facilities for more efficient service. New types of telephone plants, and operating, maintenance, and business methods are standardized by the general departments and adopted by the associated companies to the extent that they apply to local conditions. Materials and apparatus, after being standardized by the Bell Telephone Laboratories are supplied by the Western Electric Company, Inc., a company owned by the A. T. & T. Co., which manufactures them or purchases them, as the case may be, in quantities that insure large economies.

This, then, is the organization that renders telephone service to the nation; which enabled nearly 22 billion local voice messages to be made last year; and which could spend a total of 15,000,000 dollars for research—progress insurance—in 1930, and 585,000,000 dollars for additions, betterments, and replacements in the same period.



Typical underground cable run ducts showing materials used and the method of construction



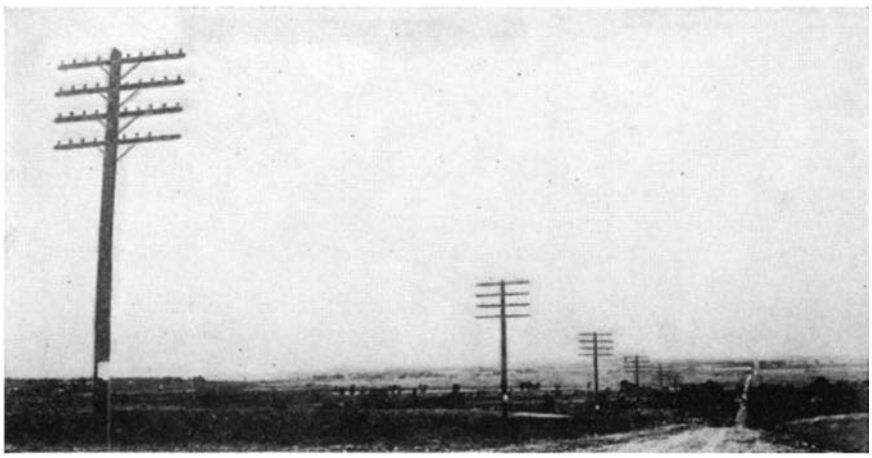
Cross-country aerial toll cables of this type now stretch for hundreds of miles over the United States and many thousand miles of extensions are planned

A word might be said here about the faithful young women who constitute an important part of this system: the operators who do their best to serve us whether we speak good English or a language of grunts, gulps, and profanity. In 1930, the Bell System employed an average operating force of 119,000 young women for local calls and approximately 40,000 at the toll boards. These young women are very carefully trained, and most often when we complain of the service, the fault is our own.

The belief is rather general that the dial telephones which are now being installed by the hundreds of thousands all over the country are throwing many of these operators out of work, that the number of operators required when the dial 'phones are in operation will be much less than at present. Such is not the case. Experience to date with dial 'phones has shown that it is actually necessary to increase the number employed. Furthermore, with this modern system, the operator must be able to take care of an infinite variety of requests from the user who dials "operator." She must supply any kind of information at a moment's notice, make connections for toll and other special calls, and assist in the general operation of the system. When conversion to the dial system began in 1921, there were 128,000 operators but in 1930, with approximately one third of the telephones dial-equipped, there were about 159,000 operators.

Making the change from manually operated instruments to the dial system is a job of the first magnitude and will not be completed for a good many years to come. During 1930, the change was effected on 800,000 telephones, bringing the total of dial telephones to approximately 5,000,000 or about one third of the total owned by the Bell System.

Particular attention has always been given to the apparatus installed on



Open wire pole line construction of a type that is familiar to the entire country. Much research was necessary to allow the increase in number of wires carried

the subscriber's premises for after all, that is one of the most important parts of the entire system. Recognizing this, the Bell Laboratories have worked and are still working strenuously to improve the transmitter and the receiver, two fundamentally important elements of this apparatus. The efficiency of these parts has been greatly increased so that now the transmitter acts as a high-ratio amplifier of the voice and the receiver reproduces very faithfully the voice from the other end of the wire.

PASSING over other details of the telephone plant such as installation of new equipment, cables, lines, and so forth, maintenance and extensions, we come to the subject of toll service or, as it is more generally known, long distance service. Toll service is a term designating service between two telephones not in the same local exchange area. An outstanding feature of the operation of the telephone system during recent years has been the rapid growth of this service. Company figures indicate that during the last five years, the number of completed toll messages has increased by 67 percent. In the same period, the number of telephones has increased by 28 percent. From these figures it will be noted that the number of toll messages is increasing at a more rapid rate than is the number of telephones; in other words the number of toll messages *per telephone* has increased by 30 percent.

Those of us who have occasion to make long distance calls now and then must admit that one obvious reason for this increase is the material improvement in the service. This applies not only to the greater speed in getting our calls through, but also to the improved clarity of the human voice as it is brought to us over thousands of miles. Here again the company records prove illuminating. In 1920, the average time required to put through a toll call, from the time the call is placed to the time the person called makes a response or the operator gives a report, was seven minutes. A sharp drop to 4½ minutes was made in this time-lapse in 1921; and from that time on there was a steady speeding up of service until, in 1930, the time required was one minute.

Radio-telephone connections are rapidly being completed between the United States and all parts of the world, 91 percent of the world's telephones being now within call from any Bell telephone. Only five countries having more than 100,000 telephones are not now connected to the Bell System. Projects now under way to span the Pacific should eventually eliminate three of these countries. As for service to our nearest neighbors, we are connected with Canada by a well-developed arrangement of lines; and have been connected with Mexico since 1927.

The special services of the American Telephone and Telegraph Company include telegraph service, operation of telephone lines for private use, arrangement of telephone networks for radio broadcasting programs, telephony in connection with aircraft operation, ship-to-shore telephony, operation of teletypewriter systems, and telephone services for railroads. On over 60 percent of the total railway mileage, the train dispatching is now done by telephone.

Bell engineers have also done intensive development work in the field of television and have made much progress, as is attested by a demonstration given at the Bell Laboratories some months ago. At that time the writer sat in a booth and held a two-way conversation with a friend in a similar booth at the company's main office at 195 Broadway, New York, three miles distant. In each booth the image of the speaker at the other end of the line—the distant station—was reproduced in miniature with great fidelity. In this demonstration which gave a promise of extremely important developments yet to come, 5 special telephone circuits were used to carry the electrical impulses which reproduced the voices and the images.

COMPANY research in connection with the faithful recording and reproduction of sound has led to certain "by-products" such as the improvement of phonographs and their records. The Orthophonic Victrola is an example of such development and an extension of this development produced the talking motion picture. Sound research has also led to the development, in close cooperation with members of the medical profession, of devices of value to persons having abnormal hearing or speech. Important by-products of this nature are: the audiometer, which is useful in determining the "hearing ability" of individuals; and the artificial larynx which makes speech possible for those who have lost their natural larynx due to pathological conditions. Other by-products of interest to the medical profession include the electrical stethoscope and the electro-cardiograph.

In summing up, it may be said that the telephone has come to be one of the outstanding symbols of the modern age. Business and industry could no more function without it—properly and at their present tempo—than they could function without the swift carriers of commerce. With the telephone already closely co-ordinated with industry and trade, the company anticipates the demand for services and is looking forward to a more rapid growth of telephone usage in the United States than ever before.

A private branch exchange which takes care of 1600 stations. Through it incoming calls are distributed and various extensions may call each other

A BOOK-PRINT READER FOR THE BLIND

By ROBERT E. NAUMBURG*

ALTHOUGH it is more than 100 years since the invention of the dot system of raised printing for the blind by the Frenchman, Louis Braille, less than one book in a thousand has been put into embossed type, and there is no probability of embossed type books ever catching up with the quantity of books printed in ink. The limiting factor in the Braille system is the enormously increased size of any ordinary book "translated" into Braille. Due to this, attempts have been made to work out methods by which the blind may read type-printed books. My invention, the Printing Visagraph, is the result of much intensive development work to this end.

The purpose of the Printing Visagraph is to allow a blind person to sit in his home or in a public library and read any book available to those with sight. This machine takes the place of the human eye and it must, therefore, have mechanical or electrical eyes of its own. Either a selenium cell or a photo-electric cell may be used.

A STRAIGHT filament lamp throws a fine beam of light radially on a scanning disk and illuminates six concentric rows of holes. The six beams of light pass, in a vertical row, through lenses onto the pages of the book to be read. All six beams are reflected to a single cell which is close to the book but out of the way of the direct beams of light.

The six spots of light set up currents of six frequencies which are then amplified and filtered through a radio filter. Each of the filtered frequencies goes to one of the six magnets in the printer. Each magnet controls a printing point.

When the point of light falls on white paper and is reflected onto the cell, current flows and one magnet pulls down its armature, keeping the printing point away from the aluminum foil. When the point of light falls on black printing, there is no reflection of light to the cell and therefore no current flows in the magnet. A spring then pulls the printing point upward to make an indentation in the aluminum foil from below, which may be felt or seen from above.

There are two main parts to the Printing Visagraph. The lighthouse or optical or scanning system is at the left of the reader, and the printer or reproducing system is at the reader's right. The ordinary printed book is open, face up, under a plate of glass under the scanning system. The lighthouse travels from left to right, over each line of the printed page, very much as the human eye would do. At the same time the printer travels from left to right under the roll of aluminum foil, but with a magnified motion in order to make larger letters that may be felt. Like the human eye also, the scanning system returns to the left margin quickly, and does no reading on the return stroke.

The foil used is of pure sheet aluminum, with grooves running both vertically and horizontally, forming a fine screen-like pattern. These fine walls of metal act as reservoirs and allow the metal to "flow" freely without being torn by the embossing point. After the machine has formed the raised letters on the foil, the sheets may be preserved by applying shellac or other material to the back, or the impressions may be erased by squeezing the aluminum through a pair of rollers.

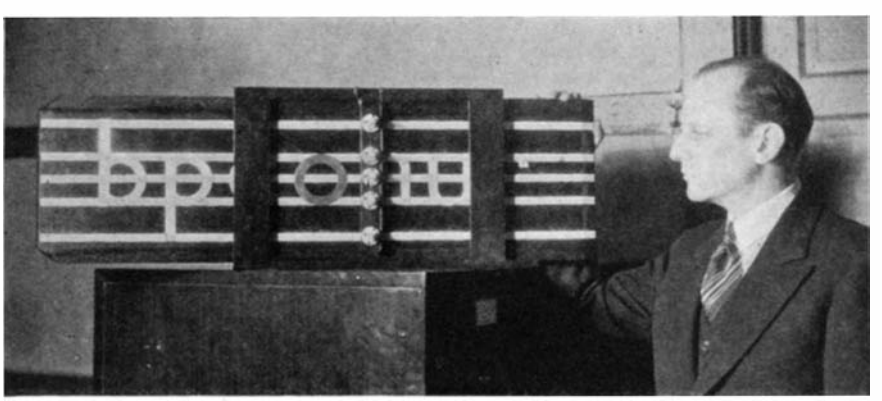
A handle at the left side of the reader allows him to space the book from line to line and feed the aluminum foil from its roll. The line spacer is variable and may be set once for each book. The scanning points are made to fit the size of the type by adjusting a lens. This is also done once for each book.

The height of the letters on the aluminum foil does not vary with changes in type in the printed book, because the magnets and printing points are spaced a certain distance apart and do not vary. The height of a letter is about the same as that of Braille letters for which the finger of most blind persons has already been trained. Indeed, experience has shown that blind persons familiar with Braille can learn to read the new type of embossed letters in a few weeks' time.

The Printing Visagraph opens up to blind people a world of literature, both classic and current, hitherto hidden from them except when friends read to them.

At the left of the blind reader are the book, printed in ink, and the scanning system. At her right is the roll of aluminum foil. Standing behind the machine is the inventor, Mr. Naumburg

The exact size and arrangement of the letters embossed on foil by the new machine



Demonstrating the manner in which the points of light scan the printed letters. This demonstrator has only five points; the machine itself now has six points

*Mr. Naumburg's address is 40 Meadow Way, Cambridge, Massachusetts.

Casings in place in a highway fill, ready for lowering of dynamite

BLASTING ROADS TO SETTLE THEM

MODERN traffic demands have made necessary the accelerated fill settlement methods in highway construction. Today, highways are mostly built or re-located on straight lines between points, a fact that very often makes it necessary to cross swamps and other soft stretches.

As implied by the name, the purpose is to accelerate by the unstinted use of explosives the settlement of "fill" material in construction work. At present the method and its variations are used in connection with highway construction across swamps, drained lakes and ponds, marshes, bottom lands, and other soft and unstable areas.

The method, however, is applicable also to railroad building and to making solid earth foundations for wharves, factory sites, parks, and any other operation on marshy lands. Also, it would seem to offer possibilities where quicksand is encountered, provided, of course, that solid bottom exists at not too great a depth.

IT opens a relatively new and rather important field for explosives in construction. It further emphasizes the value of explosives as time savers. Furthermore, it presents new opportunities for the application of engineering principles, research, and experimentation.

According to a report of a committee of the American Road Builders Association, ". . . swamps, marshes, and peat bogs represent the most treacherous areas over which modern highway embankments are constructed."

In a general description, Larry F. Livingston, of the du Pont Company, says: "The use of explosives is particularly successful in displacing underlying unstable material and in compacting filled embankments in such areas.

"There are two distinct methods of doing this type of work. In general: one is to blast as large a ditch as possible along the center line of the projected highway. Such a ditch may be 30 feet wide and eight feet deep. Then fill in this ditch and pile up a sufficient quantity of material to cause a considerable natural settlement, due to the weight of the fill.

"The second method is to place the required fill on top of the marsh and load the dynamite in the mud or muck underneath the fill material. The force of the explosion pushes the muck to the sides and the fill settles into place because the lateral resistance of the muck and semi-liquid mud of marsh or swamp is far less than the pressure of the great weight of earth fill piled along a highway right of way.

"Because of the diversity of factors involved and conditions encountered, many variations and combinations of the two methods are used."

Alfred Mathewson, of the du Pont Company, states: "The first fill settlement blasting of which there seems to be any authentic record was done in Minnesota in 1926, by the highway engineers of that state who conceived the idea that blasting in the muck below fill material would accelerate settle-

Boxes of dynamite arranged on a "three point" system of loading, before depositing fill material on right of way. See bottom diagram on opposite page

ment." The results obtained were good.

The plan of blasting a ditch along the center line of a proposed highway (referred to above) is an application to fill settlement operations of the cross-section method of blasting wide ditches or other excavations, which was developed by Mr. Mathewson.

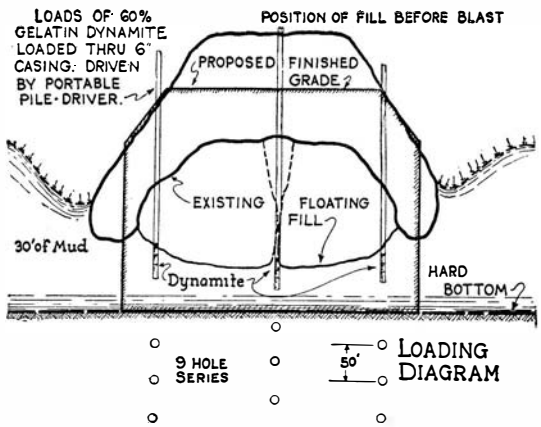
Cross-section blasting is applicable where soil, peat, or other substance is sufficiently firm to maintain ditch bank lines long enough to permit the piling of earth, sand, or other fill material along the highway center line.

Accelerating the settlement of road fills has been developed to an extent that permits the building of highways over soft and unstable areas and with so solid a foundation that permanent concrete slabs may be laid within a few months or a year of the filling operation. Formerly, without the use of explosives to facilitate settlement, it sometimes required as much as five to ten years of gradual, natural settling and adding of fill material. Even then the surface might develop uneven spots and a good road could be maintained only at high cost.

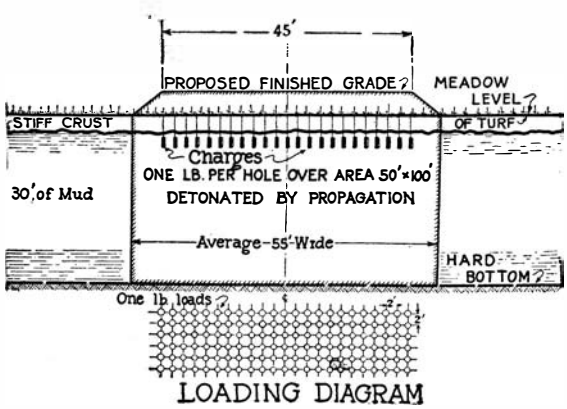
Owing to the depth of muck or mud, it sometimes is necessary to fill to a depth of many feet. Filling is being done to depths of 20 to 50 feet and even as much as 90 feet to reach solid bottom.

Banks of fill material, usually earth, are built up to considerable heights before sub-surface shooting of dynamite is done. For the greater depths, subsequent filling and blasting are done. Not infrequently, the piles of fill are 20 to 30 feet high and ramps are built up to permit dumping from trucks. This material settles considerably after the blasting, and soon settles to its predetermined level.

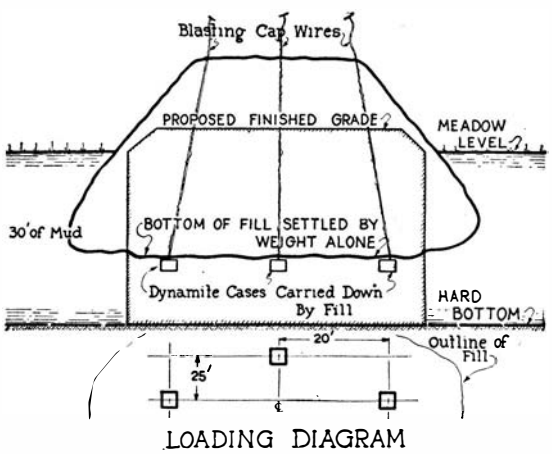
One of the methods of loading consists of placing boxes of explosives at designated points on the road line in a wedge, or triangular, system with one case ahead on the center line, across a marsh or swamp and dumping fill material on top of the cases. A cartridge in each box is primed with an electric blasting cap and wires are attached to carry current from an electric blasting machine for detonating the charge. A heavy iron wire is tied to each case of explosives and the wires from the blasting cap are wound loosely around the iron wire to prevent the breaking of the electric wiring to the dynamite charges.



Cross-section of the highway at top of opposite page showing method of loading dynamite



The propagated method of breaking up and "liquefying" a stiff earth crust before filling



When the dynamite beneath the heavy fill is detonated, the muck mushrooms out at the side

charges fired simultaneously by means of electric blasting caps and a blasting machine which generates the current to fire the caps for detonating the charges.

For cross-section blasting and, in some cases, for the deep shooting after the fill material has been deposited in a pile, the shooting is by the propagated method. In this way a line of holes, parallel rows or a center line and radial lines can be shot if there is present sufficient water in the soil to carry the "explosion wave" from load to load of dynamite once the wave is set in motion by the detonation of a single initial charge.

Before depositing fill material on a road line across a swamp or marsh, preliminary shooting should be done to destroy the "mat" of vegetable growth and decayed vegetable matter which is often several feet thick. Otherwise, such a mat will more or less "raft" the fill material and may divert it to one or both sides of the road area. Such shooting liquefies, in a measure, the mat substance and permits the fill material to sink considerably by its own weight.

To the du Pont Company should go the credit for most of the developments in connection with accelerated fill settlement methods and their variations as outlined here.

Another means of loading is through pipes or casings sunk in the fill material to the desired depth. Before loading, a small charge—a stick of dynamite—is sometimes lowered to the bottom of the casing and exploded electrically to form a pocket or chamber in the muck of sufficient size to receive the working charge of up to 150 pounds of dynamite. The casings, however, are removed before the heavy shooting is done.

Shooting electrically is usually done in series—several

Fill material piled within road lines before sub-surface blasting. For either three-point or casing loading the material should be piled high for a deep fill

ASQUITH AND KITCHENER

A Biographical Study of Two Eminent Englishmen

By CAPTAIN W. D. PULESTON
United States Navy

POSTERITY will pass final judgment on the prominent actors in the World War, but the present generation will certainly form its own opinions. We commend to our readers this careful appraisal of two of England's great men, prepared by a trained analytical observer, and suggest that they re-read the previous articles by the same author on Clemenceau and Foch which appeared in our issues for May and June, 1931.
—*The Editor*

THE severest test of any form of government is a prolonged war. In practice the responsibility of government falls on certain individuals. In Great Britain during almost two years of war these enormous burdens lay heaviest on the shoulders of Asquith and Kitchener. When they undertook their Herculean task in 1914 these two leaders were barely past 60, which means they were born and reared in the full influence of the Victorian ideals when Englishmen were openly earnest and when they bore their "white man's burden" proudly.

They came roughly from the same stratum of society, the upper middle class, Kitchener from an army family, Asquith from puritan Yorkshire nonconformist stock. They both were spared grueling poverty or stifling wealth. Asquith entered Balliol College, Oxford, in 1869, one year after Kitchener entered the Royal Military Academy at Woolwich to begin his career in the Royal Engineers.

ASQUITH'S career at Oxford was one triumph after another, while Kitchener plodded his way through Woolwich scarcely distinguished from his classmates except by his common sense. Even then Kitchener was hard to know and made few friends, while Asquith was duly elected President of the Oxford Union, the famous undergraduate debating society; but already Kitchener had made several visits to Europe studying French and German while Asquith knew only England.

Kitchener was a devoted member of the Church of England, joined the English Church Union and after his first visit to Palestine became a member of the Army Guild of the Holy Standard. Asquith, following his non-conformist antecedents, early in his parliamentary career led the fight for the dis-establishment of the Welsh Church.

After their academic years, without money or influence, these young men were thrown on their own resources. Asquith stayed at home and, while preparing for the bar, coached candidates for Oxford, married early, and raised five children by his first wife. Kitchener accepted an arduous surveying detail in Palestine, and studied the Arabic language. Their periods of probation were comparatively short. Asquith passed rapidly from law to politics, attracted Gladstone's attention, entered Parliament from East Fife in 1885, and entered Gladstone's last Cabinet as Home Secretary in 1892.

Above: **Asquith as a rising young solicitor, and *right:* the veteran statesman after the World War**

Kitchener's advance was almost equally rapid. By accident or design he was in Alexandria on leave from Palestine, when the British Fleet bombarded that city in 1882; and in 1883, at the invitation of Sir Evelyn Wood, he became second-in-command of the Egyptian cavalry, consisting at the time of only one regiment; he took part in the unsuccessful effort to relieve "Chinese" Gordon in Khartoum; returned to England for a brief visit in 1885, when he was presented to Queen Victoria, and gained her lasting and valuable friendship. From 1885 to 1892, Kitchener served in Zanzibar, eastern Soudan, and Egypt in various positions combining military, administrative, and judicial functions. He throve under a tropical sun and while working long hours in the tropics, his health actually improved. Only the damp, chill climate of his native England seemed to disagree with him.

Kitchener's period of subalternship was now over; he had gained the confidence of his military and civilian superiors, including such men as Lord Salisbury, Lord Roseberry, Lord Cromer, and Field Marshal Sir Evelyn Wood. And in the spring of 1892, just as Asquith was about to enter Gladstone's cabinet, Kitchener became Sirdar of Egypt. These two Englishmen, destined to work together for England's safety in the stress of war, were rising

in their widely separated spheres at almost the same relative rate.

Asquith first attracted Gladstone's interest as a free lance Liberal orator; in the middle eighties he defended Gladstone's action in sending Gordon to Khartoum, his attempted recall of Gordon, and the failure to rescue Gordon; while Kitchener gained his first prominence by the part he played in Gordon's attempted rescue. Asquith admits that defending the course of the Liberal gov-

ernment in the Khartoum incident taxed his dialectical abilities, and Kitchener found himself much embarrassed in his efforts to assist Gordon by the inconsistent attitude of both the English government and Lord Cromer.

Events now moved more rapidly for Kitchener than for Asquith. In 1895, the Salisbury government, a coalition of Tories and Liberal Unionists, overthrew Gladstone's government. Asquith, although preserving his seat in Parliament, lost his office, and his lack of private means forced him to return to the bar to support his growing family.

Lord Salisbury's party had severely censured Gladstone's failure to relieve Gordon, so it was not surprising that in 1896 the new government decided to begin the reconquest of Soudan. Kitchener was selected to command and having already reorganized the defeated and disheartened Egyptian Army, within three years he built a 230-mile railroad across a desert, fought a successful campaign against a band of Moslem religious fanatics, and firmly established the British position in northeast Africa. At Fashoda, where he encountered the triumphant French column under the intrepid Colonel Marchand, he adjusted a diplomatic incident that might easily have involved France and England in war.

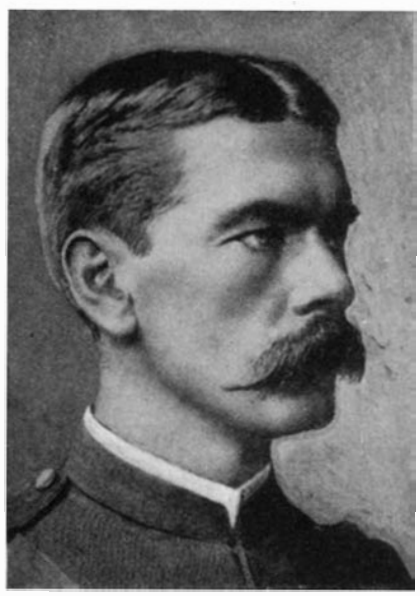
KITCHENER went from Egypt to South Africa to act as Chief of Staff for Lord Roberts, being personally nominated for this position by the Prime Minister, Lord Salisbury. After Roberts had destroyed Kruger's organized opposition, Kitchener was left in command with the more unpleasant task of suppressing the fast moving column of Boers who, under able partisan leaders, offered the same form of resistance to Kitchener that Marion and Sumter offered to Cornwallis during our Revolutionary War. For 18 long months Kitchener pursued his wary, well-horsed opponents, nor did he hesitate to destroy crops, drive off cattle, and burn houses and barns in his campaign to defeat the Boers.

As early as February, 1901, Kitchener was in conference with Botha, seeking some formula of peace that would keep the two South African republics within the British Empire, and in spite of his rigorous method of waging war, he was able a year later to take a leading part in conciliating the Boer leaders because of the confidence Botha had in Kitchener.

The South African War taxed Kitchener's capacity and physical strength and his letters to intimates reveal the despondency that occasionally engulfed him. During the long struggle he wrote a very modest letter to Broderick, the Secretary of War, suggesting that perhaps it would be wise to relieve him. Kitchener had foreseen the coming of the Boer War and in June, 1899, outlined a plan of campaign that was modeled after his successful Soudan campaign, in which light railways played a large part. But he found the mobile, intelligent Boers quite different from the fanatical Soudanese. The unwillingness of the Boers to submit to discipline and the greater strength of the British Empire eventually enabled Kitchener to bring the war to a successful conclusion, but only after a resistance that almost exhausted Kitchener, then in the prime of his manhood.

As Commander-in-Chief of the South African Field Force, Kitchener was in intimate association with Lord Milner, the British High Commissioner to South Africa, and during a four months' absence of Milner, Kitchener acted as

Below: **Kitchener thrived on his early African work.** ***Right:*** **The Kitchener the War generation knew**



High Commissioner and Commander-in-Chief. He again showed his ability to work in harmony with the civil authorities and Milner bore witness that Kitchener by "untiring energy—indomitable persistence—stoical courage—had brought complete success" and was "esteemed—by the men whom he fought and conquered."

In July, 1902, Kitchener returned to England to receive almost royal honors, and after a brief rest proceeded to India as Commander-in-Chief of the Indian Army.

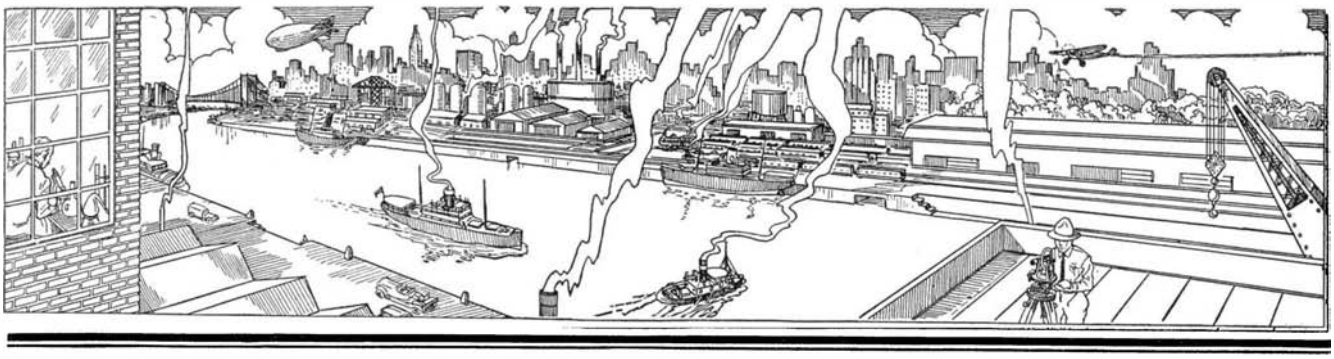
In 1891, Asquith's first wife died, and in 1894 he married Margot, the youngest daughter of Sir Charles Tennant. The vivacious Margot brought into the serious life of Asquith a brighter and lighter note. He was also beginning to emerge successfully from the drudgery that had marked his earlier days at the bar. Hereafter Asquith took more pleasure in life and later, amid the busiest days of his premiership, would steal a few hours to spend with the high-spirited coterie that formed a congenial circle around his brilliant wife. Some of his older friends looked askance at the gaiety of some of his newer associates; others wondered whether his earlier crusading spirit had not diminished, and one critic pointed to pictures of the younger and older Asquith as proof that his second marriage had softened him. Asquith himself, certainly a well

informed witness, testifies that he was blessed beyond his deserts in both marriages.

The Boer War divided the Liberal leaders into two groups; Roseberry, Grey, Haldane, and Asquith supported the war and were dubbed Imperialists, while Harcourt, Morley, Campbell-Bannerman, and Lloyd George opposed the war and were called pro-Boers. Gladstone was dead and no Liberal leader seemed capable of uniting the two factions. The Khaki election in 1900 gave the Conservatives another five years in office; thus during the decade 1895-1905 that brought Kitchener world wide recognition, Asquith to outward appearance was merely warming the opposition benches in Parliament. During this period in opposition, Asquith drew very close to Grey and Haldane without losing the esteem of Campbell-Bannerman, who had succeeded Lord Roseberry as the leader of the Liberal Party.

During the decade of Liberal opposition, Campbell-Bannerman undertook the difficult task of keeping the two groups together; Asquith was gradually recognized as second only to the leader in party councils. In 1905 Campbell-Bannerman led the Liberals to a decisive victory at the polls, and made Asquith, Chancellor of the Exchequer; Grey, Foreign Secretary; Haldane,

(*Please turn to page* 138)



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Discovers Last Chemical Element

AFTER a year of continuous scientific experiments, Dr. Fred Allison, professor of physics at the Alabama Polytechnic Institute, has announced the discovery of evidence indicating that "Element 85," the last of the undiscovered chemical elements, has been found in sea water, fluorite, apatite, monazite sand (Brazilian), kainite (Stassfurt), potassium bromide, and the laboratory reagents, hydrofluoric and hydrobromic acids.

The announcement is not final, but the evidence obtained caused Dr. Allison to refer to it as a "high order of probability" of the presence of this element in the compounds named.

On the left is the core of a marine electrolysis eliminator showing the action of electrolysis during nine months use on a ship's bottom. At the right is a new eliminator

If the element 85 evidence becomes conclusive, all of the elements of the universe will be known to science. Their discoveries have been in progress for more than a century. Several have been found within the last decade, but no scientist had perfected a method capable of detecting "85" and "87" until Dr. Allison produced his magneto-optic method, which is capable of detecting one part of substance in 100,000,000,000.—*A. E. B.*

Marine Electrolysis Eliminator

AN electrolysis eliminator which its Seattle manufacturers claim ends for all reasonable time the present "cancer" of electrolysis which eats away stern bearings, propellers and propeller shafts, rudders and shoes, is now being marketed on the Pacific Coast by the Marine Electrolysis Eliminator Company, after two years of demonstration on nearly a hundred Puget Sound ships.

The device, which is slightly concave and circular in shape, comes in three sizes, and is usually attached in pairs to the bottom of the ship, with a copper-wire hook-up to the engine, the water circulation system, the stern bearing, and the stuffing box on the propeller shaft. It is claimed that the present cause of the many trips to the dry-dock made by salt-water craft is the fact that the circulating water system, with its brass and iron piping and salt water for an electrolyte, constitutes a perfect galvanic battery. No effort is made to alter this fact, but the current's flow is reversed ingeniously.

With the eliminator installed, a removable core or electrode is the only article eaten away, the flow of formerly destructive current is reversed and electroplates and improves bearings it formerly gnawed away. "Cures" of cancerous electrolysis that formerly ate out stern-bearings as often as eight times in four months and have now been judged "permanent" after a year's operation and a dry-dock examination that proved no repairs to be necessary, are claimed by the company.

Bladder and Kidney "Cures"

IN connection with its continuing survey of medical preparations offered as cures or treatments for the more serious diseases of man, the Federal Food and Drug Administration plans, in the coming months, to direct special attention to products labeled as being effective in the treatment of diseases of the kidneys and bladder, Dr. J. J. Durrett, chief of the administration's drug-control laboratory, announces. Investigations which have been under way for several months indicate that several of these products are on the market, most of them containing ingredients possessing diuretic properties. "Where such ingredients are present in appropriate dosages," says Doctor Durrett, "the administration will not object to their being labeled as diuretics. Such preparations, however, by no means constitute treatments for the various diseases of the kidneys and bladder, among which are some of our most serious maladies. In fact, these preparations are sometimes harmful to a person suffering from these ailments."

Doctor Durrett states that although the Federal food and drugs act does not prohibit the sale of dangerous or deleterious drugs if they are truthfully labeled; nevertheless, sufferers from diseases of the kidneys and bladder are usually not able to diagnose their troubles nor to determine the character of treatment needed. In particular, they are unable to determine for themselves whether the diuretic would be useless, helpful, or harmful to them. Under the law, however, if an article which does possess diuretic properties is labeled simply as a diuretic, it is not misbranded. The administration's jurisdiction ends with seeing that labels of these medicines are truthful, both literally and in the implications which their wording conveys.

Sulfurless Rubber Avoids Tarnish

INVESTIGATION by the National Bureau of Standards has shown that the use of trinitrobenzene instead of sulfur as a vulcanizing agent for rubber produces a product which has no apparent action on such metals as copper, silver, and mercury. For example, when trinitrobenzene rubber is vulcanized in contact with copper, the metal remains bright and the aging qualities

A newly installed electrolysis eliminator on the bottom of a vessel

of the rubber are practically unaffected. Such rubber may find an important application in the manufacture of electrical insulation, since it may be applied directly to the copper without first tinning the latter. The electrical resistance is somewhat less than that of sulfur-vulcanized rubber, but adequate for practical insulation purposes. —*A. E. B.*

Pointers on Nail Points

THE point of the nail, more than the shank, determines splitting and holding qualities, according to the United States Department of Agriculture.

Investigators at the Forest Products Laboratory of the Forest Service have found that, in general, the nails with the sharper and longer tapered points develop more holding power than those having the common type of point, but they also show a greater tendency to cause splitting—especially in the harder woods—owing to the fact that they merely force aside the fibers with relatively little mutilation.

The blunter points of various shapes, because they shear off and upset the fibers in driving, have less holding power, but also less tendency to split wood.

Considering that blunt-pointed nails are effective in reducing the tendency to split the wood in nailing, and that within rather wide limits the holding power of nails depends on the length of nail in contact with displaced but unbroken wood fibers, the following general suggestions are made regarding nailing practice as affected by the type of nail point:

In light-weight woods, or in the denser species which do not split in nailing, the greatest holding power is obtained with sharp-pointed nails.

In woods which split with the common-pointed nails, two alternatives are open (aside from driving into bored holes, which gives the best results): Use nails of smaller diameter, if feasible, increasing the number to give equivalent holding power, or use blunt-pointed nails of the same length and diameter as would be used with the common-pointed nail.

The Forest Products Laboratory has designed a nail that has less tendency to cause splitting than common-point nails, and better holding power in many woods. The improved nail is tapered to the point for about a fifth of its length. The point may be either flat or slightly rounded and of any convenient shape—round, square, or otherwise. The characteristics of the nail can be varied by varying the diameter of the rounded or flat tip—without varying the length of taper—from approximately one fourth the diameter of the shank for softwoods to about three fourths the diameter of the shank for hardwoods. The blunt point of the nail just described, when used in a size adapted to the wood into which it is driven, produces sufficient shearing of fibers to obviate excessive splitting. The long taper aids in bringing the shank of the nail into intimate contact with the wood without further fiber mutilation or excessive wedging action.

A Modern "Gambling Joint"

AS much as 250,000 dollars is sometimes spent by the Aluminum Company of America in research, with no guarantee that commercially practical results will be secured. But the company has been highly successful in these scientific "gambles" says *Chemical and Metallurgical Engineering* and even when desired results did not materialize, other business has been developed in by-products of research. The company has lately built a new million dollar central laboratory at New Kensington, Pennsylvania, beautifully modern as a "lab" and also beautiful architecturally and in landscaping.—*A. E. B.*

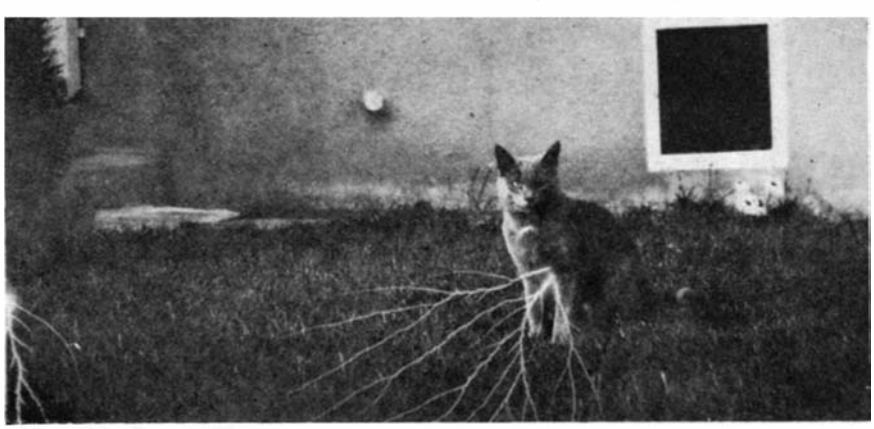
Staticat?

CAN a cat emit static?

If you stroke a cat's back in a dry, heated room you can produce sparks, but what about the cat in the accompanying photograph, which appears to be fairly bristling with sparks?

This photograph was submitted by a reader in Los Angeles, Mrs. Raymond Shields, who states in her letter that she did not notice anything unusual at the time the picture was taken. "But," she comments, "after the picture was developed I remembered that I had picked up the cat immediately following the exposure and he snarled at me—something he has never done. Evidently he either received a shock or it hurt him in some way. A radio aerial is on top of the building in the background; could that have had any connection with this peculiar phenomenon?"

An interesting little problem; especially in view of the fact that science still has much to learn concerning peculiar electrical effects and therefore cannot arbitrarily rule out any one of them merely because it is unknown.

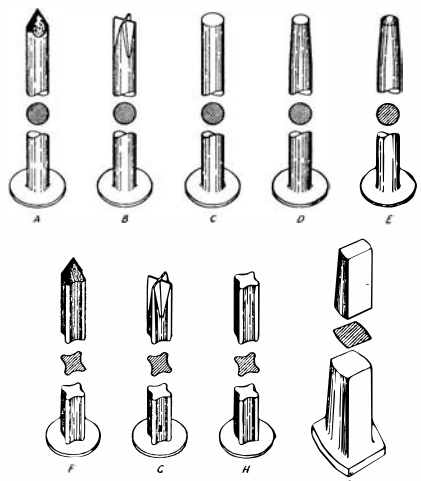


Courtesy Mrs. Raymond Shields

A correspondent wanted to know whether the static was emitted by the cat in the picture. The static at left of picture bears out an expert's explanation

It is easy to connect the presence of the radio with the spark—though just exactly why this should be done is another problem, since ordinary radio antennas are not known to do much sparking, even *via* cats. Moreover, the cat does seem to wear a rather annoyed, resentful expression. The conclusion seems obvious, at least if one has enough of the will-to-believe, that this cat is a broadcaster of static.

However, as a precaution, the photograph was sent to the Eastman Kodak Company, whose employes know much about photographs, and the following reply was received:



Some of the nails investigated by the United States Forest Products Laboratory, showing, D and E, the two types recommended by them

"The marking on the negative is, as you infer, produced by static and would have occurred under the same conditions, regardless of the subject photographed. The result can be produced by rapidly unrolling a spool of film and in cold, dry weather the effect is so pronounced that the sparks can be readily seen in a photographic darkroom."

The problem now is, why did the cat snarl?—*A. G. I.*

Ultra-Violet Light in Tuberculosis

THE use of ultra-violet rays from the carbon arc and the quartz mercury vapor arc has become generally known to the public and seems to have certain definite effects on the body. Thus, it is specific in controlling rickets and sometimes of help in tuberculosis of the intestines, of the lymph glands, and of the bones and joints.

Evidence as to any other virtues that it may have is not so well established as to be considered proved. In order to test its effects Doctors H. S. Willis and J. Cohen of the Johns Hopkins University Hospital treated groups of patients with ultra-violet rays and controlled their studies by screening one of the burners with window glass, which does not permit the short ultra-violet rays to pass. In their discussion the authors point out that the long ultra-violet rays may pass, that these rays penetrate the skin slightly (about 3 millimeters or one eighth inch), that the skin of the colored races absorbs more ultra-violet rays than that of the whites and that the exact difference in effects between the long and the short rays is not perfectly established.

The patients studied included persons with tuberculosis of the glands, of the bones and joints, of the intestines, and of the skin, and also some patients with anemia and others convalescing after operations. Ninety-one were treated with unscreened lamps and 47 with screened lamps. When all of the cases were considered it was found that just as many cases improved without the short ultra-violet rays as with them, but the patients with tuberculosis of the glands

Courtesy Field Museum of Natural History

This mammoth beryl crystal, weighing approximately 1000 pounds, was presented to the Field Museum by William J. Chalmers. This is believed to be the largest crystal of this mineral, a relative of the precious emerald, ever discovered

showed a higher percentage of improvement under the ultra-violet than those without. The authors found that the patients who were receiving the short ultra-violet rays felt better, ate better, and gained weight better than those who were receiving the screened rays. They feel that this was not a mental effect, since the patients who received the screened rays did not indicate anything like a similar beneficial effect.

Studies of this type help to establish scientifically the actual merits of such methods for the treatment of disease. They should, however, be made on a much larger scale and with a more certain control of all of the factors concerned.—*M. F.*

Old, Old Story Won't Down

WILL ancient seeds sprout? The editors of all scientific journals receive this question about once a week, yet no matter how often the belief is downed, it will not stay down. The same question has been answered by *Nature* (London) which states:

"For many years now, a popular belief has existed that seeds which have been removed from ancient tombs retain their ability to germinate. Wheat grain, the so-called 'mummy wheat', has been a case in point for several decades. This question was brought forward again during the discovery and examination of the tomb of Tutankhamen in 1923, by Howard Carter and Lord Carnarvon, and has received attention from various quarters since that date. Now another claim has been made by an American farmer, that wheat taken from the tomb of Tutankhamen has been made to grow, and this fact has received much publicity in the press. It is all a question of viability.

"The viability of a seed depends on several factors, both internal and external. Some seeds will not germinate immediately, and are said to be dormant, such dormancy again being conditioned by after-ripening processes, and so on. The result is that seed viability varies considerably within the plant kingdom. For example, the acorn is viable for one season only, whereas charlock will last for 20 or 30 years. Hawthorn, even given germinating conditions, remains dormant for the first season; but immature wheat will germinate, given the necessary conditions, as seen in the case of wheat germinating when still in the ear, during a wet season. On the other hand, mature wheat is viable for some considerable time. Not only that, the grain can withstand extreme conditions to an exceptional degree. Other plants show a similar tendency."

The same subject was discussed in *Nature* many years ago by W. Botting Hemsley, who stated that "kidney bean seeds, which had remained in the herbarium at Tournefort for 100 years, germinated; and *Mimosa pudica* will remain viable for 60 years.

"But the viability of wheat thousands of years old is a different matter. Sir E. A. Wallis Budge states in the *Times* that grain from a tomb of date 1200 B.C. was tested for him by the late Sir William Thiselton-Dyer at Kew, and gave negative results. Many others, too, have tried since, with similar results. Yet, such positive results as claimed by some, need explaining.

"The question is: Were such claimants sure of their wheat? For hundreds of years, the halls of tombs have been used as granaries by the natives. The grain can conceivably be ascribed to that, and therefore possibly be only a few years old. Also, 'mummy wheat' has become so popular that guides have resorted to tricks whereby they dig up 'mummy wheat' (in the presence of the tourist) which the guides themselves had placed there some time before. So far, there has not been one authentic case of 'mummy wheat' being viable, and it is extremely unlikely that there ever will be. A viable seed is still living and therefore respiring, however slowly. Decay is therefore taking place, since there is no anabolism. Such decay varies in rate; but it is not likely that it is so slow as to last over thousands of years."

Still the story probably will not down.

New Zinc Process

A REVOLUTIONARY new process of producing high-grade metallic zinc by the use of methane or natural gas as a reducing agent, devised by Charles G. Maier, metallurgist, at the Pacific Experiment Station of the U. S. Bureau of Mines, was described at a recent meeting of the American Zinc Institute held in St. Louis.

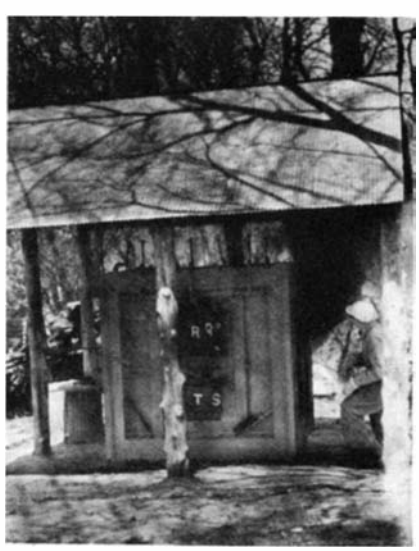
A critical study of zinc smelting with the object of reducing production costs and improving the quality of the zinc was begun by the Bureau of Mines three years ago. The new process is a by-product of these basic studies and is additionally remarkable as being an application of precise knowledge of chemical fundamentals.

Recent improvements in metallurgy require higher grades of zinc. Formerly prime western spelter was the standard of quality, but now the stage has been reached where electrolytic zinc of 99.99 percent purity is the standard. The new process is expected to produce zinc fully as pure as any commercially available today.—*A. E. B.*

Anti-Knock from Ocean Water

OCEAN water will become to a greater extent the source of chemicals from which anti-knock compounds for motor gasoline are made if experiments now in progress prove successful. The Dow Chemical Company and Ethyl Gasoline Corporation are undertaking a joint venture for further production of bromine from ocean water. The Dow Chemical Company is the largest manufacturer of bromides in the world. Ethyl Gasoline Corporation is a subsidiary of General Motors Corporation and Standard Oil Company of New Jersey, and is now the largest user of bromides in the world. It manufactures an anti-knock compound for gasoline marketed under the trade name "Ethyl." Ethylene dibromide is used in the manufacture of Ethyl fluid and the popularity of Ethyl gasoline has greatly increased the demand for bromides.

Under an arrangement with Ethyl Gasoline Corporation, The Dow Chemical Company has undertaken to construct and equip an experimental plant for the extraction of



A cloud of smoke escaping (at right) from the dust explosion investigations house in Virginia

bromine from ocean water. A strip of land three fifths of a mile in width and extending from the Atlantic Ocean to Cape Fear River—about two miles north of old Fort Fisher—has been acquired for the purpose of locating the experimental plant. This location is about 17 miles south of Wilmington in New Hanover County, North Carolina. The plan provides for utilizing ocean water and, after extracting the bromine, discharging into Cape Fear River. It is expected that construction work will begin in the very near future, with the hope of having the experimental plant in operation during the present year. If the plan proves feasible, the two companies intend to organize a subsidiary corporation and

construct a plant for commercial production on a large scale.

According to United States Bureau of Mines figures, the bromine recovered in 1930 by the producers from natural brine, and the bromine content of bitterns used in the manufacture of bromine compounds, was 8,462,800 pounds valued at 2,109,974 dollars. This was an increase of 32 percent in quantity and 20 percent in value over the output of 6,414,620 pounds valued at 1,759,325 dollars in 1929. In 1930 as in 1929 the increase was due in most part to bromine required for ethylene dibromide used in the manufacture of Ethyl gasoline.

—*A. E. B.*

A Diesel on the Race Track

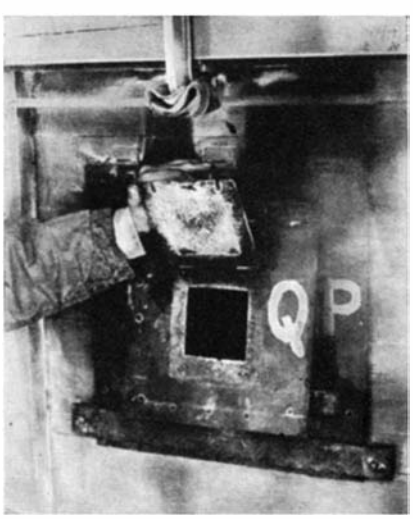
TO our knowledge the first Diesel-engined racer ever to be entered in a race on the Indianapolis Motor Speedway, C. M. Cummins' car made such a good showing during the annual 500-mile race on May 30 as to excite widespread interest. Mr. Cummins, the designer, of Columbus, Indiana, is a builder of marine Diesel engines; it will be remembered that last year he installed one of his standard marine oil-burning engines in a Packard chassis and made a notable trip from Columbus to New York and return (See SCIENTIFIC AMERICAN, May 1930—*Editor*).

While the Cummins racer finished twelfth in a field of 17 cars, its performance was good. During the entire race it did not make a single stop, and it survived the costly 16-cylinder creations and some of the eights. The cost of the oil consumed as fuel for the 500 miles was approximately $2.40—the per mile cost therefore figuring out at less than one half cent. The Diesel racer's speed averaged 86.17 miles an hour.

Study Dust Explosions

IN its effort to reduce the loss of life and property resulting from dust explosions in industrial plants, the United States Department of Agriculture has built an experimental "dust-explosion house" at Arlington Farm, Virginia, which is equipped with swinging iron vent doors and windows to permit the force of the explosion to escape without blowing up the building.

The "dust-explosion house" is a heavily reinforced compartment of approximately 100 cubic feet volume. Engineers in the Bureau of Chemistry and Soils are now conducting experiments to determine the proper venting area necessary to protect buildings of various sizes in industries subject to dust explosions. Dust explosions are produced in the experimental house at will by blowing starch, flour, grain dust, or other powdered combustible material from a number of hemispherical cups. The dust cloud is ignited by blowing it on a heated electric coil.



One of the iron vents for the escape of gases in dust explosions

There are at least 28,000 industrial plants in the United States subject to danger from dust explosions, the department engineers say. These plants employ more than a million workers and manufacture products with an annual value in excess of ten billion dollars. Among the various products which yield explosive dusts are grain, starch, sugar, wood, paper, cork, fertilizer, dried milk, chocolate, rubber, and sulfur.

A New Endurance Flight Record

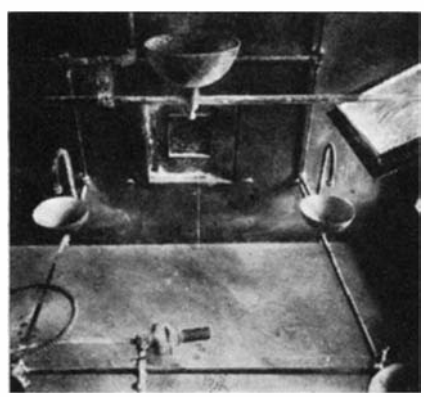
THE fuel economy of the new Packard Diesel airplane engine was again demonstrated when pilots Walter Lees and Fred Brossy kept a Bellanca plane, with enlarged wings and a Packard Diesel engine, in the air over Jacksonville Beach, Florida, for 84 hours and 33 minutes, landing at 7:20 P.M. on May 28. Replying to our congratulations on this splendid achievement, Alvan Macauley, President of the Packard Motor Car Company, gave such an interesting account of the successful flight and the two previous ones that we asked for, and were given, permission to publish his entire letter. It will be noted from this letter, which follows below, that even after setting a record that promises to stand for some time, the plane landed with sufficient fuel for another four or five hours of flight.

"Dear Mr. Munn:

"We very much appreciated your telegram received this morning, congratulating us on the performance of the Packard Diesel at Jacksonville Beach, Florida, where we won the world's record for continuous non-refill flight by nine hours and ten minutes. As you well know, a test of the kind we undertook requires sound fundamentals, a trained and conscientious personnel, and several months of careful preparation. Our two aviators even went to the extent of dieting, losing about 10 pounds each, in order to favor the success of the venture.

"So far as I know, neither Walter Lees nor Fred Brossy, our pilots, is a dramatic writer. If either were, he could tell an interesting story of the last two flights. We made three attempts. In the second attempt, when within an hour and fourteen minutes of the world's record, a terrific storm broke that was appalling in its intensity. The aviators were flying on the beach, water on one side, jungle on the other. They recognized they must either escape the storm or land with the record almost in sight. The rules required them to keep within observation of the flight officials. They headed for the storm and measured its height and width, hoping to find a way up or through. Up was apparently out of the question, as they would have gone out of the view of the flight officials. It was evident the black clouds were too heavy to see through, if they were at any considerable height. They skirted the whole front of the approaching storm and found no opening, so they returned to their beacon to await the possibility of riding out the storm. As it broke upon them it was increasingly evident the storm could not be mastered. For a time they circled closely, one man with his head out of the window keeping the beacon in sight, and the other piloting. The rain meanwhile descended in torrents, accompanied by a high wind. It became worse and worse until navigation became almost impossible as dusk deepened. Finally the pilots were obliged to make a hurried landing 11 miles down the beach and actually out of sight of the official observers, so they were unable in this second attempt to get even credit for having broken the American record, as they did by a comfortable margin.

"The third and successful effort was less dramatic, but still very interesting. Throughout all the trials the motor functioned perfectly. They arose from the beach easily regardless of the weight of the plane in comparison to the size of the wings. They drew for fuel first from the belly tank, releasably attached to the under side of the fuselage. On attempting to release the belly tank, however, it wouldn't release and they had to carry it about 12 hours before they ingeniously contrived to trip the latch and drop it upon the beach. Then they began to use the fuel stored in five-gallon cans in the cabin and all went well until, after emptying one of the cans and throwing it out, it caught on the stabilizer brace. Mr. Brossy, the pilot, at intervals attempted by banking and diving the plane, to dislodge the can, but without results. Finally Walter Lees, the senior pilot, crawled back into the rear of the plane, slit the fabric, reached out and was able to remove the obstruction, which had become a serious menace, afterwards sewing up the fabric and repairing it so that it lasted to the end of the flight. After that, they had a few near storms but wound up the flight successfully and uneventfully and settled on the beach just before nightfall with sufficient fuel to have continued the flight for four or five hours longer.

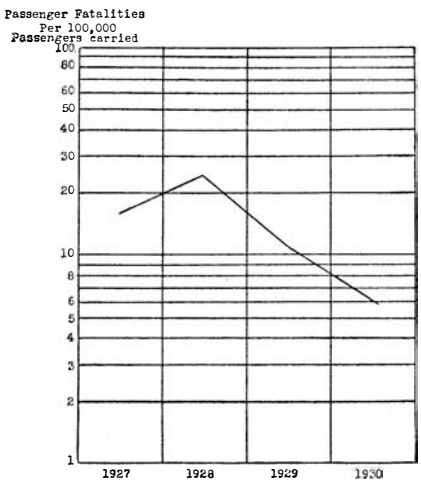


Interior of dust explosion house showing cups from which various dusts are blown for test explosions, and the ignition coil in front

"An interesting fact was that they were unable to gage accurately the proper proportions of fuel oil and lubricating oil to take aloft. They found as time passed that they had too much lubricating oil, so they simply dumped it in the tanks, mixing it with the fuel oil, and consumed both. About 15 gallons of lubricating oil were used in

this way. Towards the latter part of the test, therefore, they were being driven by lubricating oil. It didn't seem at all to bother the motor, which will run on almost any liquid fuel. It does very well, you know, on kerosene.

"While in Jacksonville no effort was made to stretch the mileage or to travel at high speed, it is significant that the distance cov-



Passenger safety is increasing on our scheduled air transport lines

ered was considerably more than enough to fly from New York to Europe and return without touching land for refueling, or to make the round trip from New York to California and return. We shall have more exact figures as to the distance traveled, which has been estimated at 6600 miles. At that figure the plane could have flown around the earth with but three stops for supplies.

Cordially yours,

ALVAN MACAULEY, *President*"

Aviation Significance of Piccard's Flight

OUR newspapers have "covered" Professor Piccard's splendid flight in so complete a fashion that we will not burden our readers with a complete story. We will endeavour to answer but one question. Has this balloon expedition any significance for aviation? It has.

It is only a question of a year or two before practical experiments will be made with altitude planes in which the passengers will be seated in a hermetically sealed cabin supplied artificially with air at ground level pressure; the engine will be supplied with supercharged air so that power will be maintained at altitude; greater speeds will be attained than is possible in navigation at lower levels.

Also in a few years more, the rocket will be the subject of practical experiments for carrying mail across the Atlantic. If a rocket can be projected high enough, it will enter a region of very thin air, where the air resistance will be almost negligible. We do not believe in rocket airplanes, but we do believe that a rocket designed on the principle of a projectile can be made to work ultimately. The rocket will rise to great heights, and travel along a parabola, just like a shell, with the advantage that for the major part of its flight it will be flying in what is, to all intents and purposes, a vacuum. Professor Piccard's flight will give us more data about the stratosphere, that region of the atmosphere, more than 12,000 meters in height, where the temperature no longer drops as altitude is further increased; that, at least, is the generally accepted theory. Any such data will, of course, be invaluable to designers of altitude craft.—*A. K.*

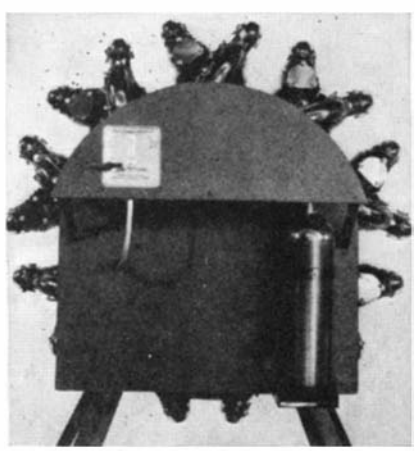
Airplane Reliability

IT MAY be true that the aviation industry is passing through a period of depression and adjustment; aircraft manufacturers have been particularly hard hit and inventories are being adjusted only by severe price cuts and strict limitations of production. In air transport operations, on the other hand, progress is rapid and entirely satisfactory.

The Aeronautical Chamber of Commerce reports that during 1930, 34 air transport lines reported a total of 28,833,967 miles flown in scheduled operations, or an increase of 42.4 percent over 1929. Still more remarkable is the increase in passengers carried—385,910 passengers were carried on scheduled lines in 1930. This is an increase of 220,647 passengers or 134 percent above the number carried in 1929. Passenger miles for the year 1930 total 94,545,744. The average length of a passenger trip, for the year as a whole, was 245 miles.

Still more remarkable is the progress made in reliability and safety.

Less than 7 percent of the total trips scheduled by the 34 lines were not completed. The trips scheduled but not completed total 3275. It is interesting to analyze the causes that led to abandonment of these trips: 91 percent were abandoned because of bad weather; insufficient traffic accounted for 6.44 percent; other causes for 1.1 percent; mechanical difficulties were responsible for only 1.46 percent of the trips abandoned. This is a remarkable tribute to the present reliability of the airplane.



Tank of CO_2 for the fire extinguisher, under an airplane cowl

As a result of this increased mechanical reliability, of the efficient aids to navigation installed by the Department of Commerce, and of the stringent rules propounded by the Department, there was also a highly satisfactory decrease in the rate of passenger fatalities for the year 1930. More than 3,900,000 passenger miles were flown for each individual passenger fatality. This is equivalent to a plane with ten passengers flying 15 times around the earth at the equator, for each individual fatality recorded.

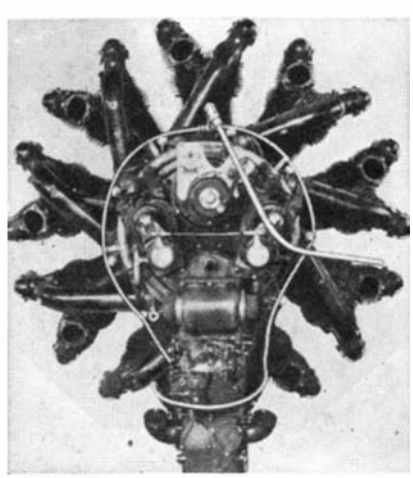
The progress in passenger safety is strikingly illustrated by an accompanying chart. The first burst of passenger traffic increased the fatalities per hundred thousand passengers carried to something like 25 in 1928. By the middle of 1930, the graph shows that the number of fatalities sank to six per hundred thousand and the trend of the graph is evidently sharply downwards. While there is no doubt that passenger air travel is still far from approaching railroad safety, it is quite evident that the airplane is getting safer from day to day.—*A. K.*

A Practical Aircraft Fire Extinguisher

TO anyone who has seen an airplane crash to the ground and burst into flames with the occupants pinned beneath the wreckage, fire hazard remains an unpleasant memory. Anything that can be done to minimize fire hazard is worth while. Pending the development of the fuel-oil aircraft engine, one of the most practical safety measures is the installation of permanent fire extinguisher equipment on board the airplane.

One of the effective fire extinguishers now available, called the "Lux" extinguisher, consists of three major parts. One is a steel cylinder containing carbon dioxide at 850 pounds pressure. Carbon dioxide is an inert, non-poisonous substance which cannot support combustion and which puts out an engine fire the moment a cloud of the gas surrounds the engine. Another advantage of this gas is that it is non-corrosive, dry, and clean and does not damage electrical or other equipment. The steel gas cylinder is usually installed in an upright position, behind the fire wall. The gas when compressed to 850 pounds is in liquid form, and is sealed by a metal disk. The second major part of the apparatus is the control and control panel, which is shown mounted at the left.

When used on a multi-engined plane, the control lever of the extinguisher can be set at the position corresponding to the engine which is in trouble. When in position, the handle can be pulled back and by an arrangement of a flexible cable, run in a quarter inch aluminum tubing, be made to operate a specially designed cutter valve on the cylinder, thus releasing the gas. The direction valve then allows the gas to dis-



Courtesy Walter Kidde and Company

Lux distributing tubing installed around the engine mounting with a loop about the carbureter and a nozzle in the carbureter intake

charge under its own pressure to the engine selected by the control handle. To distribute the gas, a perforated ring of tubing 7/16 of an inch in diameter, the third major part, is installed around the engine, with a perforated loop about the carbureter and an outlet in the carbureter intake. Even when the slipstream is driving the air past the engine, the carbon dioxide cloud has proved effective again and again in extinguishing violent flames.—*A. K.*

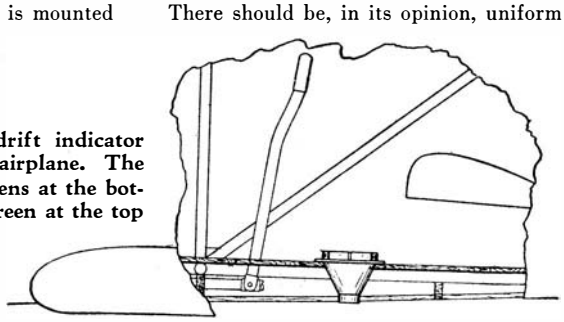
A New Drift Indicator

A PILOT may have his airplane correctly headed by compass, due north, along the line AH in one of our sketches. But if the wind is from the side and from ahead, as shown by the arrow W, then his actual course will be along the line AC. He will be drifting away from the correct course. The angle D will be the angle of drift. If no correction is made for this angle of drift, navigation becomes hopeless.

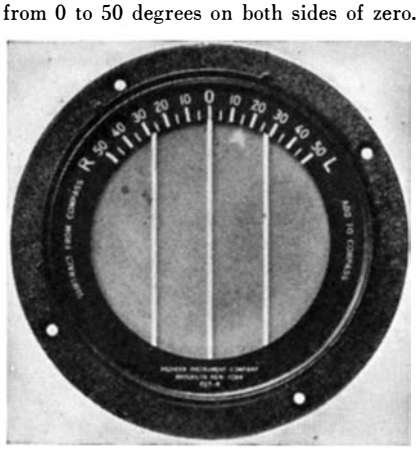
A variety of drift indicators have been employed. The latest and perhaps the most practical of such instruments is the Pioneer Drift Indicator.

This new instrument is shown in a photograph and its installation is illustrated in one of our sketches. It is a very light and compact instrument and is so mounted that observations can be made through the floor of the cabin without it being necessary for the pilot to open windows or to look over the side of the cockpit.

In the top of the instrument is mounted a ground glass 3⅜ inches in diameter. A lens is inserted in the bottom of the funnel-shaped case. As the airplane moves over the ground, an image of the ground below is thrown upon the ground glass screen and objects on the ground appear to travel across the screen in the direction of the movement of the airplane. The screen itself is rotatable and is provided with parallel sight wires and an angular scale graduated from 0 to 50 degrees on both sides of zero.



Installation of the new drift indicator in the fuselage of an airplane. The funnel-shaped case has a lens at the bottom and a ground glass screen at the top



A "moving picture" of objects on the ground passes across the glass screen of this drift indicator

To make an observation of drift, it is only necessary to rotate the screen either to the left or right until objects on the ground appear to travel in a line along the screen parallel to the sight wires. The angle of drift is then read directly from the scale. In order to correct the compass course, the angle of drift is either added or subtracted from it. To prevent mistakes in deciding whether the drift should be added or subtracted, the instrument itself is plainly marked on the right side "add to compass heading" and on the left side "subtract from compass heading."

While flying at night, lighted objects, such as street lights or electric signs, show up on the screen with remarkable clearness. It is therefore just as easy to take a drift reading at night as in the daytime, provided of course that the plane is passing over lighted objects of sufficient brilliancy.

—*A. K.*

Aids to Air Commerce

THE Chamber of Commerce of the United States is keenly interested in the continued progress of air transportation and has a special Committee on Aeronautics functioning toward this end. This Committee is composed of authoritative business men and representative air-line executives. The recommendations of this Committee to the Nineteenth Annual Meeting of the Chamber of Commerce are, therefore, worthy of serious consideration.

There should be, in its opinion, uniform aeronautic licensing laws, and the Committee urges those states which have not yet enacted legislation requiring Federal licenses for aircraft and airmen, to pass such legislation. Undoubtedly, this legislation would assure not only uniformity but a higher standard of flight safety throughout the country.

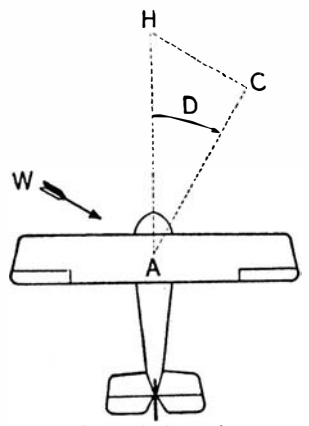
Again, the Committee urges that the states enact legislation enabling municipalities and counties to acquire, develop, and operate airports.

In spite of the perennial complaint that the laws of the country multiply too fast, the legislation under these two items, as we hope our readers will agree, would be entirely legitimate and reasonable.

The states are also asked to help in the local enforcement of the Air Traffic Rules of the Department of Commerce. They are, perhaps, more likely to secure local enforcement of Air Traffic Rules than observance of another famous set of rules which we will not name.

The Chamber also urges the extension of Federal airways and the increased building of proper landing facilities and airports. Air marking is undoubtedly of the greatest help to the pilot; to avoid confusion it should be uniform in character and with such uniformity of air marking, Chambers of Commerce in every city should be concerned.

Nobody thought of airport zoning a few years ago; now the subject is becoming acute from two points of view. The approaches to the airport must be zoned so that pilots are not hampered by tall buildings or high-tension transmission wires. On the other hand, the noise and dust pertaining to an airport may ruin a pleasant residential district. Therefore, restriction to airport sites also has to be considered.



How a plane drifts off its course as explained in accompanying text

The available supply of helium in this country is practically inexhaustible. Moved by the recent disasters in lighter-than-air flights abroad made with inflammable hydrogen gas, the Federal Government, reversing its previous policy, has arranged for the export of helium gas under certain restrictions for use in airships. The Committee approves and also suggests Federal legislation to encourage the development of commercial lighter-than-air services.

We feel that this is altogether a most constructive and reasonable report—*A. K.*

The Photo-Electric Cell in Fog Flying

EXPERIMENTS conducted by W. F. Westendorp of the research laboratories of the General Electric Company with a photo-electric cell may be of considerable service in fog or blind flying.

Fog consists of particles of moisture, or moisture surrounding particles of dust. When a beam of light travels through a fog, it is partially dispersed, partially absorbed. At any rate it no longer travels in a definite straight line. The eye can no longer see the source of light, but notes vaguely a certain diffused and weak light effect.

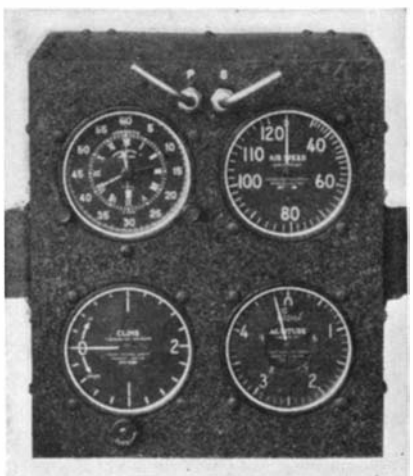
A photo-electric cell is much more sensitive to changes of light intensity than the human eye and, moreover, with the use of vacuum tube amplifiers, its indications can be greatly strengthened.

A photo-electric cell has been mounted at the tail of the plane, and provided with an amplifying system and two indicators in the pilot's cockpit. One indicator tells the pilot on which side the light is more intense; the other indicator tells him whether the light is becoming more or less intense. Hence with the aid of the photo-electric cell, he can judge on what side the airport beacon lies, and also whether he is approaching or leaving the beacon. A neon tube has been employed in these experiments, with a current pulsating at the rate of 1000 cycles a second. The experiments

so far have been extremely promising. We hope to give our readers more complete information on this interesting device a little later.—*A. K.*

Seaplane Float Test Basin

IN these days, when faith in the future of the United States seems to be slightly shaken, it is refreshing to think that our country leads at least in one or two things. The new 30 by 60-foot wind tunnel is the largest in the world and will greatly advance American aviation. The new seaplane channel opened by the National Advisory Committee, is also the largest and most advanced type of apparatus for testing floats and flying boat hulls.



Close-up of the new test kit with which investigations of the performance of airplanes may be made

Some 60 years ago, an Englishman by the name of Froude built the first towing basin, in which models of surface vessels were towed at a speed of some 10 miles per hour so that their drag or water resistance could be measured. Although marine people are most conservative, this form of investigation became popular quite rapidly and water towing basins are now available in all civilized countries. The towing basin at Washington has been active for many years, and all the important, modern vessels built for the Navy and for the American merchant marine have undergone model tests at this station. With the advent of aviation, however, the speeds of the Washington Navy Yard basin have become inadequate.

In the new channel at Langley Field, full size floats will be propelled through the water at a speed of 60 miles per hour. The carriage shown in our photograph is built of steel tubing, and is provided with two driving motors. The carriage runs on rubber wheels, and current is taken from the overhead rails after the fashion of an electric trolley car.

The channel is some 2400 feet long. This enables the carriage to maintain an absolutely steady speed for a run of 1000 feet, with sufficient margin for acceleration and deceleration. On the carriage are the observers and automatic recording instruments. Below the carriage, as our photograph shows, is the float to be tested, flexibly attached to the carriage. The suspension of the carriage and the arrangement of the weighing apparatus is such that the drag, the lift, and the pitching moments of the float can all be measured. The trim of the float can also be changed to suit the purposes of the investigation. It is expected that the new channel will greatly advance the art of float design, giving us finally floats which will provide the quickest take-off, the least spray, and at the same time the minimum aerodynamic resistance in the air.

A question often asked is: why can not water tunnels be built just like wind tunnels? The reason is that water is some 800 times as heavy as air, so that in order to build a water tunnel of a certain size and speed, 800 times as much power would be needed as in the air tunnel. While the power required in this new water channel is not negligible, it is not nearly as prohibitive as would be the case for an installation where the float would be at rest and the water made to circulate around it. —*A. K.*

New Airplane Test Kit

ONE of the most important things in the construction of airplanes is the determination of its performance. The speed of an automobile has, as a rule, nothing to do with its safety, but in an airplane, certain aspects of performance are an inherent part of safety.

For example, it is very important to know the stalling speed of an airplane, or, in other words, the slowest speed which it can comfortably maintain when coming in to land with its engine off. Evidently, safety will be increased by ability to glide in at a slow speed. Rate of climb is also an important factor, as is the angle of climb. To be safe, an airplane must have a certain minimum rate of climb (400 feet a minute is required by the Department of Commerce), and it must also be able to climb at a steep angle with the horizontal so that it can clear obstructions nicely.

The take-off time is not so much a measure of safety but a short take-off time is of obvious desirability in airplane operation.

In multi-engined ships, it is indispensable that flight should be maintained with one motor out of commission. A multi-engined ship which cannot maintain height with one motor out, is actually more dangerous than a single-engined ship.

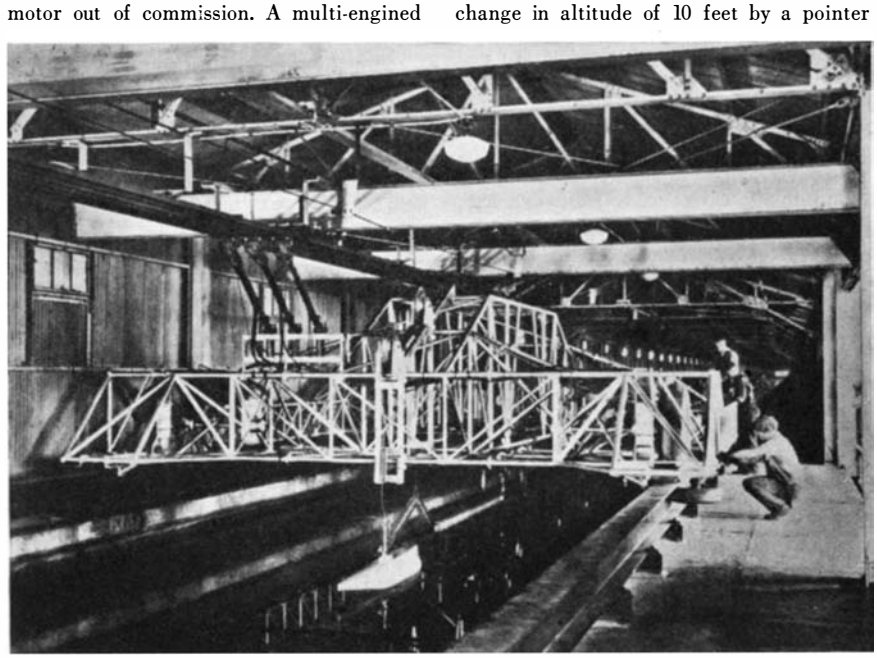
The determination of all these points in performance is quite a difficult and complicated matter and involves the use of many instruments. Hitherto, these instruments have been separately mounted and not standardized, but a new test kit brought out by the Pioneer Instrument Company is calculated to remove many of the difficulties involved. The various instruments are now mounted in a case which can be held readily in the observer's cockpit or attached to the instrument board through flexible suspension.

In the top left hand corner of the unit there is a clock equipped with a "stop" hand, as well as another reference hand which can be manually set by means of a knob in the center of the front glass. With this, time of take-off can be accurately determined.

In ordinary flying, it is high speed which is important. Therefore, the conventional air-speed indicator is graduated for high speeds. In the new test kit the air-speed indicator is specially calibrated for the low range of the speed with graduations at two miles per hour. The air-speed indicator is, in principle, an air-tight case with a flexible diaphragm in its center. One side of the diaphragm is connected to the pressure side of a pitot tube; the other side of the diaphragm is connected to the suction side of the tube. The difference in pressure moves the diaphragm and hence, the indicator.

It is customary to mount the pitot tube pointing outward ahead of the airplane wings. Unfortunately, the flow of air around the wings disturbs the condition at the pitot tube and makes it highly unreliable, particularly at low speeds. Therefore, for measuring the slow speed of an airplane, it is desirable to hang the pitot tube at the end of a long cable some 40 feet or so below the airplane. This is the plan to be adopted in the new test kit.

Another important feature is the measure of the rate of climb. For this a sensitive altimeter is employed which will show a change in altitude of 10 feet by a pointer



Full-size seaplane floats are propelled in this Langley Field channel at 60 miles an hour. The channel is nearly half a mile long, 24 feet wide, and 12 feet deep

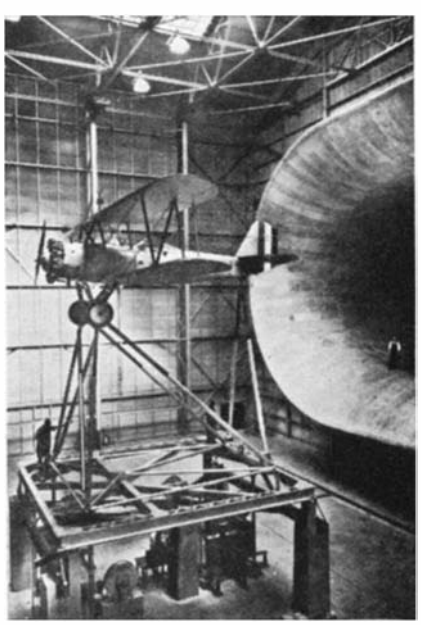
movement of slightly more than one eighth of an inch.

Making performance tests is great fun, but it also requires care and ingenuity and every improvement in instrumentation is a decided help—*A. K.*

A Giant Wind Tunnel

IN all wind tunnels the same principle is employed: a propeller draws the air past the model of the airplane; the model is mounted on wires or a spindle and the forces and moments are measured on carefully designed balances. The reason for the popularity of wind tunnels is that they allow the characteristics of the airplane to be carefully and readily studied before it is flown.

There are many tunnels now available in the United States, at Langley Field, at the Army Station in Dayton, and at the Guggenheim Schools of Aeronautics at Stanford, New York University, and so on. These tunnels have a working section at the narrowest parts of their channels of some eight or nine feet in diameter, and the average speed at which experiments are conducted is from 60 to 80 miles an hour. The airplane models employed are about 36 inches in span. These tunnels are of great usefulness to the airplane designer and in skilled hands give him much information. They may also be used to determine the value of an invention in the most practical and quickest fashion. There is, however, a "scale" effect which makes all results obtained in these tunnels inferior to those



The largest wind tunnel in the world which has just been completed at Langley Field, Virginia. A full-size airplane is on the frame before it and a man stands in its throat to give a size comparison

actually obtained in flight. This is not altogether a disadvantage since the designers' estimates become more conservative thereby. It is, however, highly desirable, from a scientific point of view, to know exactly what this scale effect is. Therefore larger tunnels in which actual, full size airplanes can be tested have long been considered desirable. The sole difficulty in building such very large wind tunnels is the question of the financial expenditure involved.

The National Advisory Committee for Aeronautics, when the United States was still prosperous and no deficit faced the Treasury, was fortunate enough to secure adequate appropriations for the construction of a giant wind tunnel. This has just been completed. No official figures are available as to the cost of this tunnel, but it is understood that the cost ran well over a million dollars.

The tunnel is in the form of a huge, flattened out figure of eight. The working section of the tunnel is placed at the center of the figure of eight, where there is a break in the walls of the channel. The air flows past this break in the walls without any deviation, the entrance cone and the exit cone from the working section being carefully designed to this end. The actual working section—the section where the airplane is to be tested—is 30 feet high and 60 feet wide, so that an average full-size airplane can be tested.

The air is drawn past the working section by two large propellers, each 34 feet in diameter, and each driven by a 4000 horsepower electric motor. The air drawn past the propellers is then carefully guided past vanes, flows back in the return channels (which are the top and the bottom respectively of the giant figure of eight) and is then again guided back into the central part of the tunnel. With the propellers working at full power, a maximum air speed of 115 miles per hour is produced in the working section.

The airplane to be tested is placed on a floating platform, and supported aloft by hinged tubular struts. These struts transmit forces to six balances placed below, so that the three forces: lift, drag, and transverse, and the three moments: pitching, rolling, and yawing or turning are automatically measured or weighed on the balances. All measurements are simultaneous and a marked card emerges from each balance, not unlike in principle to the weighing machine ticket offered in our drug stores!

The tunnel was officially opened recently at Langley Field, at a ceremony attended by leaders of the aviation industry, and representatives of government aviation departments. The tunnel was so huge that the audience was awed; the impression was similar to that produced by a cathedral. One aircraft constructor expressed the general feeling very aptly: "I don't believe it. They do it all with mirrors."

The new wind tunnel will not displace all other tunnels; it will merely extend and clarify their results. Nor will it replace actual full flight testing. But it will be a marvellous instrument for research.

The scientific pilot will clamber aboard on a long, movable ladder, give the signal for the starting of the tunnel propellers, press a button and start his own engine. Then he will be actually flying. The huge platform will be pitched or turned at will, and accurate observations under conditions simulating actual flight will be quickly and readily made.—*A. K.*

Plane Types in Army Maneuvers

THE dramatic maneuvers through the mid-west and the east of the Army's First Provisional Air Division, composed of 672 planes, were carried out successfully in May with no serious accident to any pilot

Using the new test kit for investigating airplane performance, described on the opposite page

or plane. The plane-miles flown totalled well over 3,000,000.

The 672 planes participating in these maneuvers were divided into the following types and makes:

Pursuits:	135	Boeing P-12
	75	Curtiss Hawk
Bombardment:	10	Curtiss Condors
	34	Keystone Bombers
Light Bombardment:	36	Douglas BT
Attack:	70	Curtiss A-3
Observation:	142	Douglas Observation
	63	Curtiss Falcons
	60	Thomas-Morse Observation
Transport Group:	23	Fokker Transports
	11	Ford Transports
	5	Douglas Transports
	4	Sikorsky Transports
	2	Northrop Transports
Photographic:	2	Fairchild
Total	672	

Engines used to power the 672 planes are divided into types and makes as follows:

Pratt & Whitney Wasp	289
Pratt & Whitney Hornet	119
Curtiss Conqueror and D-12	214
Wright Whirlwind J-6	45
Wright Cyclone	16
Liberty	81
Curtiss Hex	1
Total	765

New Oil-less Bearing Material

PRACTICALLY all so-called "oil-less" metal bearings are mounted without oil or grease in motors which turn only a few revolutions, and then are idle for a considerable time. Automobile starting motors consume most of the output.

A new self-lubricating bearing metal re-

cently developed can also be used with lubricant instead of the present oil-requiring bearing materials. If the supply, or film, of lubricant should for any reason become inadequate, this new bearing metal is capable of resisting the heating action of friction for a considerable length of time, by means of its own lubricating qualities.

This new bearing metal is the result of countless tests to determine what materials reduce friction most. When these were discovered, it was found that they could not be incorporated in an oil. Therefore, they were put in the bearing itself—right where they are needed.

The bearing is made by mixing one or more metallic powders with one or more materials yielding a soapy substance. The ingredients are put in a cold mold and subjected to a pressure of approximately 40,000 pounds per square inch. The temperature is gradually raised until it reaches about 400 degrees Fahrenheit—nearly twice that required to boil water. After keeping the mold at this temperature for half an hour, the pressure is raised to 200,000 pounds per square inch. The pressure is then released and the mold allowed to cool. The bearing is then removed from the mold.

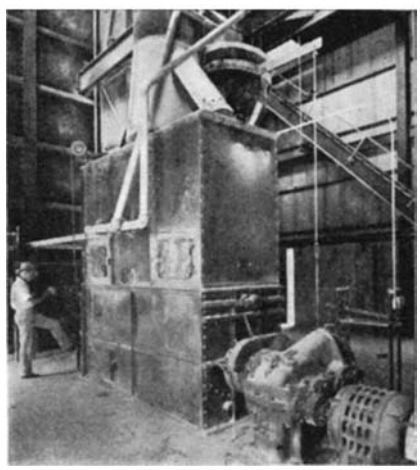
Bearings made of this new material can either be made to certain specifications, according to the mold used, or they can be made in blank and machined to the size desired.—*A. E. B.*

The Mechanism of Swallowing

FOR many years physiologists have studied the mechanism of swallowing. As pointed out by A. E. Barclay, once swallowing has started, the human being has no control over the mechanism. We can swallow lying on the back, on the face, or even upside down, but, regardless of the position, once the act is started it is impossible to stop. For this reason numerous accidents occur, such as the swallowing of safety pins or other unusual objects which happen to get into the mouth.

The modern science of radiology has made it possible to watch the entire act of swallowing from the moment the material touches the tongue until it passes into the stomach. It takes a solid substance a half second to make the route and a liquid can do it in a quarter of a second. The sequence of events as now established by the use of the X ray is another demonstration of the intricacy as well as the enormous mechanical efficiency of the human body. As an example of what happens when things go wrong, Doctor Barclay cites the difficulty of having mucus stick just below the nasal pharynx. It is at a point just too low to be dislodged by sniffling and just too high to be swallowed. No matter how hard we swallow or how hard we sniffle nothing happens, until, by purely mechanical action, the mucus reaches a point where suction can be exerted on it from either above or below.

The phases of swallowing, as outlined by Doctor Barclay, include closing of the nose and mouth, raising of the larynx and obliteration of its upper part by the tongue, obliteration of the pharynx by raising the larynx and retracting the tongue, opening of the pharynx with the closing of three outlets, whereby negative pressure is established. This is established by dropping the larynx and allowing the tongue to go forward. In this position the food is passed over the back of the tongue, sucked into the mouth of the larynx which, after it receives the food, drops down to its normal position, thus opening up the wind pipe again after the food has passed. The entire mechanism is controlled by nervous impulses which establish conditions of motion, negative pressure, and suction, and which produce a prompt and continuous movement of the material from the mouth to the stomach.—*M. F.*



In the hydrator, automatically weighed batches of quick lime are treated with exactly enough water to hydrate the lime in the process for making lime from oyster shells

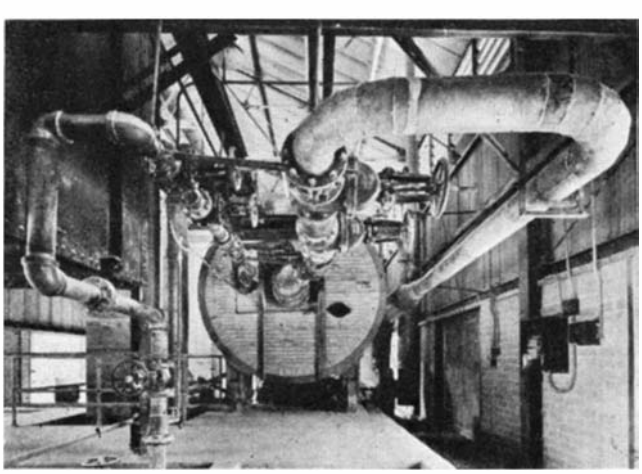
New Process for Removing Gases

A NEW process for removing the acidic gases, hydrogen sulfide and sulfur dioxide, from gases, which will create tremendous savings for the petroleum industry and the natural and manufactured gas industries, was announced at a recent meeting of the American Chemical Society. The process, the invention of R. R. Bottoms, director of research for the Girdler Corporation and a recognized authority on the purification and liquefaction of gases, employs triethanolamine, a new type of chemical reagent of such high absorption capacity that small mechanical equipment is required. According to Dr. Bottoms, the suitability of triethanolamine for such a purpose has been definitely settled through the experience of the Helium Company in the operation of its carbon dioxide removal system at Thatcher, Colorado.—*A. E. B.*

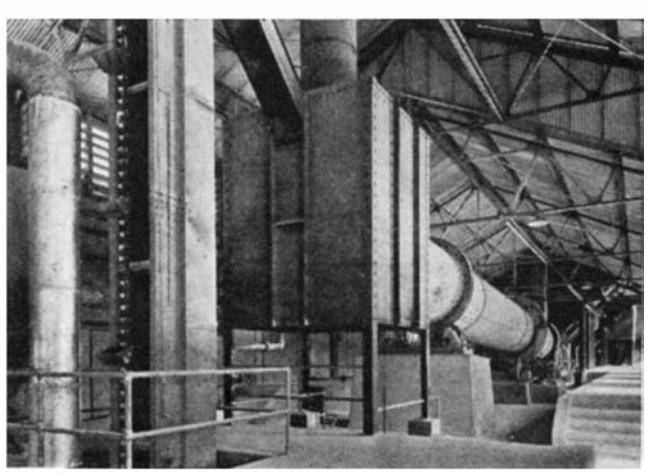
Pure Lime from Oyster Shells

A FLOURISHING industry that uses oyster shells as its raw material and produces an exceptionally pure grade of lime is described by J. B. Nealey in a recent issue of *Chemical and Metallurgical Engineering*. Ordinary commercial lime, such as used by contractors, is made by "burning" limestone, which, chemically speaking, is calcium carbonate. The chemical industries which use lime as a reagent demand a purer product and it was because oyster shells are almost pure calcium carbonate that this industry sprang up to supply the demand for "chemical lime." This plant, the only one of the kind in the world, is operated by the Haden Lime Company of Houston, Texas.

Shells to be made into lime are washed to remove silt, and crushed to a uniform size. They are then fed into gas-fired rotary kilns where they are heated to 2400° Fahrenheit. The kiln is 125 feet long, rotating at one revolution per minute so that a batch of shells passes through in about two and one quarter hours. Burned lime drops from the discharge end of the kiln into a pit whence it is elevated by bucket conveyors to a cooler. After the lime has cooled it is carried to a great steel hopper,



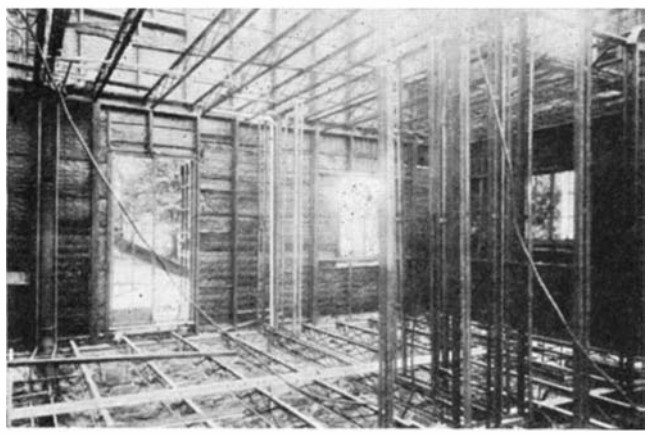
Clean oyster shells are fed into the firing end of the rotary gas-fired kiln shown with its gas and air piping, and temperature control at the right. The kiln is 125 feet long



Hot lime from the kiln is automatically and correctly cooled before going to the bins. This rotary cooler, 60 feet long and six feet in diameter, is fed from a bucket conveyor

of 22,000 cubic feet capacity. Mechanical "feeders" remove lime from this hopper and transport it to hydrators where it is mixed with exactly the right quantity of water to "hydrate" the burned lime. This hydration yields a white powder which must then be pulverized to insure uniformity in particle size, after which the product is ready for the storage bins and the automatic bagging machines. The hydrated lime from this plant is so fine that over 98 percent will pass through a 325-mesh screen.—*A. E. B.*

Building the two-story, six-room dwelling of arc-welded steel frame-work. A frame panel being welded to a sill



Interior view of the welded frame house showing floor joists, partition panels, and Steeltex backing of walls

A Welded Dwelling House

WHAT is probably the first completely welded brick and steel dwelling constructed by electric arc welding was recently built for and is now being occupied by C. E. Anthony of Larchmont Gardens, New York. It is a six-room, two-story building, 32 feet by 26 feet, with full basement and a two-car basement garage, and is built on a foundation of stone and concrete.

The entire framework and all interior partitions were made up of standard size panel frames previously fabricated in the welding shop from 1½-inch angles. The fabricated panels were then welded to a plate sill, and adjoining panels were welded together at their edges to make a solid structure throughout. The second floor was erected in exactly the same manner and was welded to the top of the first floor sections. Electric current for all field welding was generated by a General Electric gasoline engine-driven arc welding set.

Steeltex, a two-inch wire mesh spot welded at each juncture and interwoven with fire-resisting, waterproof paper, was laid directly over the floor joists and covered with a two-inch course of concrete to make up the floor. The roof covering consists of Steeltex placed directly over four-inch channel rafters and covered with a two-inch layer of Nailcrete, a concrete asbestos composition of such characteristics that nails can be driven into it for laying shingles. A layer of slate shingles was used.

The outside of the house is finished off with a brick veneer, inside which is placed a layer of Steeltex, to the top of the second floor level. The gables and dormer are finished with stucco. The interior finish of the house consists of Steeltex over the framework, and hard plaster. The floors are covered with Armstrong inlaid linoleum with a felt backing on both the first and second floors. The stairways are steel with ornamental iron railings, welded in place, and have Sutterlith treads—a composition of plaster of Paris, cement, and sawdust. All baseboards are also made of this material.

Many advantages are claimed for the welded type of construction, among them being the following: rapidity and noiselessness of construction; use of standard panels; flexibility of design; fireproof construction, giving lower insurance rate; rigidity and solidity, eliminating vibration; low rate of depreciation; and soundproof walls.

See Hope of Cure for Athlete's Foot

POSSIBILITY that a cure may be found for the widespread condition known popularly as athlete's foot was indicated in studies reported by Dr. Marion B. Sulzberger and Dr. Fred Wise of New York City at the recent meeting of the American Medical Association in Philadelphia.

Athlete's foot, or ringworm of the foot, is due to infection with the ringworm organism, which is a fungus. Both the number and severity of cases are increasing to an alarming extent. Besides the original condition of the foot, secondary skin eruptions may develop. These secondary eruptions are believed to be caused by a special sensitiveness to the ringworm organism which is distributed through the blood stream. The secondary eruptions are called dermatophytids, while the primary foci of infection are known medically as dermatophytoses. The dermatophytids, curiously enough, do not contain the actual organisms causing the trouble.

The completed dwelling with frame made up of welded steel panels

Other organs besides the skin can become sensitive, Drs. Sulzberger and Wise stated. They believe that this sensitiveness to fungi may be the cause of otherwise inexplicable cases of hay fever and asthma.

Drs. Sulzberger and Wise attempted to de-sensitize a number of patients by injections of trichophytin, a vaccine made from the fungus that causes the disease, the trichophyton. Of 18 patients treated, 15 were either wholly or partially de-sensitized and 10 seemed benefited by the treatment, showing either freedom from the trouble for a relatively long time, marked improvement, or apparent cure. General use of the method is not justified from the results in this small number of cases, but the study gives rise to the hope that this annoying condition may be controlled.

At the same session, four cases in which persons who had ringworm in their feet or elsewhere and developed sensitiveness to other substances as a result of the sensitive condition of their skin were described by Dr. Cleveland White and Dr. Samuel J. Taub of Chicago.

Cottonseed oil, buckwheat, oatmeal, and silk were found to be the offending substances respectively in each of four young women who consulted these physicians for skin eruptions. Three of them eliminated the offending foods from their diet and the fourth stopped wearing silk, whereupon they all recovered.

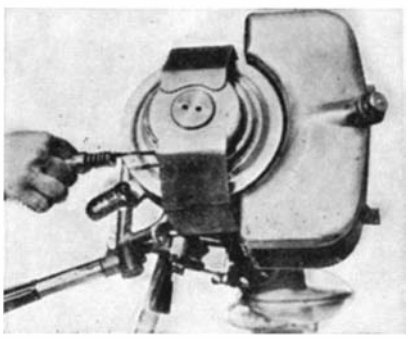
A strange feature of the cases was that none of the patients had had any such disturbance before they acquired the ringworm infection. From this fact, the physicians concluded that in some people who have fungus infections the skin is so altered that it becomes sensitive to certain foods or external irritants.—*Science Service.*

New Chemical from Apple Peels

URSOLIC acid, a new chemical that appears to have promising possibilities for commercial use, is being extracted from the waxlike coating of apple peels in a laboratory of the United States Department of Agriculture. Dr. Charles E. Sando, of the Bureau of Chemistry and Soils, who for many years has been investigating the chemical nature of the surface coating of apples, perfected the method for extracting

the compound, in the form of a powder, from apple pomace. Recently he has sent samples to several commercial concerns for study by their research departments.

Perhaps the most promising use for this new chemical is in the paint and varnish industry. The fact that the powder is resinous to the touch and is water repellant suggested its use in varnishes. Preliminary tests made by the American Paint and Varnish Manufacturers' Association show that ursolic acid increases the gloss and water resistance of cellulose lacquers.



The steel tape of the Ree-Koil starter winds itself for the next pull

Another effect of adding small amounts of ursolic acid to lacquers is to extend the time required for drying. This seemed to improve the brushing qualities of the lacquers so treated, especially for the first coat.

Doctor Sando has found that apples differ with respect to the amount of waxlike substance found on their surface at harvesting time. Arkansas Black, Delicious, and Grimes Golden contain relatively large quantities of ursolic acid, while Yellow Transparent, Rhode Island Greening, and York Imperial have much smaller amounts.

If there is sufficient demand it would be possible to produce 500,000 pounds of ursolic acid in this country annually, it is estimated. The principal sources would be wastes from canning plants, skins left from dehydration of apples, and from apple pomace, the residue produced in the manufacture of cider and vinegar.

Outboard Motor Starters

ON the new Johnson Ree-Koil starter, a steel tape which automatically winds itself into its container in readiness for the next pull as soon as it is released, replaces the conventional rope starter.

The operator grips the handle, pulls once, twice, until the motor starts. When the handle is released the steel tape winds back into starting position for the next pull.

The new starter is of such simple construction that it is estimated it will last, without any service necessities, for the lifetime of the motor. It has been released as standard equipment for Sea-Horse Models 4, 12, 16, 24, 32, and racing motors.

Another starter which operates on the inertia principle and which may be easily installed on any outboard motor, has been developed by the Eclipse Aviation Corporation, East Orange, New Jersey. The manufacturers claim that, with this starter, a small child can start even the largest outboard motor with ease.

To operate the Eclipse starter, a small detachable hand crank is applied to a spindle at the top. This crank is easily and gradually revolved until a small, light weight fly-wheel contained within the starter is brought, through gearing, up to a very high speed.

Usually not more than 10 seconds maximum is required to bring the fly-wheel up to normal speed. When it is revolving fast enough, the operator ceases cranking, the hand crank is automatically detached, and a large button is disclosed which, when pressed, engages the starter with the engine. The enormous energy stored in the rapidly revolving fly-wheel is thus utilized to crank the engine.

The starter cranks the engine at an initial speed of 750 revolutions per minute or higher. This cranking speed ensures positive starting under the most adverse conditions. Generally speaking, (allowing for different engine sizes and characteristics) the engine is turned over about 20 to 25 revolutions. To absorb stresses which may occur should the engine back-fire, a built-in clutch protects both starter and engine against damage.

"Hand Raised" Parasites Destroy Range Pests

MILLIONS of small wasplike insects are now being liberated on the cattle ranges of the southwest to destroy the eggs of the range caterpillar, a pest which, after having been comparatively inactive there for 10 years, threatens to eat up all the range grass over a wide area.

In the 1914 outbreak nature provided the parasites to control the range pest. This year entomologists of the United States Department of Agriculture are providing them to help nature renew the supply that has almost entirely disappeared from the region.

To be ready for the coming of the caterpillars, Government entomologists through the winter produced the parasites at the rate of 60,000 a day and placed them in cold storage at the Tempe, Arizona, field station. The vast insect army is now being deployed over the grazing grounds where the range caterpillar is present in the egg stage in large numbers. The tiny parasites will at once attack the caterpillar eggs and, it is hoped, quickly reduce the number of caterpillars to normal.

Similar parasites are being tried out against many insect pests, including the alfalfa weevil, codling moth, oriental fruit worm, and the corn borer, but this is the first time they have been tried on a large scale against the range caterpillar.

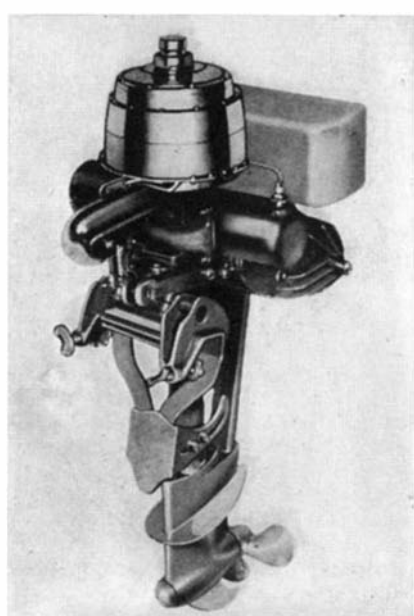
"Range caterpillars," says Dr. W. H. Larrimer, in charge of the Department of Agriculture's work on cereal and forage insects, "are such greedy and wasteful feeders that sometimes they seem to eat from habit rather than from hunger. They destroy the range not only by chewing the grass down to the roots, but also by covering any uneaten blades with shed skins and poisonous spines, thus spoiling the pasture for the stock. Recently this pest, long familiar on ranges and pastures, has added cultivated crops to its diet."

New Lubricant Made from Paraffin

PARAFFIN wax, formerly a troublesome by-product of petroleum distillation, has just been converted into a superior grade of lubricating oil, according to a statement just made by a member of the petroleum research committee of the Society of Automotive Engineers. While it has been known for some time that the molecules of the ideal lubricant were made up of two hydrogen atoms and one carbon atom, it has remained for a chemist of the Standard Oil Company of Indiana to produce a synthetic lubricating oil having this ideal structure. In the natural oils it has been very difficult and expensive to secure such "olefines" but new methods of modern research have revealed a way to crack paraffin and secure an oil of pale-straw color, highly resistant to oxidation and capable of standing up under high temperature. Engineers explain that the viscosity can be easily controlled and that therefore this oil is well suited for severe service at either thickening low temperatures or thinning high temperatures.

Investigate Industrial Uses for Sugar

DR. E. R. WEIDLEIN, director of the Mellon Institute of Industrial Research, has announced that the institution has lately begun a broad investigation into possible industrial uses for raw and refined sugar. The research will be carried on by a multiple Industrial Fellowship that will be sustained by the Sugar Institute, Inc., of New York, an organization that represents the cane-sugar refiners of the United States. The comprehensive program of investigation will be supervised by Dr. G. D. Beal, assistant director of Mellon Institute, and by Dr. G. J. Cox, Senior Industrial Fellow. They and the scientists who will be under their direction in endeavoring to find and to develop uses for sugar in various industries will have the close advisory collaboration of Dr. L. H. Cretcher, the sugar specialist, who is the head of Mellon Institute's department of research in pure chemistry.



When the inertia starter is cranked, it starts the motor without effort

According to Dr. Weidlein, various studies made by private research workers have already indicated results of industrial promise; these findings will be carefully studied in the laboratories of the Mellon Institute. Most of these proposals relate to applications for sugar in such technological

operations as wood preservation, textile finishing, and the manufacture of adhesives. Sugar is thought to merit searching investigation as a basic raw material for employment in various branches of chemical industry. Four chemists, headed by Dr. Cox, have begun the initial scientific research of the Industrial Fellowship. Additions will be made to this staff, as needed, from time to time.—*A. E. B.*

Heat-Resistant Truck Inner Tube

DEVELOPMENT of a new product in the rubber industry has just been completed, it is indicated in the announcement by the General Tire and Rubber Company that its engineers have just perfected a new black tube for truck tires.

"Use of a new heat-resisting compound gives the new black tube its principal point of superiority over the ordinary tubes now in use for truck tire casings throughout the country," says Charles J. Jahant, vice-president of the company, in charge of production.

"Internally-generated heat is the principal enemy and destroyer of truck tire tubes. This new black tube has proved that it is able to resist this heat to a degree not previously thought possible. In tests, sections of the best red molded tubes, of leading makes, were spliced to sections of the new black tubes. Then they were run on test trucks until the tubes failed. In every case, the red half of the tube crystallized and went to pieces, while the black half remained intact, flexible, elastic, and practically as good as new. The pieces of the red sections, which broke into small bits, were brittle and lifeless and could be pulled apart with thumb and finger."

The accompanying picture shows the result of one of the tests described above, with the red tube sections in pieces and the black tube section intact.

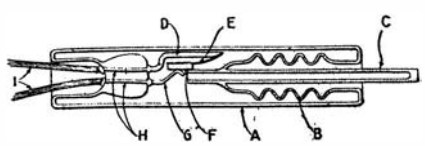
Vulcanized to an ordinary tube, the new truck tire tube resists heat while the other tube deteriorates

An Electrical Hair Trigger

A NEW vacuum contact for use wherever a positive rapid and durable electrical contact is needed in circuits handling up to six amperes continuous load or eight amperes intermittently, at potentials up to 220 volts, has recently been placed on the market. It can be operated by hand, by mechanical means, or by an electromagnetic agency in conjunction with a telephone type relay. This contact is especially well adapted for use in telegraph and telephone circuits, for railway switches and signals, for fire and burglar alarm systems, controllers, advertising signs, rectifiers, electric ranges, and other applications where a considerable wattage must be controlled by a minimum of energy. It operates in any position and is unaffected by movement or shaking.

The accompanying diagram presents the operating details of the vacuum contact. It will be noted that the principle is extremely simple. It makes use of the elastic property of glass to cause the mechanical actuation of contacts sealed in vacuum. The bellows *B*, because of their shape and the tempering of the glass, are highly elastic. A slight movement of the stem or protruding rod *C* is communicated to the movable contact block *E*, causing it to separate from contact block *G* which is stationary. The spring *E* makes positive contact between the contacts when no pressure is applied to the stem. The contacts are maintained in the evacuated glass tube *A*. The leads are indicated at *I*.

The vacuum contact is a development of Siemens & Halske of Germany and has met with wide application in that country as well as in Great Britain. It is now being introduced in the United States by the Burgess Battery Company of New York and Chicago.



The electrical hair trigger which is explained in the text herewith

Operating in a vacuum, the vacuum contact is free from serious arcing and corroded contacts. It can handle its rated current as fast as 40 breaks per second. The make and break are positive and clean, without the hang-overs and chattering experienced with other forms of contacts, as proved by comparative oscillograph recordings. The vacuum contact requires a movement of only 0.02 of an inch at the end of its stem, which can be brought about by a force of less than 10 ounces, and usually but 6 ounces. The temperature rise at the rated current is extremely slight. The circuit is broken without arcing at less than 0.001 of an inch separation of the contact blocks. The small movement and slight force required for operation lowers the total cost by the elimination of mechanical links. As for life, one of these contacts has been operated, at a rate of 10 times per second, 124,000,000 times without breakdown.

Paraffin Saves Bananas from Decay

BANANAS can be saved from one of their most costly types of spoilage by the simple trick of anointing the cut end of the stalk with paraffin. This discovery has been made as the result of a joint research conducted at Cambridge, England, by R. G. Tompkins of the Low Temperature Station and Dr. R. M. Woodman of the School of Agriculture.

One of the most serious causes of spoilage in bananas is rotting which spreads from the cut stalk. Molds grow where the stalk is cut and cause rot. If the mold growth in the cut stalk could be prevented, this form of spoilage would disappear. The same type of rot is also found in pineapples and melons.

The delicate little tube which controls powerful electrical circuits

Mr. Tompkins and Dr. Woodman treated the cut stalks of bananas with a number of substances to see whether mold growth could be prevented in this way. Fungicides proved to be practically useless. Borax, copper sulfate, corrosive sublimate, formaldehyde, and potassium permanganate, all of which usually destroy fungi, were not able to prevent the rot of bananas.

Excellent results were obtained, however, with substances which block the surface of the cut stalk mechanically. Thus there was no subsequent rotting if the banana ends were dipped in melted paraffin wax. The rotting was also considerably reduced when the banana ends were smeared with vaseline.—*Science Service.*

Ultra-Violet Protective Paint

AN improved paint for protection from ultra-violet radiation has been announced by the General Electric Company. Developed particularly to absorb the dangerous invisible rays of ultra-violet light produced in arc welding, the paint is used on the walls and ceilings of rooms in which electric arc welding equipment is being used. Better adhesion and no tendency to powder off the surface have been attained in this new, gray, oil-type paint. Petroleum spirits are used for thinning the paint, which dries in approximately two hours.

—*A. E. B.*

Operation Saves Victims of Mercury Poisoning

AN operation which will save the lives of persons who have swallowed the deadly poison, bichloride of mercury, was described by Dr. Samuel Berger of Cleveland, at the meeting of the American Medical Association in Philadelphia recently.

The operation is called cecostomy and consists of an opening into the cecum, which is a sort of dilated pouch into which open the large and small intestine and the appendix.

Dr. Berger and associates, Drs. H. S. Applebaum and A. M. Young, examined carefully the bodies of persons who had died by poisoning with bichloride of

mercury. They found that gangrene developed in the lower intestine in a large percentage of patients who lived beyond the first 24 hours after swallowing the poison. This gangrene was responsible for the deaths of these patients.

The treatment which Dr. Berger and associates then instituted consisted of a constant flushing of the gastro-intestinal system with water through the opening made by the cecostomy operation. This flushing interrupts the passage of the poison from the colon to the stomach and averts the development of gangrene.

The procedure is only successful when performed within a few hours after the poison has been swallowed, Dr. Berger emphasized. Patients in whom it was carried out after two days or more all died. —*Science Service.*

Plane To Fly Six Miles High

AIRPLANES flying at heights of over six miles, which can reach much higher speeds than existing machines, are being constructed at the famous Junkerswerke at Dessau, Germany. Already the first airplane to be used for research in this work has been constructed with the assistance of the German Institute for Research in Air Communication and the scientific Notgemeinschaft. [See also page 127, February 1931 SCIENTIFIC AMERICAN. *Editor.*]

The mysterious guns of the German army, bombarding Paris at a distance of 75 miles, were the first practical application of the decidedly lower resistance of the "stratosphere," that tenuous layer of the atmosphere lying above a height of six miles. The chief aim of the new machine is to reach high altitudes and to find paths which can be used as regular airplane trade routes. It is not built for high speed or long flights, since it is regarded as an experimental laboratory for the study of the special conditions prevailing in the stratosphere. High speed can easily be attained at these heights. Recording rockets and balloons have been previously used to explore the stratosphere.

The airplane is a Junkers metal deep-deck, single-motored machine of 60-foot wing breadth and 9000 pounds weight. A small compressor keeps the air pressure normal for the men within the cabin, which is double-walled and air-tight. Control of the motor and steering is done by levers in the cabin working in air-tight shafts. The motor itself is of a special type and has an air pump to supply enough air from the thin air at these heights.

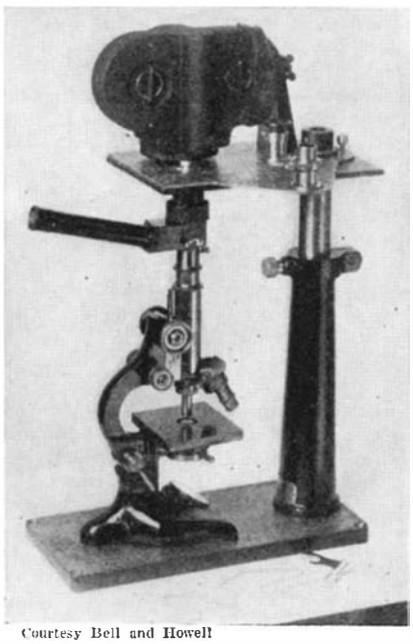
On the basis of experiments with this machine a new air pump will be designed for altitudes up to 10 miles. A large installation of scientific instruments forms the equipment.—*Science Service.*

Stronger Alloys Cast Under Pressure

EVIDENCE that alloys of improved quality may be obtained by casting them under pressure has been established by the experimental work of a German chemist, G. Welter. Alloys which usually are cast under atmospheric pressure have been subjected to hydrostatic pressure before their crystallization. Experiments were conducted under pressures from 500 gradually up to 20,000 atmospheres. Resultant improvements in the material were proportional to the increase in pressure. Silicon aluminum alloys had their tensile strength increased from 10 to 20 percent, and alloys hardened under high pressure in general showed a denser and less porous structure than those made by the normal methods.—*A. E. B.*

Micro-Movies for the Amateur

IN order to give the owner of a 16-millimeter motion picture camera the opportunity to make film records of micro-



Courtesy Bell and Howell

The outfit designed by Dr. Rosenberger for making micro-movies

scopic objects, such as the animal and plant life found in almost any drop of water, also bacteria, the flow of protoplasm in plant cells, micro-chemical experiments, and a host of other fascinating subjects, Dr. Heinz Rosenberger of the Rockefeller Institute for Medical Research has designed the simple outfit shown in an illustration herewith. Its essentials are the camera, a microscope, and a stand having a focusing and beam centering device. An eyepiece permits focusing and seeing the object as it is photographed.

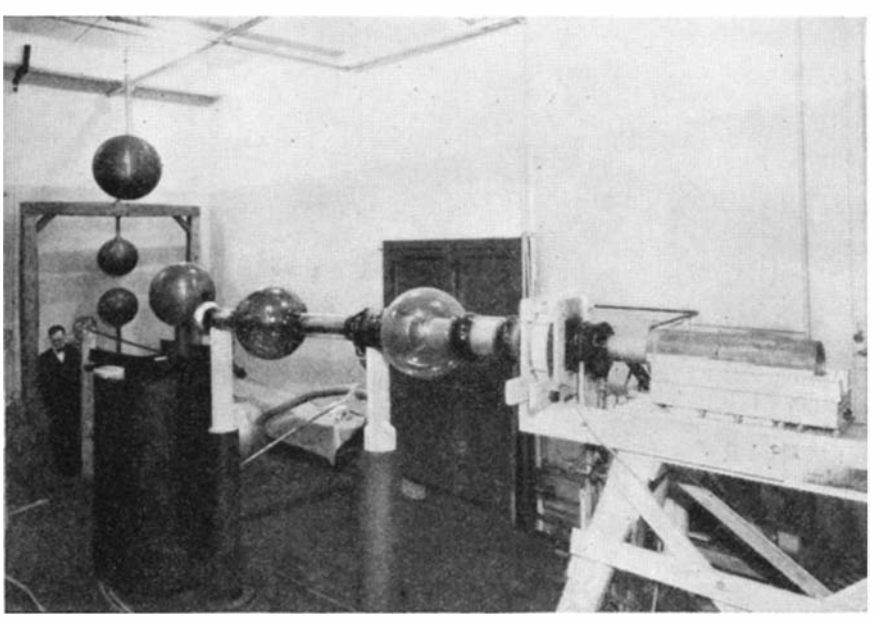
Dr. Rosenberger is one of that comparatively small group of scientific workers who have one foot in pure science—in this case biology—and the other in refined mechanics and design. When the designer of refined apparatus is either a scientist alone, or a mechanic alone, the apparatus generally shows the deficiency; it is at best only "a square peg in a round hole," but when he is both, the apparatus also shows it—favorably. Dr. Rosenberger has also designed micro-cinematographic apparatus for professional biologists but this is vastly more complex and is scarcely known outside the special field it covers—though it is widely known within that field.

900,000-Volt X Rays

X RAYS at 900,000 volts, over four times as high a voltage as is being used in today's most powerful therapy tubes, have been attained by Dr. W. D. Coolidge, associate director of the General Electric research laboratory at Schenectady. Such a decided increase in voltage, and hence increase in penetrating power of the rays, was made possible by a system of "cascading" the tube, an arrangement devised by Dr. Coolidge in his work with high-voltage cathode-ray tubes.

The 900,000-volt X-ray tube, Dr. Coolidge said, is built in two sections. In his previous work in cathode-ray tube development it was found that tubes can be built for very high voltages by the use of a cascade (or sectional) system, and that by this method there appears to be no limit to the voltage which can be used. The target replaces the "window" of the cathode-ray tube so that, instead of cathode rays being emitted by the tube through such a "window," X rays of exceedingly high penetrability are generated by the impact of the electrons (or cathode rays) on the target.

By dividing tubes into sections, each of which may be good for as much as 300,000 volts, a three-section cathode-ray tube for 900,000 volts was constructed some years ago. Such a cascade or multi-sectional system, Dr. Coolidge found, promises to permit the building of vacuum discharge tubes for as high voltage as can be generated—and voltages of millions are being produced in the Pittsfield laboratory of the



900,000-volt X rays are obtained with this giant tube

General Electric Company. The use of the cascade tube applies equally well to X-ray and cathode-ray tubes, since the latter may be converted into the former by the addition of a suitable target.

The highest voltage Coolidge X-ray tubes used commercially at the present time are of 200,000 volts peak capacity, and are of two types—water-cooled and air-cooled. Both are adaptable for X-ray therapy. The air-cooled type has been used to considerable advantage in industrial applications of X rays, since the high voltage gives the necessary penetration required for examining the heavier metal objects. Industrially, higher voltages would permit radiography of thicker metals, and shorten times of exposures.

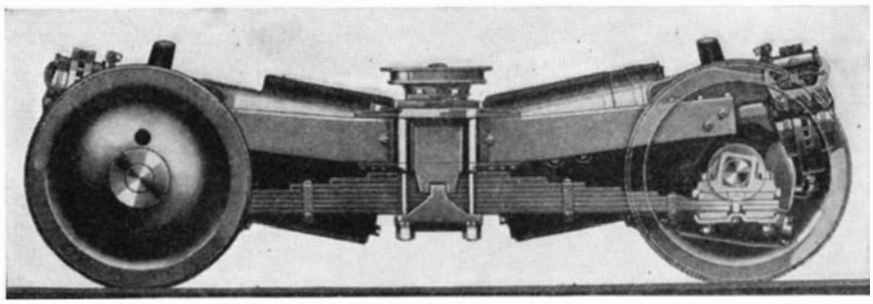
Quiet Street Car Truck

FIFTY thousand Detroiters crowded Woodward Avenue recently to celebrate the adoption of "quiet" street cars on the city's municipal system. In the parade that was featured were several of the 20 new cars recently ordered which are equipped with the noise-eliminating trucks.

The street car truck is a contribution of Detroit automobile experience in a new field of transportation. It has been developed by Nelson R. Brownyer and a staff of engineers of the Timken-Detroit Axle Company. They have applied many automobile features to the truck, particularly in lightening it, and in carrying most of the weight as "sprung" weight.

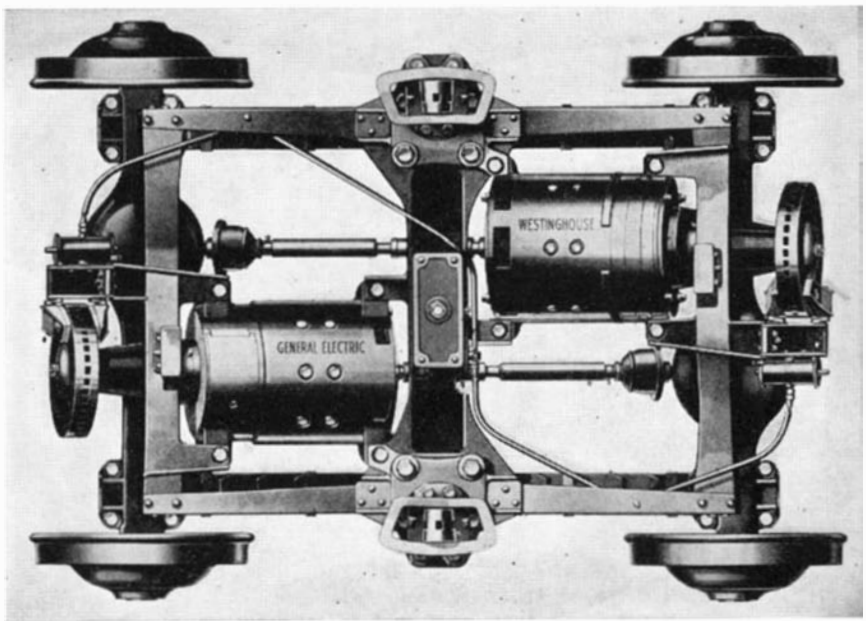
A reduction of 3400 pounds per truck has been effected. This has an important bearing on the question of track maintenance, a bugbear of city street railway systems. But the principal contribution of the new truck is its "quiet" operation. Sound tests made in Detroit and Chicago have indicated that the same car, equipped with these trucks, is 50 percent less noisy in straight running on smooth track and in going over switches and crossings, than the car equipped with present type trucks.

Worm gears eliminate gear noise completely. A new type of brake, developed out of automobile experience, can not make any noise in its operation. The brake is a disk applied to the end of the armature shaft of each motor. The 50 horsepower electric motors, the brake and the frame of the truck are carried as "sprung" weight, and only the dead weight of the wheels and axles has "unsprung" contact with the track. Long leaf automobile-type springs are used. The clattering and banging of an average car going over a "diamond" crossing is changed to a metallic thud as the wheels strike the joints. The ends of the springs are mounted in rubber, and the general impression of a running car, whether on smooth or rough track or on crossings is that it is "light on its feet."



Side view of the new quiet street car truck

Members of noise abatement commissions in New York and Chicago, and the head of the public health committee of the Detroit Board of Commerce have heralded the truck as a distinct contribution to the health of city dwellers. Prominent street transportation officials from as far away as Seattle, showed their interest in the development by coming to Detroit for the one-day celebration.



Differentials, motors, and other features of the new street car truck

Silver, a Construction Material in Chemical Plants

RECENT changes in the economic position of silver and their influence on its price have caused chemical engineers to cease regarding silver as "bullion" and to consider its use as a material for the construction of plant equipment. Thus, pieces of apparatus weighing 300 to 400 pounds are being made from pure silver, most of them for handling acetic acid. Because of its resistance to attack by organic acids, silver is especially adapted for equipment used in the preparation of foodstuffs.

Silver and the precious metals frequently occur in ores in very small quantities, often little more than traces, but the metallurgical methods of today are such that all these small quantities are collected, and in the bulk represent a very respectable and increasing output. Therefore, according to Donald McDonald in a recent paper presented before the Society of Chemical Industry, large quantities of silver are coming automatically upon the market as by-products in the production of other metals, such as lead, copper, zinc, and nickel—metals for which there is sufficient continuous demand to insure the permanency of the operations concerned in their production.

In considering the use of silver as a material of construction, it is necessary to deal with a phenomenon which is capable of affecting some of the physical properties of the metal, and which is so peculiar as to be almost unique in commercial metallurgy. This is the power of absorbing large quantities of oxygen when in the molten state—most, but not all, of which it disengages on solidification. Thus, in casting silver, the dissolved oxygen is apt to cause blowholes. Further, as a certain amount of gas remains in solution even after solidification, the physical properties of the specimen are bound to vary somewhat with the casting conditions and the extent or efficacy of any previous deoxidation treatment. Such deoxidation enables sound castings to be produced by experienced hands. A layer of charcoal on the surface of the molten metal for a few minutes before pouring is enough for most practical purposes.

Silver is the best conductor of heat and electricity of all the metals. It resists attack by caustic alkalies. Sulfuric acid does not attack it appreciably at room temperature unless some oxidizing agent is present. Chlorine attacks it, forming silver chloride, but strangely enough, this insoluble silver chloride forms a very hard, impervious coating on the silver, which protects it from further attack.

The most extensive application to chemical plants evident so far is in the condensation and general handling of acetic acid, which is particularly corrosive at the moment of condensation. Because of its superior thermal properties, a silver condenser can be considerably smaller than a copper one designed to do the same work. The use of silver is spreading to the food industries. In the distilled vinegar industry the use of copper, even when tinned, has not yielded universally satisfactory results, and trouble has occurred when the vinegar made in it is employed as a pickling medi-

(*Please turn to page* 136)

CURRENT BULLETIN BRIEFS

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

TENDENCIES IN LIGHTING PRACTICE 1930 by A. L. Powell, describes and illustrates some of the latest developments in lighting. *General Electric Company, Nela Park Engineering Department, Cleveland, Ohio.—Gratis.*

BIBLIOGRAPHY OF AERONAUTICS, 1929 (National Advisory Committee for Aeronautics) is a valuable book of reference. *Superintendent of Documents, Washington, D. C.—25 cents (money order).*

ASTRONOMY MADE EASY is a 119 page booklet originally designed as a companion to the celestial globe. Contains much real astronomical lore, in addition to a survey of the heavens. *Rand McNally and Company, 536 South Clark St., Chicago.—One dollar.*

RECOMMENDED MINIMUM REQUIREMENTS FOR FIRE RESISTANCE IN BUILDINGS (Building and Housing, No. 14, Bureau of Standards) is a report of the Department of Commerce Building Code Committee. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

WILD DUCK FOODS OF NORTH DAKOTA LAKES (Technical Bulletin No. 221, U. S. Department of Agriculture) by Franklin P. Metcalf, gives the result of detailed studies of 500 lakes. *Superintendent of Documents, Washington, D. C.—15 cents (coin or money order).*

THE OBSTACLES AND PITFALLS OF INVENTORS by Joseph Rossman, Ph.D., deals with an interesting phase of invention. It is a complete chapter from Dr. Rossman's new book "The Psychology of the Inventor." *The Inventor's Publishing Company, 1266 New Hampshire Ave., Washington, D. C.—Gratis.*

ON THE ART OF METALLOGRAPHY (Technical Publication No. 421, The American Institute of Mining and Metallurgical Engineers) by Francis F. Lucas gives his Howe Memorial Lecture and supplies valuable information on the structure of metals. There is a beautifully executed colored plate. *The American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York City.—36 cents.*

YEARBOOK OF THE CARNEGIE INSTITUTION OF WASHINGTON, 1930. A 438-page account of the large amount of research in biology, chemistry, astronomy, genetics, geophysics, terrestrial magnetism, nutrition, physics, physiology, seismology, and other sciences, performed during one year by the many branches of the Institution. *Carnegie Institution of Washington, Washington, D. C.—One dollar.*

THE PHARMACOLOGY OF THALLIUM AND ITS USE IN RODENT CONTROL. (U. S. Dept. of Agriculture Technical Bulletin 238). Thallium, though too dangerous for general use, is suitable where highly resistant rodents require extermination. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

BROWN POTENTIOMETER PYROMETERS (Catalogue No. 1101, Brown Instrument Co.) describes the very latest developments in these instruments which have very wide industrial uses. *Sent to executives by the Brown Instrument Company, Philadelphia, Pa.—Gratis.*

EMULSIONS, THEORY AND PRACTICE WITH ACTUAL WORKING FORMULAE describes seven new emulsifying preparations. *Glyco Products Co. Inc. Bush Terminal Building, No. 5, Brooklyn, N. Y.—Gratis.*

LUBRICATING OPEN GEARS gives a tested formula in detail. The leaflet may be obtained from the *Link Belt Company, Chicago, Ill.—Gratis.*

THE MELLON INSTITUTE AND THE AWARD OF THE AMERICAN INSTITUTE OF CHEMISTS' MEDAL TO MESSRS. ANDREW AND RICHARD MELLON (*The Chemist*, Vol. VIII. No. 7) describes both the old and the new building of the Mellon Institute as well as awards to the Field-Marshals of American finance and industry—the Mellon Brothers. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

THE QUARTER-HORSEPOWER PORTABLE MOTOR ON THE FARM (Report No. 3, April 1931, National Rural Electric Project) describes the uses, installation costs, and so on of small farm portable motors. This is one of a series of leaflets which can be obtained from the *National Rural Electric Project, College Park, Md.—Gratis.*

A LIST OF THE BOOKS, BULLETINS, JOURNAL CONTRIBUTIONS AND PATENTS BY MEMBERS OF MELLON INSTITUTE OF INDUSTRIAL RESEARCH DURING THE CALENDAR YEAR 1930 (Bibliographic Series, Fourth Supplement to Bulletin No. 2) by Lois Heaton Pugsley lists the achievements of the members who are conducting research work at that splendid institution. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

THE EFFECT OF SMELTER ATMOSPHERES ON THE QUALITY OF ENAMELS FOR SHEET STEEL (University of Illinois Bulletin Vol. XXVIII. No. 32, Bulletin No. 224, Engineering Experiment Station) by Andrew I. Andrews and Emanuel A. Hertzell, deals with a highly technical subject of considerable importance. *Engineering Experiment Station, University of Illinois, Urbana, Ill.—10 cents.*

PSYCHOLOGICAL PRINCIPLES IN AUTOMOTIVE DRIVING (Contributions in Psychology No. 11, the Ohio State University Studies) by Albert P. Weiss, Ph.D. and Alvhh R. Lauer, Ph.D. analyzes the visual factors involved in automotive driving. Special apparatus was designed for use in the studies. *The Ohio State University, Columbus, Ohio.—$1.50.*

A FIELD KEY TO THE GENERA OF WILD AND CULTIVATED HARDY TREES OF THE NORTHEASTERN UNITED STATES AND CANADA by Mary Franklin Barrett describes a system for finding the names of trees by means of characteristics possessed by their leaves, stems, and winter buds. *Mary Franklin Barrett, 64 Park Ave., Bloomfield, N. J.—35 cents.*

LABORATORY TESTS OF REINFORCED CONCRETE ARCHES WITH DECKS (University of Illinois Bulletin Vol. XXVIII. No. 34—Bulletin No. 226 Engineering Experiment Station) by Wilbur M. Wilson, describes interesting tests with specially designed machinery. *Engineering Experiment Station, University of Illinois, Urbana, Ill.—50 cents.*

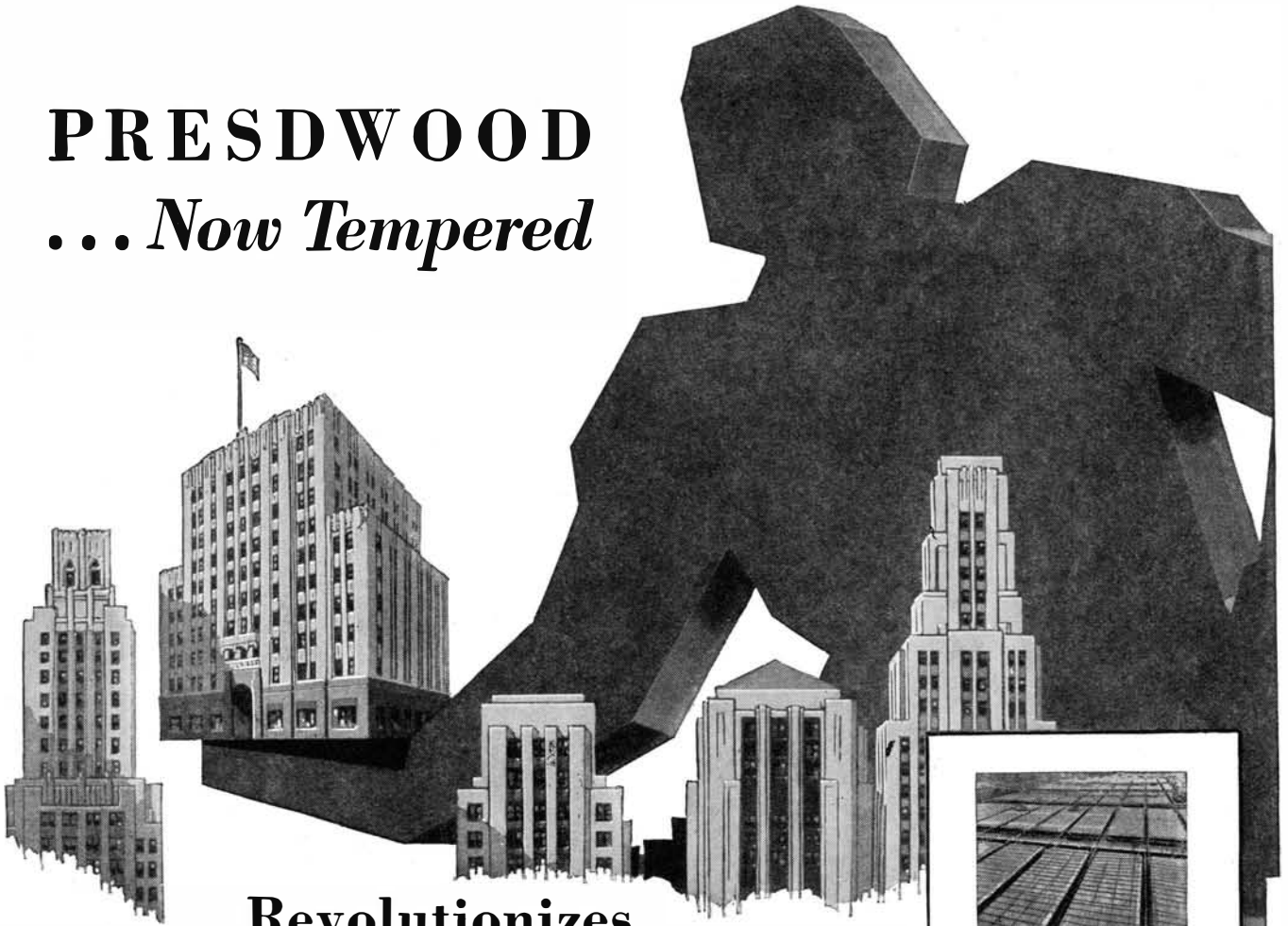
RESEARCH SERVICE FOR INDUSTRY (Engineering Research Circular No. 5, Department of Engineering Research, University of Michigan, Ann Arbor, Mich.) describes the splendid facilities for research which this institution affords. It is profusely illustrated. *Department of Engineering Research, University of Michigan, Ann Arbor, Mich.—Gratis.*

STANDARD THICKNESSES, WEIGHTS AND TOLERANCES OF SHEET METAL (Circular of the Bureau of Standards No. 391) gives a series of valuable tables indicating customary practice. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE USE OF COLLOIDAL GRAPHITE IN THE MANUFACTURE OF RESISTANCES describes the ability of colloidal-graphited water to form tenacious conducting films on paper, glass, and so forth, and is extensively utilized in the manufacture of certain types of electrical resistances, particularly in radio work. *Acheson Oildag Co., 654 Madison Ave., New York City.—Gratis.*

CARE AND REPAIR OF THE HOUSE, Building and Housing Publications BH15 of the Bureau of Standards, gives practical instructions for all kinds of jobs—some of them rather intricate—for which householders ordinarily are forced to call in the plumber, carpenter, electrician and others. For example, waterproofing a wet cellar; insulating a heating system; and so on. *Superintendent of Documents, Washington, D. C.—20 cents (money order).*

PRESDWOOD
...*Now Tempered*



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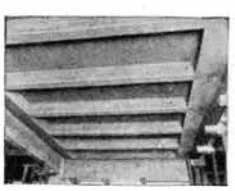
The St. Louis University's School of Commerce & Finance. Gillespie & Daley, contractors, used 60,000 sq. ft. ¼" Presdwood as concrete forms for 150,000 sq. ft. area, producing smooth surface concrete of notable strength. The 3' x 12' pans permitted saving in concrete due to their size

With the Presdwood forms, there was a reduction in size and quantity of lumber used. Shoring was used under beams only; no re-shoring required. Quick erection and stripping helped to reduce cost



Note the smooth surface of the concrete—no grinding, extra finishing or plastering required. After being stripped, the Presdwood used was removed and made into forms for other concrete construction

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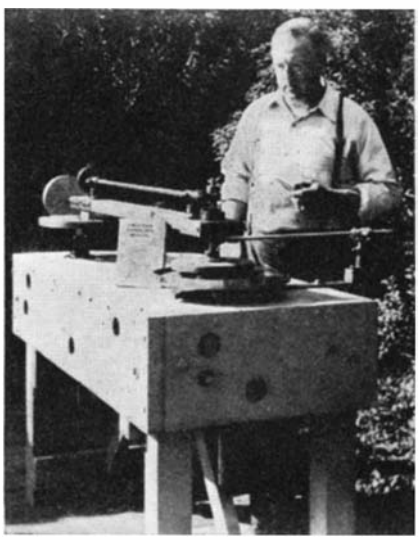
THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

THE Sixth Annual Convention of amateur telescope enthusiasts will be held at Stellafane, near Springfield, southeastern Vermont, Saturday, July 25. This is probably the only invitation that will be issued, as the Springfield people tell us that the number of enthusiasts has now increased past their power to mail individual announcements, but that the latch-string hangs just as far out as it always has and always will.



Electricity grinds, Graves watches

These wholly informal gatherings usually attract several hundred amateur telescope makers and users, men, women and children, and a drive to Stellafane makes an interesting week-end. Come in your old clothes, or if you haven't that much this sad year, come anyway. If you camp, bring along your camp outfit—there's plenty of room—and if you don't, there's a hotel in the village.

AS WAS stated explicitly in "Amateur Telescope Making," (the instruction book from which the many telescopes described from month to month in this department of the magazine were made) most workers make the concave mirrors of their reflecting telescopes by hand, and this method has no drawbacks except to the lazy. But if one wishes to do it with a machine and actually enjoys concocting a machine—in other words, if the worker is possessed of the true mechanical instinct—then a machine is the thing to have and one need make no apology for it. One of the more serious addicts of the telescope making hobby, Mr. Byron L. Graves of Los Angeles (336 South June Street) has made such a machine, essentially the Porter type shown at B, Figure 3, page 151 of "Amateur Telescope Making."

Mr. Graves, who was formerly with the Ford Motor Company and later had much to do with airplane development in California, obtained suggestions and help directly from Mr. Porter in nearby Pasadena. Later at our request he described his fun in the following letters:

"With the new edition of 'Amateur Telescope Making' in one hand and a saw in the other, I built a bench and mounted on it the Porter grinder and polisher, assembled out of old parts picked up around junk piles—with the exception of the gears, which are standard stock Boston, as well as the mounts for the bearings. You are mistaken; the grinder is not an engineer's job. I know little or nothing about engineering, having been engaged in the Ford assembling and selling business—operating Ford branches—for 19 years previous to 1926.

"I had the good fortune to meet the backyard astronomer's friend, Mr. Russell W. Porter, who is busy on the big 200-inch job over at 'Cal Tech,' but not too busy to talk to an amateur telescope maker. He told me the proper speed to use on the machine, namely 4 r.p.m. for the main table (revolving) on which rests the tool, and 1 or 2 r.p.m. for the mirror disk (in the opposite direction). The stroke speed is regulated for about 45 per minute. Any length stroke may be had by simply sliding the crank pin on the old Barnes face plate, in or out. In grinding I speeded up to 55, with corresponding increase of speed in table and mirror. When it came to final polishing I used a weight to balance the load so that the mirror just about touched the tool.

"I got pretty well discouraged once or twice when I overshot the mark and missed the parabola by about half an inch. I don't know when I have spent as many pleasant evenings as I have had grinding and polishing and figuring my little six-inch mirror. The results? Well, I can count the braces on the big tower at the Mount Wilson Observatory from my back yard—over 20 miles away. My stars don't have tails on them, either, and they have a dark spot in the center under focus and the same over. I never had seen another reflecting telescope or speculum, so that Irish preacher Ellison did a pretty good job of instructing by book. By the way, if that fellow lived on this side of the Atlantic I would join his church and attend every Sunday morning. For, if he can preach as well as he describes this telescope thing, I wouldn't care what religion he put out. He told just one lie in the whole book, namely, the time he takes to make a six-inch speculum from start to finish."

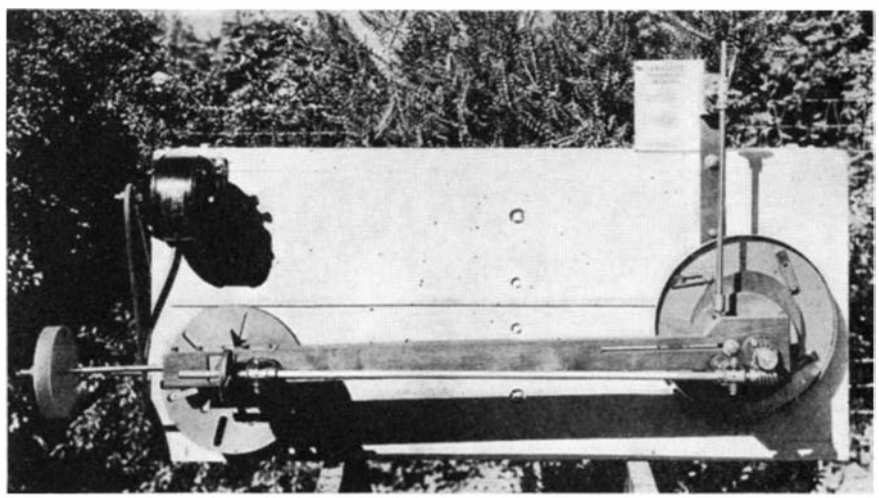
Some months after receiving the above letter, Mr. Graves was asked how he was making out. This is what he replied:

"I've been so busy on this new hobby that I have neglected my home and family, to say nothing of business affairs. Porter came over from Pasadena and gave my first attempt the 'once over'. He said she looked O.K. but of course the mirror didn't amount to much—I think he said she had spherical adenoids due to too tight lacing. I loosened her up and she now shows a round image of a star in or out of focus.

"The enclosed photograph will give you some idea of how the thing looks. My neighbor on the north said it wouldn't do to have a fire in this neighborhood, as the firemen would certainly try to couple an engine suction hose to the thing. Neighbor on the south made a remark which came to me through the 'grape vine telegraph'—namely their maid to our maid to my wife: said it looked like 'Spark Plug.' Well, I did cover the end up with an old felt hat one night and threw a blanket over the rest of it.

"Standard six inch cast iron pipe fittings were used for the mount and it is as solid as the rock of ages. The only part on the job that I didn't make in my 'nut' shop back of the garage was the rack and pinion for focusing. I bought this for a dollar from a second-hand moving-picture supply house. The pipe fittings cost eight dollars and a half.

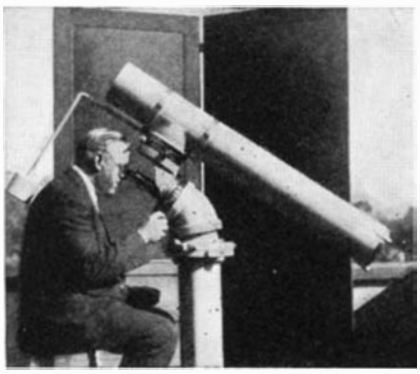
"The setting circles were made of brass



Mr. Graves' neat version of the Porter grinding-polishing machine

bands and fastened on with small pins like those used for fastening the nameplates on electric motors. I had to remove the threads on the short nipple and in the flange at its base in order to tilt the polar axis to 34°, our latitude. I drilled a couple of holes through flange and nipple and inserted bolts—one on either side—on which to hinge the nipple while making the adjustment. Then I locked it in place by means of a bolt acting as a set-screw (thread in the flange) as you will see by the photograph.

"The tube is made of heavy gage black iron electric welded. I squirted it with



The "fire plug or Spark Plug" mounting

three coats of Duco primer and four coats of regular finishing Duco, rubbing down with fine emery paper and water after each coat. Two more coats of primer would have filled it perfectly but it doesn't look bad for an outdoor finish."

BETWEEN the fire-plug mounting that when suitably dressed up looked like the old hoss "Spark Plug" of the well-known comics, and the neighbors' pertinent or impertinent comments, Mr. Graves appears to have had his money's worth of fun. Just look at the pedestal he used—six-inch pipe fittings. Then contrast it with some of the one-inch fittings that some have used. That eight fifty was a good investment in rigidity and in appearance too. To emphasize the value of rigid mountings in even a light breeze, here is a note written by Dr. T. A. Jaggar, the volcanologist. He is referring to Mount Harkness, California, 8000 feet high. "The *entire mountain top*," he says, "is shaken by strong winds and the seismographs (mounted in a closed excavation in its top) show a very irregular record on windy days. Puffs and gusts of wind produce records of tremor with considerable amplitude." Because a telescope amplifies vibrations it is fully as sensitive to shakes as a seismograph. Even Mr. Graves' six-inch pipe fittings can be no stiffer than Mount Harkness. It is hard to overdo in the matter of providing for rigidity in a mounting.

Mr. Graves spoke of the time it takes to make a six-inch speculum. Ellison has set up a record of something like six hours from the beginning of the grinding to the end of figuring, but few of us are Ellisons. It is a fact that most new workers will spend about 30 evenings making a speculum. Well, what of it if it's all fun, as Mr. Graves says?

Don't forget the two gatherings of amateur telescope enthusiasts—at Springfield, Vermont, July 25 and Pittsburgh, August 8-9.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 131)

um. Fine silver stills and condensers, and silver-alloy taps and cocks are being generally employed to overcome the manifold troubles experienced in these particular industries.

For the melting and casting of the caustic alkalis, silver apparatus is employed, and stands up to its work well. An application of silver which has some slight connection with chemical engineering is in the Drumm storage battery. This is an alkaline electrical accumulator which, it is claimed, has much higher rates of charge and discharge than are found with any other known type and a much greater capacity per unit of weight.—*A. E. B.*

Soapless Cleansing Solution

A CLEANSING solution, recommended for many household uses, is described by *Silicate P's & Q's*. The formula is covered by United States Patent 1753395. A mixture of 33 parts silicate of soda, 66 parts saturated borax water, and one part of ammonia is prepared by dissolving the borax, adding the ammonia, and stirring this into the silicate, thereby preventing gelation. One part of this solution in 10 parts of water is recommended for cleaning painted walls, woodwork, rugs, tapestries, or as a mechanic's cleanser. The inventor offers this as a convenient solution which will serve as a softener, will be nonirritant to the skin, and will not solidify or produce sediment.—*A. E. B.*

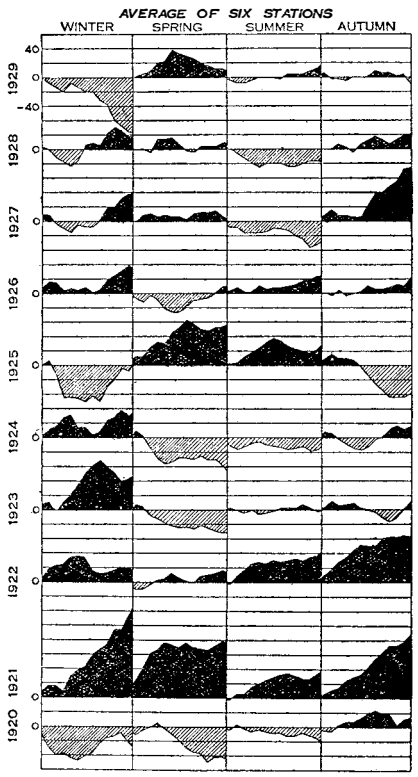
"Why, I Remember When . . ."

"THE earth's climate must be changing. We don't get the kind of winters we used to get. Why, I remember when I was a boy. . . ."

Probably every generation since the beginning has heard the same kind of statement from old-timers, but there really *is* ample scientific evidence that the past decade has been abnormally warm in the United States—which is not by any means to support the general claims of "when I was a boy." W. A. Mattice of the United States Weather Bureau at Washington has made a study of the past 10 years' weather in the United States and published a summary of the findings in the *Monthly Weather Review*, scientific journal of the Weather Bureau. From this we reproduce a set of graphs which tells much.

Mr. Mattice selected the records obtained at the six weather stations respectively at Washington, Cincinnati, Kansas City, Denver, Salt Lake City, and Sacramento. His graphs are composites of these six sets of weather records. They need perhaps some explanation. Looking at the graphs as a whole, the black areas represent warmer weather than normal and the gray areas cooler weather than normal. The zeros in the margin merely represent normal and have nothing to do with the actual temperatures. The black masses above zero and the gray masses below signify accumulated departures from normal, each horizontal line representing 20 degrees, Fahrenheit. We might just as well not notice such details which involve a technical method of representation regularly employed by meteorologists, for the black and gray areas tell the story. There is seen to be more black than gray—more warm than cold—in the last decade.

As Mr. Mattice puts it, "A general survey of the composite graph indicates that the past 10 years have been mild, on the whole, except 1920, and, with the exception of 1929 and 1925, the winters have also been rather mild. Springs also show a tendency



The weather has been abnormally warm but climates are not changing

toward mildness, while summers apparently are close to normal. Autumns are also mild, especially 1921, 1922, and 1927. It would seem, therefore, that the claim that the past 10 years have been rather mild is substantiated by the evidence presented."

What, then, about "when I was a boy"?

The abnormalities Mr. Mattice exhibits have no connection with this familiar kind of argument. It is manifestly incorrect to attempt to judge the weather of the entire area of the United States from the observed weather in one small locality where the weather may have been exceptional, and it is equally unsafe to attempt an estimate of the whole world's weather from that of the United States. It would be equally unsafe to base a claim for permanently changed world climate on any 10 years or even on any 100 years, of weather records. As meteorologists know, the world's climate swings back and forth in a manner not yet fully understood. There is evidence for various cycles, short and long. These, with probable other effects, are superimposed on one another and the combined curve is not easy to figure out because it is so complicated and because our records cover so short a period of time. He who assumes that the world's weather has undergone a permanent change "since he was a boy" is like the man who, having had immediate and bitter experience

with stocks and depressions, assumes that a permanent change has set in. Neither can see the woods for the trees.

Finally our memories and general impressions often play tricks on even the most level-headed of us.

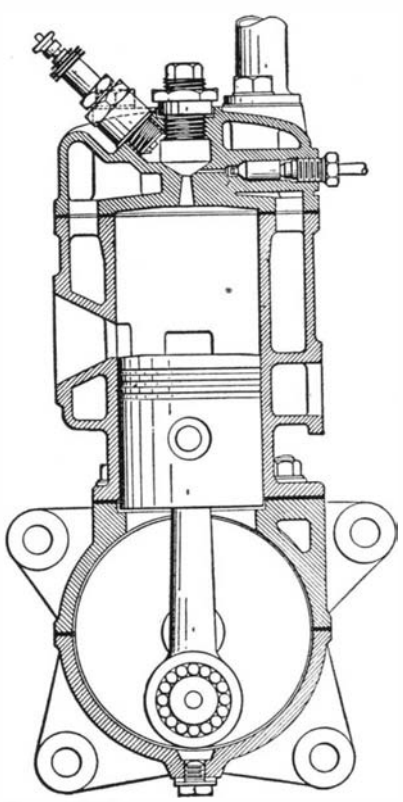
New German Semi-Diesel Engine

IN THE development of the high-speed oil engine, the semi-Diesel principle will not down, as many feel the lower pressures permit a reduction in weight and cost.

An interesting attempt has been made in this direction in Germany by two German engineers, who have invented a new type of motor to work either as Diesel or semi-Diesel, in which the lower compression and spark-plug ignition of the latter are the sole points of difference between the two systems.

The principle of operation of the motor is highly interesting. The inventors, Eugen Thomas and Robert Stuhr, of Düsseldorf, consider high-pressure pumps and small-bore nozzles objectionable in high-speed Diesels, as they are expensive to manufacture, while the nozzles are likely to give trouble through clogging up. The inventors have circumvented these difficulties by the adoption of a low-pressure fuel-feed system and a new form of ante-chamber.

The upper part of this ante-chamber is cylindrical in shape and has a flat top, and the bottom consists of a flat funnel with the



Courtesy *Power*

The new German semi-Diesel engine

apex pointing downward. The apex is connected by a vertical passage of conical section, and a horizontal passage in the wall of the ante-chamber communicates with the delivery side of the low-pressure fuel pump.

When the piston goes up on the compression stroke the fuel pump commences delivery at a very early stage, and has, therefore, to overcome but a slight pressure in the ante-chamber. Owing to the venturi-like form of the vertical passage a high speed is imparted to the air on its progress into the ante-chamber, the speed being higher the greater the piston speed. This high velocity causes a partial vacuum to set up around the top rim of the connecting passage, which draws in the fuel oil being delivered by the pump. A certain quantity of the fuel leaks over the rim and is caught by the air current, to atomize the fuel finely. The sudden increase of pressure caused by the explosion reverses the air current, closes the non-return valve in the fuel-feed opening and drives the burning gas and remaining fuel charge into the engine cylinder, where combustion is completed.

The speed of the converted semi-Diesel motor reaches 3000 revolutions per minute. Combustion is exceedingly good, for the exhaust gas shows no traces of odor even when starting or when changing gears. A single cylinder experimental engine built by the inventors ran at 4000 revolutions per minute, and they hope to obtain that speed in a new engine specially designed from the start to work on the principle evolved by them.

The obvious advantage of this type of motor is its extraordinary simplicity and the cheapness with which it can be produced, since expensive high-pressure pumps and finely calibrated and worked nozzles are dispensed with. The principle of working is just as applicable to four-stroke-cycle motors as to two-stroke-cycle.—Edwin P. A. Heinze, in *Power*.

In Defense of the Laundry

"THE laundries use acid on my clothes" is a common complaint.

Too common! The laundrymen have grown tired of hearing it and set their chemists to find proof that it is not so.

That was easy, for George H. Johnson, director of research for the Laundryowners National Association, says to the public:

"Next time you suspect that acid is used to get clothes clean, fool around with the innards of an automobile until your hands are greasy, and then try to get them clean with vinegar, or any other acid. Acids never did and never will remove dirt from clothes."—*A. E. B.*

Hafnium Has as Yet Few Uses

HAFNIUM, one of the most abundant of the newly discovered elements, has not yet found a definite place for itself in industry, according to the United States Bureau of Mines. A commercial future for hafnium is, however, already glimpsed in the radio industry, and its high melting point and electronic emissivity have already led to the taking out of patents for its use in radio tubes and incandescent electric lamp filaments and for the cathode surfaces of devices such as X-ray tubes and rectifiers.

Hafnium, which is element number 72, takes its name from Hafniae, the Latin name for Copenhagen, Denmark, where the research work of Coster and Hevesy, discoverers of the element, was performed, says Paul M. Tyler in a report recently published by the Bureau of Mines.

Due to the fact that the separation of hafnium compounds from zirconium compounds is laborious, and because of the lack of any extensive demand, hafnium compounds are expensive and not particularly easy to obtain in the market. In the

United States practically none of the metal seems to be available, but hafnia (the oxide) and hafnium chloride can be purchased in small quantities at a price of approximately 25 dollars a gram. Ores containing up to about 3 percent of hafnia can be bought for about 50 cents a pound and ore containing 5.5 percent may be had for $1.50 a pound.

The first hafnium salts produced in the United States were made by the late Prof. C. James of the University of New Hampshire in 1924 from crytolite obtained near Bedford, New York. However, although the zirconium salt which he prepared concomitantly appears to have been free from hafnium, the hafnium salt was unfortunately contaminated in process by zirconium through the interchange of fractions by careless workmen who had access to the laboratory. To date, therefore, pure hafnium salts have apparently not been prepared in the western hemisphere.—*A. E. B.*

ASQUITH AND KITCHENER

(*Continued from page* 117)

Secretary for War; Morley, Secretary for Ireland; and Lloyd George, President of the Board of Trade. By extending equal recognition to both branches of the Liberal Party and by the unexpected abilities he showed during his two years as Prime Minister, at his death in 1908 Campbell-Bannerman bequeathed to Asquith the Premiership, a good working majority in the Commons, and a united party.

While fortune again smiled on Asquith, Kitchener had become involved in a dispute with Lord Curzon, Viceroy of India, and had to be content with accomplishing considerably less than the reforms he had planned for the Indian Army. From India he went in 1910 to Australia where he laid the foundation of the present Australian Army. On his return to England, King Edward presented him with the baton of the Field Marshal and used his influence to have Kitchener made Viceroy of India in succession to Lord Minto. This was Kitchener's real ambition, but John Morley, who had become Secretary of State for India, would not have him, and though Asquith would have been glad to please his Sovereign and honor Kitchener, he would not overrule the responsible Cabinet Minister.

This incident is interesting as the first direct official contact of Asquith and Kitchener, one the Prime Minister of Great Britain, the other the Empire's greatest soldier except Lord Roberts then retired. King Edward died shortly afterwards and Kitchener believed that had Edward lived, he would have prevailed upon Morley to make Kitchener the Viceroy. If so, Kitchener would have been in India in 1914 and would probably have been retained there during the war.

After this failure, Kitchener was unemployed until 1911, when he was sent to Egypt, the scene of his first successes, as British Agent and Consul General. He was as successful as Satrap as he had been as Sirdar, and during his three years in Egypt he quieted the unrest in that unhappy country by removing some of the abuses that distressed the miserable Egyptian peasants. Kitchener was at his best in Egypt and in spite of the occasional bombs hurled at him and the Khedive, he led a quieter life in Egypt than Asquith did in England, for this was the period of the militant suffragettes, the struggle with the House of Lords, and the Carson volunteers in Ulster.

Simultaneously, foreign affairs pressed on Asquith for decision. Grey at the Foreign Office confronted one European crisis after another until the Agadir incident in 1911 forced the most optimistic and pacifistic members of the Cabinet to realize that Europe was on the brink of war. Asquith was already aware that Great Britain could no longer hold aloof from a major European war, and as Prime Minister increased the usefulness of the Committee of Imperial Defense. He opposed Lord Robert's program for compulsory service and gave his powerful support to Lord Haldane's alternative scheme that provided an Expeditionary Force of six divisions of regulars ready for instant service, a Territorial Force for home defense, and the Special Reserve to provide replacements for the Expeditionary Force. The main disadvantage of the Territorial organization was that its members could not be ordered abroad without their consent.

IN addition to this land force, the British Navy, the largest in the world, although no longer up to the "two-power" standard and increasingly pressed by the German High Seas Fleet, was potentially on the side of Britain's allies. The relative weakening of the British Navy was due to the need for appropriations for old-age insurance and other modern social legislation strongly urged by Lloyd George, Morley, and John Burns. The struggle for naval funds was led by McKenna, First Lord of the Admiralty, while it was opposed in the Cabinet by Lloyd George and Winston Churchill until the Agadir incident.

At a secret meeting of the Committee of Imperial Defense in 1911 subsequent to Agadir, Asquith made the astonishing discovery that the War Office and the Admiralty were poles apart on their war plans. The Army contemplated landing the whole Expeditionary Force in France; the Navy proposed landing this same force in detachments along the Baltic shores of Prussia. Admiral Wilson supported the Navy view, but General Nicholson pointed out the unwisdom of this plan in view of the German railway system and superior army. On conclusion of a very stormy meeting, Haldane, who had studied the German organization for war and had labored for six years preparing the Expeditionary Force for dispatch to France, told Asquith he would no longer accept responsibility for the Army unless a drastic change were made at the Admiralty in order to bring the two services into accord.

Asquith decided in favor of Haldane and the Army plan, and sent Winston Churchill and Prince Louis of Battenberg to relieve McKenna and Sir Arthur Wilson of their posts in the Admiralty with instructions to organize a proper Naval General Staff. Lloyd George was also converted by the Agadir incident, made his defiant Mansion House speech, and definitely aligned himself with the party in the Cabinet who believed war with Germany was probable if not inevitable. With Lloyd George came

Churchill and this gave Asquith for the first time a working majority in the Cabinet willing to support reasonable preparations for war. Lord Loreburn, Lord Morley, and John Burns were still pacifistic, but Asquith could now proceed with more firmness in foreign affairs.

Time pressed, for early in 1912 Churchill found it necessary to recall a squadron of battleships from the Mediterranean to reinforce the British Fleet in the North Sea; this practically abandoned the Mediterranean and the Army chiefs promptly asked the Navy if, in the event of war, the communications with the Army garrisons in Malta and Egypt could be maintained. The Navy answered "No." Asquith again confronted a major problem; the Foreign Office advised him that he had three alternatives: (1) To get the French Fleet to guarantee British communications in the Mediterranean; (2) To make an alliance with Germany; (3) To increase the Fleet so that the North Sea and Mediterranean could both be held. The Government thought it could not afford the expenditures necessary to raise the strength of the fleet; an alliance with Germany would acknowledge her as the dominant European power, a result repugnant to the entire Cabinet; so the Cabinet decided to turn over its interests in the Mediterranean to France. In return, this obligated Great Britain to protect French interests in the North Sea and the Atlantic, and linked Great Britain by ties of honor as well as of interest.

Germany learned of these conversations, realized that England was definitely committed to France, and ceased her efforts to detach England from the Entente. This change in attitude actually improved the relations between England and Germany; for Grey industriously sought some formula to satisfy German aspirations and in spite of the strains caused by the Balkan War in 1913, Britain and Germany individually were more friendly in the spring of 1914 than in the previous decade. Asquith was fully occupied with domestic affairs, had complete confidence in Grey's intentions and abilities, and gave him a free hand at the Foreign Office. In the spring of 1914, Grey had practically concluded an agreement with Germany that settled all questions at issue directly between Germany and Great Britain, including the vexatious question of the Berlin-Bagdad Railway. But Germany was linked to Austria, and Great Britain to France and Russia; a residue of bitterness and suspicion remained in both countries, and the naval rivalry continued.

IN the spring and summer of 1914, Asquith's government was fully occupied with the Ulster movement under Carson which took on serious proportions because many Conservative leaders and Army officers were openly or secretly for Ulster. At the height of the crisis, Asquith accepted the resignation of the Secretary for War and took personal charge of the War Office. He had waited, perhaps over long, for the situation to develop, but then he acted firmly and took personal direction of the War Department, which would be the critical post.

At a cabinet meeting on July 24, called primarily to consider Ulster, the interest of the members first turned toward Serbia and Austria. For the next 10 days Asquith presided while the Cabinet grappled with the question of war or peace. He was kept informed of Grey's efforts to avoid war, and he permitted Churchill to keep the British Fleet, which chanced to be carrying out a test mobilization, on a war basis. He was anxious lest the Cabinet split along the line of cleavage that had rent the Liberal Party during the Boer War; he feared that a formidable number of colleagues would resign, that public opinion would divide on the question and Britain enter a major war with a divided people.

EVIDENCE now available indicates that Asquith was unnecessarily apprehensive about Britain's willingness to accept Germany's challenge; hostile critics say he was forced into the war by public opinion, but there was some reason for his hesitation. The murder of the Archduke had at first excited sympathy for Austria among average Englishmen who could see no reason for their getting involved in a Balkan war. At the prospect of a European war, as Asquith had feared, the Cabinet split at first into almost equal groups, the interventionists led by Grey, the non-interventionists by Lloyd George. Possibly an appeal by Asquith to public opinion would have forced the hands of his reluctant colleagues. Even so, a split Cabinet on the eve of war was not to be lightly accepted, so the French Ambassador was told as late as August 1, that "France must make her own decision at this moment, without reckoning on an assistance which we (the Government) are not now in a position to promise."

By August 2, the situation was crystallizing; Bonar Law, leader of the Conservatives, wrote Asquith to "offer an unhesitating support to the Government in any measures" they took to assist France. On the same afternoon, Asquith with the Cabinet consent was able to inform Germany and France that German ships would not be allowed to pass through the North Sea or English Channel to attack the coast or shipping of France. Thus England honored her written obligation to France, which called only for naval assistance. The situation developed rapidly thereafter and the German invasion of Belgium so stirred British public opinion that on August 14, Asquith, marching with a united people and practically a unanimous cabinet, brought the full support of the British Empire to the Entente, and for over four years the British people redeemed in generous measure all British promises, written or implied.

Thus in his own groping, halting, almost faltering way, Asquith brought his country into the war, and with it a united party. Fortunately for England, Churchill, who delighted in responsibility, had already mobilized the British Fleet and deployed it between England and the enemy, so the Cabinet could debate the question of war in safety. But England's almost allies, France and Russia, writhed in agony while the decision hung in the balance; abroad doubts arose about England's good faith and precious time was wasted. In judging Asquith's conduct, American readers must remember that the Prime Minister does not have the same authority over his cabinet that our President has; he is only the "first among equals" and must persuade rather than direct.

(To be concluded)

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

Langmuir Patent Invalid

THE patent covering high vacuum radio tubes, acknowledged to be the type universally used in radio receiving sets, was declared invalid on May 25 by the Supreme Court of the United States, reports *The United States Daily*. The decision of the Circuit Court of Appeals for the Third Circuit, which the Supreme Court reversed, was given on page 142, of the February, 1931 issue of the SCIENTIFIC AMERICAN.

The validity of the Langmuir patent, No. 1558436, owned by the General Electric Company, had been contested by the De Forest Radio Company, charged with infringement of the patent.

The court concluded in an opinion by Mr. Justice Stone that the production of the high vacuum tube, in view of the prior art which included contributions of Dr. Lee de Forest, resulted only from skill of those practiced in the art and did not constitute invention, and, therefore, was not patentable.

Explaining the claims for the high vacuum tube, the opinion states that they cover methods "of creating the high vacuum by freeing the tube of occluded gas by heating tubes and electrodes and by electronic bombardment, at the same time evacuating the tube of air or gas by approved methods."

"It suffices to say," the court concluded, "that an examination of the prior art discloses that long before the earliest date claimed for Langmuir, the necessity of removing occluded gas from tubes or other electrical discharge devices in order to produce a high vacuum, and the methods of doing it were known, as was the procedure for construction of the high vacuum tube by expelling occluded gas while evacuating the tube."

While high vacuum was an effective means of producing in the old tubes of the art the stable current which could not be produced "in the presence of ionization," according to the opinion, there was no suggestion of the discovery "of a scientific truth that essentially different principles control the discharge in low vacuum tubes from those which operate in high."

Granting a difference between the low vacuum and high vacuum tubes, the court declares: "It is no more than the scientific explanation of what Lilifield and others knew, before Langmuir, of the effect of the high vacuum on the discharge, and the methods and devices for procuring the vacuum. It is method and device which may be patented, and not the scientific explanation of their operation."

Chemical Patents

APPLICATIONS for patents relating to chemistry comprise one eighth of the issuance activities of the United States Patent Office, the Commissioner of Patents, Thomas E. Robertson, stated recently.

Of the 63 technical divisions in the Patent Office devoted to consideration of applications for patents, eight deal almost exclusively with subjects relating to chemistry.

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.

Additional information made available by Mr. Robertson follows:

Latest figures show a total of 17,058 applications awaiting action by the chemical divisions. This mass of work is distributed in jurisdictions of the various "chemical divisions" as follows:

Heating, metal founding, metallurgy, and metal treatment, 991; carbon chemistry, 2185; glass, plastic block and earthenware apparatus, and plastics, 2623; distillation, heating and illuminating gas, and mineral oils, 2590; plastic liquid coating compositions, and coating, 2500; electrochemistry, laminated fabrics, paper making, and substance preparation, 1977; chemistry, alcohol, fertilizers, cement and lime, hides, skins and leather, and fuel, 1719; bleaching and dying, explosive, pyrotechnic and match compositions, oils, fats, and glue, preserving, sugar, starch, and carbohydrates, 2473.

AAA Trademark Upheld

THE Automobile Owners Association of America, of Baltimore, Maryland, is not entitled to register, as a trademark for maps, especially mileage road maps, a mark consisting of an elliptically shaped device containing the applicant's name and having within the outer line a smaller concentrically positioned elliptical figure within which is the representation of a shield covering the body of a conventional representation of an eagle, the head, wings, and feet of which show beyond the edges of the shield, according to a decision by First Assistant Commissioner Kinnan.

The ground of the decision is that this mark is confusingly similar to a previously registered mark (registration No. 155,190) of The American Automobile Association, Inc., of Washington, D. C., consisting of a rectangular panel upon which appear the opposer's name with an elliptical figure in the center containing the letters "AAA" and above which is a representation of the wings of a bird, presumably an eagle, and used as a trademark for the same goods.

In his decision, after stating that it was at least doubtful that applicant's mark was confusingly similar to other marks of the opposer consisting respectively of two intertwined automobile wheels with the letters "AAA" placed thereon, and an elliptical figure within which are the letters "AAA," and stating that there was reasonable probability of confusion between applicant's mark and that of registration No. 155,190, the First Assistant Commissioner said:

"Elliptic and rectangular panels for signs, trademarks, and so forth are so very common that the difference in contour here shown would not be readily noted or remembered, especially where the marks do not appear side by side for comparison. The applicant has taken substantially the entire group of words appearing upon the opposer's panel, merely transposing their relative positions but conveying the same impression and information."

Film Case Review Sought

A PETITION for review of a case involving a patent claimed "as the patent which made possible, and upon which has been built, the talking motion picture art" has just been filed with the Supreme Court of the United States, reports *The United States Daily*.

General Talking Pictures Corporation and De Forest Phono-films seek the review by the court of a decision of the Circuit Court of Appeals for the Third Circuit holding the Reis patent, No. 1607480, covering a method or process used in reproducing talking pictures, not infringed by apparatus used by The Stanley Company of America. (See page 426, June, 1931, SCIENTIFIC AMERICAN.)

The patent in suit, according to the petition, relates "to the method of reproducing sound waves photographically recorded on motion picture film." The patent concerns only the reproduction of talking pictures.

In setting out the contribution of the patentee to the art, the petition states:

"Reis discovered a method of recording and reproducing sound waves which made it possible to use the relatively slow speed of film travel which was standard in the motion picture industry, without overlapping and distortion of the sound wave images. That method, in so far as it relates to reproduction of photographically recorded sound waves, constitutes the invention shown, described and claimed in the patent in suit.

"It was Reis' discovery that if the light-sensitive surface or film is moved in such relation to an aperture that the area of exposure does not exceed the area of the aperture, it was possible to produce and reproduce a perfect sound record, and also possible to adapt it to standard motion picture speed without incurring overlapping of the sound wave images.

"That the Reis method solved the problem which had retarded the development of the art for many years is evidenced by the fact that talking motion pictures are now a universally accepted fact, and that all projectors employed therewith, by one means or another, employ the Reis method —moving the film sound record in such relation to the aperture that the area of exposure of the sound record is limited to the area of the aperture, with the film moving at a speed of travel standard to the motion picture industry."

The petitioners complain of the lower court's opinion on the ground that it erroneously held "a method or process patent not infringed, because of differences in mechanical structure between the alleged infringing device and that illustrated in the patents as one means of use."

Chemical Coating Makes Glass Opalescent

A COATING for application to glass, which will give an opalescent effect, is disclosed in United States Patent 1752792, says a recent issue of *Silicate P's & Q's*, house organ of the Philadelphia Quartz Company. One hundred grams of kaolin, 50 grams of zinc phosphate, 15 grams of caustic soda, and 1000 cubic centimeters of sodium silicate of specific gravity 1.025 are claimed as a mixture which is very efficient for use in electric lamp bulbs or similar glass objects.

The original method of using an opal glass was expensive and unsatisfactory because under the high heat there were certain decompositions which shortened the bulb life. Etching of the glass by hydrofluoric acid gave diffusion but not opalescence, and decreased the light efficiency. The present mixture absorbs less light, does not affect the bulb strength, flows easily so it is a simple matter to coat the bulb interior, and aids in sealing the glass. The silicate, when dehydrated, acts also as a pigment. If a colored coating is desired, the color may be added and the amount of filler proportionately decreased to maintain the proper consistency for application.

The coating is applied by spraying or flushing into the bulb, the excess is removed by draining or a vacuum and this is followed by subjecting to a relatively high heat to produce instantaneous setting. Baking for three or four minutes at 300° Centigrade to dehydrate the binder, to solidify the coating completely, and to remove occluded gases, finishes the job. The coating is entirely permanent although it can be removed by abrading and flushing with water if that should be necessary.—*A. E. B.*

Price Fixing Banned

THE Federal Trade Commission has ordered Coty, Inc., importer and dealer in cosmetics, New York, to discontinue methods of resale price maintenance.

The company is to stop carrying into effect by agreements, contracts, or co-operation, a system of suggested resale prices for the articles it sells by such means as (1) agreements with wholesale or retail dealers that the company's products will be resold by such dealers at prices specified by the company; (2) procuring assurances from either wholesale or retail dealers that the prices fixed by the company for resale of its products will be observed by such dealers; and (3) seeking co-operation of dealers in maintenance of resale prices suggested by the company for its products.

The Commission found that the company made it generally known to the trade by letters, telegrams, and interviews, that it expects dealers handling its products to maintain its suggested prices. When information would be received by the company indicating that vendors of Coty articles in a particular city were not maintaining the suggested prices, the company would send its agents to such a city to interview these dealers, and to point out to them the company's price maintenance policy and insist that they maintain suggested prices. Such agents would obtain from the wholesale and retail dealers agreements to maintain such prices.

The company has refused to sell its products to wholesale and retail dealers who have not maintained suggested prices and who will not agree to maintain such prices in the future.

The company has furnished names of wholesale or retail dealers whom it has refused to supply with products, directly to those dealers who maintain the respondent's suggested prices or who are selling in the territory where are situated the dealers who had been cut off.

Since 1928 the company has not made a practice of notifying its vendees when such price cutting dealers have been cut off for failure to observe the suggested resale prices.

"Tiol" versus "Tydol"

A RECENT decision by the Patent Office holds that The Pure Oil Company, of Chicago, Illinois is not entitled to register, as a trademark for motor fuel oil, lubricants and greases, and so forth, the term "Tiol," in view of the prior use and registration by the Tide Water Oil Company, of Bayonne, New Jersey, of the term "Tydol" as a trademark for gasoline and "Tycol" as a trademark for lubricants and greases.

In his decision, after referring to applicant's argument that the term "Tiol" is but a mere variant of the applicant's mark "Tiolene" used long prior to any date of use claimed by the applicant and already registered, and noting applicant's argument that the opposer's marks are confusingly similar to its mark "Tiolene," the First Assistant Commissioner said that, while it was stipulated that no actual confusion had taken place,

". . . yet the similarity of the applicant's mark to those of the opposer is regarded as such that confusion in trade would be almost inevitable if the marks of both parties appear in the same market upon their respective goods. The opposer's mark 'Tycol' is good upon identically the same class of goods while its mark 'Tydol' is used upon gasoline. These products, gasoline and lubricating oils, are usually sold at the same supply stations and to the same class of customers and are used in connection with motor vehicles."

Spurious Mercurochrome Outlawed

"MERCUROCHROME," the trade name for a well known antiseptic produced by a Baltimore pharmaceutical laboratory, is not to be used by another concern to describe a preparation which is not Mercurochrome, the Federal Trade Commission ruled in an order to Maurice Talmadge, Chicago, trading as DeBestt Chemical Company.

The Commission specifically ordered Talmadge to cease representing that his so-called antiseptics are "Mercurochrome" unless compounded from the chemical formula for "Mercurochrome," which is technically known as "disodium salt of dibrom-oxymercuri-fluorescein."

Talmadge designated his preparation as "Mercurochrome H. W. D. Two Percent Solution," representing it as a general antiseptic for use in place of iodine. The Commission directed him to cease representing the solution by use of that expression unless the preparation advertised is a two percent solution of the disodium salt compound of which Mercurochrome is composed, and which salt has been produced in the pharmaceutical laboratories of Hynson, Westcott & Dunning, Baltimore.

In its findings the Commission declares that Mercurochrome has been on the market and sold in the form of a two percent solution possessing a deep cherry color, for use as a general antiseptic, and has been recognized and identified both by the medical profession and the public by its trade name, "Mercurochrome," and its striking color in solution. The color is not artificially produced. The process of production is patented by Hynson, Westcott & Dunning, and is sold under that trade name with the accompanying initials "H. W. D."

The Commission found that the Chicago concern's preparation was a spurious product containing little if any Mercurochrome.

"Radiofilm" Refused Registration

IT was recently held by First Assistant Commissioner Kinnan that the R. C. A. Photophone, Inc., of New York, New York, is not entitled to register, under the Act of 1905, the notation "Radiofilm" as a trademark for combined sound and motion picture films, since the word is merely descriptive of the goods.

In his decision, after referring to certain publications with reference to the use of picture films in connection with radio transmission prior to the time applicant claims to have adopted his trademark, the Assistant Commissioner said:

"From the foregoing it is deemed clear enough that those ordinarily skilled in this art would understand the applicant's alleged trademark to mean no more than that the film was to be used in connection with radio apparatus. Indeed it would seem quite difficult to devise a notation more clearly descriptive, and descriptive only, of the goods upon which applicant uses the notation.

"As noted by the examiner it is immaterial whether the applicant's film is to be used in radio apparatus. The notation is equivalent to the statement the film is to be so used and if this is not the fact, the notation is misleading and misdescriptive."

Battery Solution Misrepresented

A CORPORATION manufacturing a battery solution signed a stipulation with the Federal Trade Commission, agreeing to cease the use in advertising matter of statements implying that the product will instantly charge, or cause an immediate electrical energy to enter plates, or that the product, when so used, will not freeze, when such is not the fact.

The company also agreed to stop use of all statements which are false, misleading, or deceptive, or that are in excess of what may be accomplished by the use of its product as a battery solution.

Books SELECTED BY THE EDITORS

DYKE'S AUTOMOBILE AND GAS ENGINE ENCYCLOPEDIA

By A. L. Dyke

ANY reference of this kind covering an ever changing field of production such as the engine industry must be up-to-the-minute in order to be really useful; at the same time it must give enough of the history of development of the individual units to lend the necessary background upon which the latest refinements are imposed. This 16th edition does just that. Personally we find it indispensable for its amazing breadth of information, running as it does into all the collateral lines of accessories covering practically every branch of automotive mechanics. If you do not know this work you should get it. If you have an old edition you should acquire this 16th—you would scarcely believe that so much new material could be produced in so few years.—Cloth $6.30; flexible $7.80, postpaid.

OPTIKS: OR A TREATISE ON THE REFLECTIONS, REFRACTIONS, INFLECTIONS AND COLOURS OF LIGHT

By Sir Isaac Newton

AN exact reprinting of the corrected fourth edition of *Optiks*, published in London, England, in 1730, three years after Newton's death. It holds a twofold interest for the physicist; first, because it "can afford us the enjoyment of a look at the personal activity of this unique man"; second, because enough of Newton's findings, formerly valued chiefly for the depth of theoretical and experimental skill which they evidence, are finding analogies in present-day research to give this book a living scientific interest. The foreword is by Professor Albert Einstein and an introduction by Prof. E. T. Whittacker. In two books divided into several parts. A good second-hand copy of the original first edition sells for at least 20 dollars and rarely appears.—$2.65 postpaid.

SEEING

By M. Luckiesh, Director, and Frank Moss, Lighting Research Lab., G. E. Co.

A SPECIAL corner of lighting on which little data has been available is now strongly illuminated by this new book. It is mainly for the illuminating engineer and lighting specialist, but almost equally for the psychologist, physiologist, ophthalmologist, optician and optometrist, and all others interested in the science of good seeing. In every industrial plant there is or should be someone who understands more than superficially the important connection between lighting, vision, and production. This book will measurably deepen such an understanding. Some of the contents are: fatigue, contrast, speed of seeing, effect of surroundings, glare, general lighting, cost and value, and so on. A theoretical, basic book that is practical too.—$5.20 postpaid.—*A. G. I.*

THE BOOK OF THE MICROSCOPE

By Gerald Beavis

NEARLY everyone has examined a dead fly's wing or a dull, featureless hair under the microscope but relatively few realize, even remotely, the endless extent, the wide variety, and the lively fascination of the invisible world that lies so close to us wherever we go. This new and popular book of 246 pages (illustrated) provides a pleasant approach to the world of microscopic marvels. Without any of the earmarks of a treatise or textbook it tells how to observe and what to observe in the animal, vegetable, and mineral kingdoms. This vast world contains an endless variety of subjects. Microscopy, once tasted, usually becomes a lifetime hobby and incidentally it is an inexpensive one. Thanks to mass production it is now possible to buy microscopes magnifying two or three hundred diameters for only ten or twenty dollars and these are of excellent quality. A million marvels await the amateur microscope fiend. It is a good way to keep sane and out of jail. —$2.65 postpaid.—*A. G. I.*

SCIENCE AND FIRST PRINCIPLES

By F. S. C. Northrop, Assoc. Prof. Philos., Yale

HEISENBERG'S principle of uncertainty and other new concepts having recently upset the scientific applecart, everybody is now trying to right it up again, and this book is a philosopher's attempt to do so. The reader will be the final judge whether this aid from without the ranks of science is efficacious or only results—as we think—in confusion worse confounded. The book would not be light summer reading for *Homo neanderthalensis*, but a sapient *Homo sapiens* could manage it easily if he had previously kept track of the more significant trends in profound scientific thought.—$3.20 postpaid.—*A. G. I.*

GEOPHYSICAL METHODS OF PROSPECTING

By C. A. Heiland, Prof. Geophysics, Colo. School of Mines

A VERY practical 163-page treatise on all the methods of geophysical prospecting, containing data on costs, makers of the various apparatus, names of oil and mining companies which use it and to what extent. The author is one of the leading authorities on this form of scientific and practical research. To be obtained directly from the Colorado School of Mines, Golden, Colo.—$1.15 postpaid.

FLYING DUTCHMAN

By Anthony H. G. Fokker and Bruce Gould

BUILDING a plane before he ever saw one in the air, the "Flying Dutchman" taught himself to fly. He was the first to loop-the-loop and eventually designed the Fokker planes that made Immelman and Richthofen famous. Coming to this country he today, at the age of 40, stands at the head of an international organization distributing the products of his genius throughout the world. Fearless and self confident, he says what he thinks, as he has acted throughout his life. The comments on Byrd, Balchen, and other fliers are spicy and entirely his own line of belief. Much of the history of aviation is enclosed in this story. One of the most interesting books of its kind that has appeared.—$3.20 postpaid.

SAILING THE SKIES

By Malcolm Ross

AN introduction to the sport of gliding designed to satisfy the curiosity of those unable to take actual instruction and to furnish the gliding student with the information he needs before he first sets foot to the rudder bar. It tells why planes fly, takes tips

from the birds, describes the best types of gliders and sailplanes and their launching methods, discusses air currents and gliding terrain, weather and clouds and gives accounts of great soaring flights and how they were made.—$2.65 postpaid.

RECORDING SOUND FOR MOTION PICTURES

Edited by Lester Cowan

A SERIES of lectures prepared for the Academy School of Sound Fundamentals, reinforced by additional chapters and a complete glossary of terms, is here presented in book form. Numerous photographs and drawings supplement the explanatory text. Some fundamentals are given, but in general the purpose of the book is to acquaint those familiar with "silent" motion picture work with the sound recording processes. Although parts of the work are involved and technical, the greater portion should be understandable and informative to the average person who desires to be "up" on sound picture matters.—$5.20 postpaid—*A. P. P.*

PHOTOGRAPHIC AMUSEMENTS

By Frank R. Fraprie and Walter E. Woodbury

ALTHOUGH this book first made its appearance in 1896, it has gone through numerous editions since that time, each one being brought up to date, yet retaining the most interesting features of the original. The book in its present form is presented essentially for the photographer who does everything from making his exposures to printing his own positives; however, even the veriest tyro who snaps the picture and turns the film over to an "amateur finisher" will find much to intrigue him. Subjects covered range from simple double exposures, "ghost" pictures, and double printing to solar photography, photo-caricatures, trick effects in "home movies," and the so-called modernistic phases of both still and motion photography. The part dealing with camera angles interested us most; it explains many points that, when viewing finished photos and movies, have often puzzled. If you own a camera, you will want to read this book and acquire knowledge that will help you to depart from the monotony of ordinary photography. As a source from which to devise your own trick effects, you will find that the suggestions given will open fields hitherto explored only by professionals and rabid "camera fiends."—$3.20 postpaid.—*A. P. P.*

BUTTERFLY AND MOTH BOOK

By E. Robertson-Miller

THE result of personal studies and observations of the more familiar species during many years, given in a readable way, amply illustrated. Life-stories of the moths and butterflies all of us are likely to encounter and about which most of us know nothing. 281 pages. 5″ x 7½″.—$2.65 postpaid.

MAGAZINE MAKING

By John Bakeless

ANYTHING which pertains to his work is naturally of interest to an editor; we therefore approached the reading of this book with anticipation. Nor were we disappointed as we read and found that what is essentially a text book is as interesting as a novel. The author has taken a subject which, seemingly simple, presents ramifications that are not apparent on the surface, and from his years of experience in the business has built up a running story that will hold the attention not only of those actively connected with editorial work, but of anyone who reads magazines. In scope, the book covers every branch of magazine publishing from the economic basis of the business, through the organization of the staff—the editorial, circulation, and advertising departments—to the relationships between authors and editors, and magazine publicity. A comprehensive bibliography furnishes a vast array of titles for further reading on the subject.—$3.20 postpaid.—*A. P. P.*

NOGUCHI

By Gustav Eckstein

EXTREMELY well done both in format and outline, this very enthusiastic biography delineates the fine shades of contrast in this, one of the most important and picturesque lives that the broad field of science has produced. Master of the technique of pure culture, his success in any one line of his many researches would have made him internationally famous. All his endeavors were impelled by an almost frenzied desire to alleviate human suffering, and he never hesitated in his work on virulent bacilli. Truly a martyr to science in every sense of the word.—$5.20 postpaid.

MEMORIES OF SIXTY YEARS

By Henry Sanderson Furniss

SEMI-BLIND from youth because of lack of prophylactic treatment at birth, with a courage and will that nothing could overpower, Lord Sanderson eventually became a strong force in politics, known throughout the land. However, it will probably be his work with the blind for which his memory will eventually be cherished, for in the endeavor along this line he was a pioneer, lending his own experience, as well as his constructive ability, to its firm establishment. One reads this autobiography with a feeling of tremendous admiration and stimulation—told as it is in simple, matter-of-fact, though easy flowing style.—$3.20 postpaid.

THE HISTORY AND IDEALS OF AMERICAN ART

By Eugen Neuhaus

IT IS rare that we have the combination, as in this case, of a historian and a critic who can make an esthetic analysis of the glorious material which our easel and mural painters have presented. The author is Professor of Art in the University of California, thus being in a position to record the beginnings and the development of art in the West and on the Pacific Coast; a valuable point usually forgotten. The subject is developed along two lines: first the tracing of the various influences derived from Europe and elsewhere, which has helped to shape American art; and second the association of artists by subject affinity, which greatly clarifies a comprehension of the various schools. Many artists cannot be classified as their work is what might be called "tangential," but these men and women are not neglected in this interesting text. There are 142 softly executed engravings of paintings and also reproductions of a few etchings and lithographs; the process employed permits this lavish illustrative material. The concise readable style of this able critic makes a work of enjoyment entirely apart from the usual art criticism.—$6.85 postpaid. —*A. A. H.*

THE ROAD BACK

By Erich Maria Remarque

UNDOUBTEDLY this is a more finished product than "All Quiet on the Western Front," but one cannot but wonder if the physical and mental condition of the men of the small town this story describes is typical of any very great number throughout entire Germany. It takes the characters a seemingly unnecessary length of time to readjust themselves and the question readily arises as to whether they would not have sooner arrived at a sane viewpoint of life if they had gone to work and not lazed around allowing their minds to be filled with self pity. However, this is a book that must be read if for no other reason than that it does suggest the extreme penalty that war exacts in certain cases.—$2.50 postpaid.

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VOLUME 5.] NEW YORK NOVEMBER 24, 1849. [NUMBER 10.

WILSON'S SEWING MACHINE.—Fig. 1.

Figure 2.

Rail Road News.

Useful Receipts.

A. B. Wilson's Invention

1845 - 1931

DURING 1849 the SCIENTIFIC AMERICAN illustrated and described four different sewing machines that had just been produced. One of these was the invention of A. B. Wilson, later to be known as the Wheeler and Wilson.

James E. A. Gibbs saw these descriptions and they inspired him to produce the Wilcox and Gibbs sewing machine with its ingenious revolving hook to make a loop stitch.

So too Isaac M. Singer patented his machine in 1851 by substituting circular feed, thread control, gear wheels, shafting and foot drive.

Thus has SCIENTIFIC AMERICAN taken a most important part in the development of this essential household utility.

Today, as faithfully as in the past, this 86 year old magazine records scientific development.

Who can tell what future achievement may evolve from today's authenticated descriptions of industrial activities

L. S. Treadwell.

Vice-President · Advertising Director

Only when Gasoline PASSES *this* PHYSICAL EXAMINATION

can it become Ethyl Gasoline

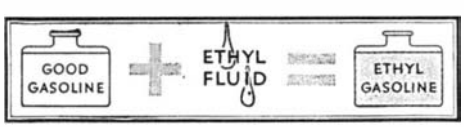
EVERY batch of Ethyl Gasoline must go through a literal third degree before it reaches the tank of your car.

First, a sample of the base gasoline goes before a board of "gasoline doctors" in one of the six Ethyl laboratories.

They delve into its ancestry for gum and sulphur, hereditary diseases of gasoline. They sound its nerves to determine how jumpy it is, how quickly it will knock. They test it for volatility—the quickness with which it changes from a liquid to a vapor ready to deliver power.

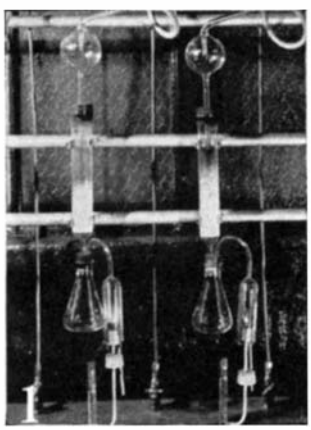
Only when gasoline passes all tests can it be mixed with Ethyl fluid. After it has been mixed at the refinery, it comes back to an Ethyl laboratory to go through the same tests for a second degree. It comes back for the third degree in the samples that Ethyl inspectors buy from roadside pumps.

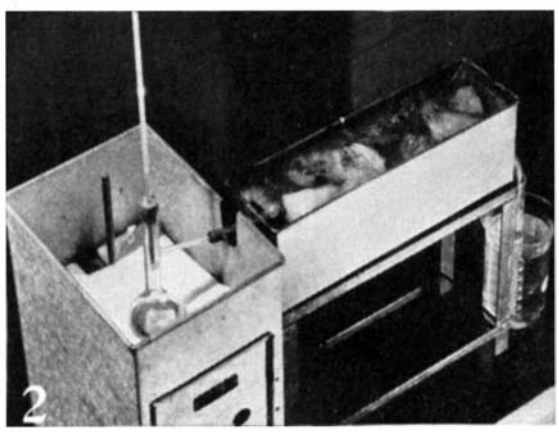
Every time you "fill 'er up with Ethyl," you get gasoline that has passed these strict tests. That's why you always get *good* gasoline—*plus controlled* combustion: the fine performance, the quicker getaway, the added power on hills that only Ethyl can give. Ethyl Gasoline Corporation, New York City.

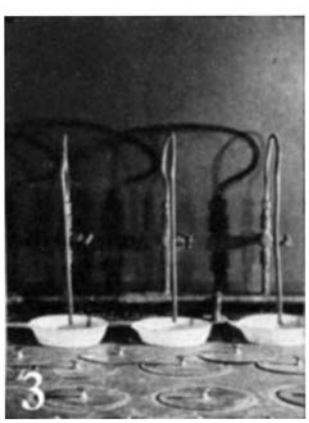


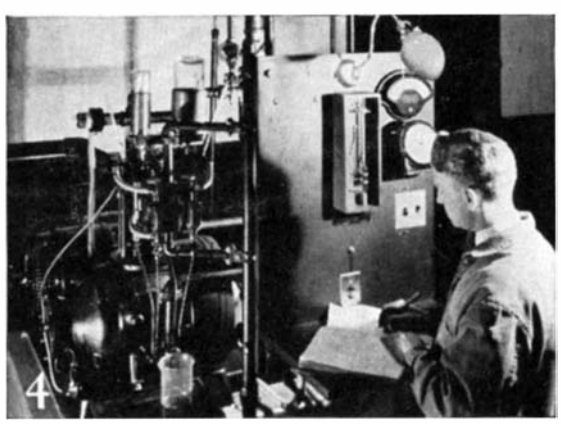
ETHYL
BRAND OF ANTI-KNOCK COMPOUND
ETHYL GASOLINE CORPORATION
NEW YORK, U.S.A.
Controls Combustion

The active ingredient used in Ethyl fluid is lead.









1. SULPHUR is as dangerous in gasoline as tonsils often are to people. So Ethyl chemists burn gasoline samples and catch the products of combustion by bubbling them through soda to make sure of low sulphur content.

2. VOLATILITY is the quality that makes you jump out of bed in the morning feeling like a six-year-old. And gasoline must have this quality before it can become Ethyl Gasoline.

3. GUM makes for intestinal sluggishness in any car. So gasoline that becomes Ethyl must have a low gum content. Shown pictured here are the evaporating dishes used to show how much gum each sample has.

4. KNOCKING is the influenza of gasoline. It is cough, sneeze and weakened power rolled into one. This test tells how much Ethyl fluid is needed to make the patient sound and healthy again—free from any knock.

ETHYL GASOLINE