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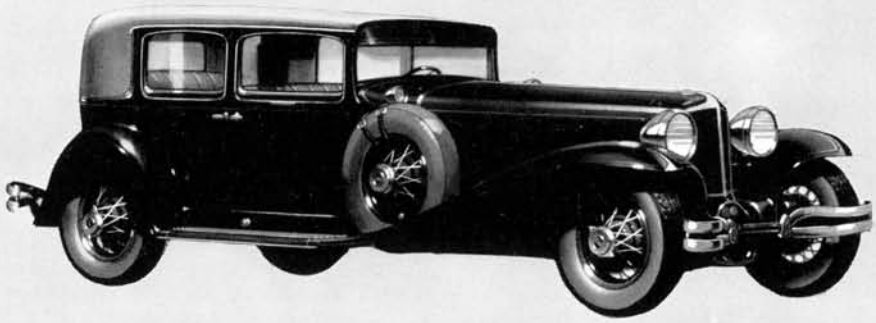

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EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

CONTENTS • APRIL • 1931

THIS MONTH'S COVER

Some of the specially built ships for transporting locomotives fully assembled across the ocean are so small that one locomotive, hoisted aboard by the ship's crane, causes the ship to list considerably. The *Beldis* of Oslo, Norway, shown in our cover painting by Howard V. Brown, has a dead-weight tonnage of 3400 tons. She is staunchly built, however, and her listing does not interfere with the loading of a number of such locomotives as the 88-ton Baldwin, which is also shown.

ACROSS THE EDITOR'S DESK

THE mail that streams continuously through an editorial office is always a source of diversified interest. Queries to be answered, comments on articles that have been published, caustic remarks from those who feel that their pet subjects have been slighted, descriptions of new inventions, manuscripts for consideration, letters from cranks on subjects ranging from unemployment to the Einstein theory—all these and more come in the day's work and all are necessary to the process of getting out a magazine that will please the greatest number of people.

●

With this great variety of mail clamoring for attention, it is pleasant to sit back once in a while and contemplate a letter such as one that reached us a few days ago. It was written by Mrs. Lillian Randall of Pasadena, California, and told of an old friend of hers, Hawley R. Drum, who has been a constant reader of the SCIENTIFIC AMERICAN for 72 years, having started at the age of seven. A self-educated man, Mr. Drum was instrumental in building the first railroad bridge across the Missouri River and, Mrs. Randall wrote, his self-acquired knowledge of surveying was so accurate that experts could find no fault with it. Through all his travels around the country, Mr. Drum has always managed to obtain the SCIENTIFIC AMERICAN as each issue appeared and now at 80 years of age he is still as ardent a reader as ever. Our hat is off to Mr. Drum for what we believe is a record in devotion to one periodical; our thanks to Mrs. Randall.

●

As we prepare the copy for this page, there is before us the original painting for the cover of our May issue. Although it concerns aviation, the phenomenon which is the center of attraction in the painting was mentioned in the Bible.

●

"Which Races Are Best?" is the title of an article scheduled for publication in our May issue which, at first glance, seems to be an excellent opening for the start of a heated controversy. But we read further and find that science cannot admit as yet that there are racial differences in intelligence. "Inferiority" and "intelligence" are relative terms and to measure either one of them, it is necessary that those under examination be given the benefit of every consideration. Even if a result could be reached, how long would it hold true? Humanity is in such a constant state of flux that all of the findings of science may be upset within a comparatively short time. We predict that this article will be widely read and will furnish material for endless discussions.

●

"Its bells can be heard eight miles distant" is said of the carillon that has just been installed and dedicated in the Riverside Church in New York City. The beautiful tones of its 72 bells will make of this church a Mecca for music lovers throughout the world. Behind this appeal to the ear is the illuminating story of the foundry where the bells, from the 10-pounder tuned to "C" to the 20-ton "bourdon," are cast with an artistic skill that is reflected in the perfect tones and overtones of the finished carillon. An article on this subject is scheduled for May.

●

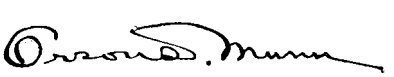
Dr. Heyl of the Bureau of Standards has written for us another article on pure science. This time his subject is "How Big is a Quantum?" Those who were "stumped" by the statement that a quantum of star light is as big as a barrel, made in Dr. Heyl's article entitled "What is a Quantum?" which appeared in our December, 1930 issue, will find in the coming dissertation more information that will undoubtedly add to their knowledge. But even Dr. Heyl states that much still remains to be learned about the quantum. Therein lies one reason for the fascination of science: we are always learning, always replacing old theories with new. Every goal reached is found to be, not the end, but a stepping stone to further discoveries.

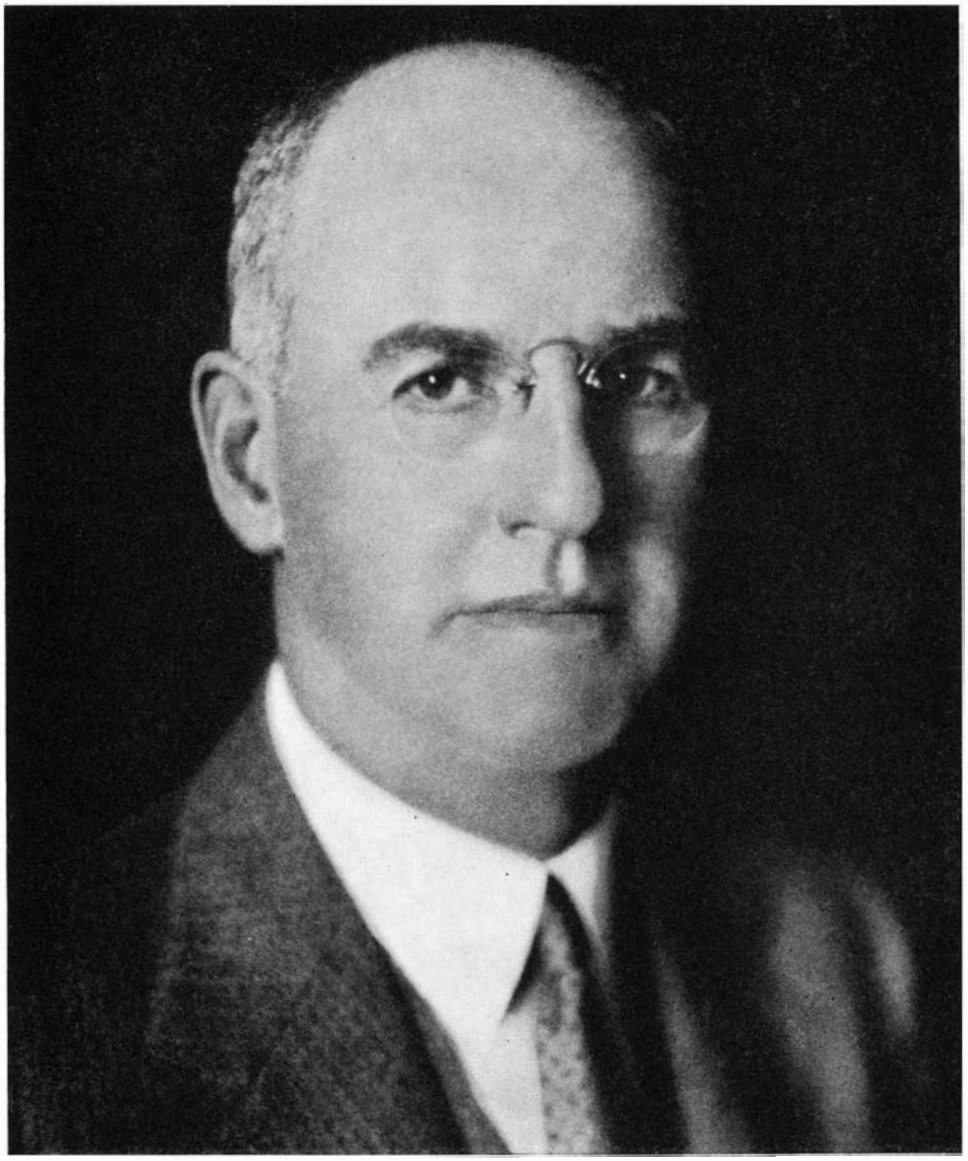
●

We have just received from England a report on further work that has been done in investigating the great Siberian meteorite fall of 1908. As the fall occurred in a remote part of the world, it received little comment at the time. Now, however, it has been discovered that a micro-barographic record of the air wave resulting from the fall was made in England, but filed away because no significance was attached to it at the time. Our correspondent has obtained, from the Russian leader of expeditions that have explored the site of the fall, some unusual photographs and sketches that will be reproduced in connection with his article.

●

Our May issue will also present articles on such diversified subjects as the new naval dirigible now under construction, a typewriter in which all of the mechanical work is done by electricity, the work of the research chemist in industry, the tallest man-made structure in the world, archeology, astronomy, and others.



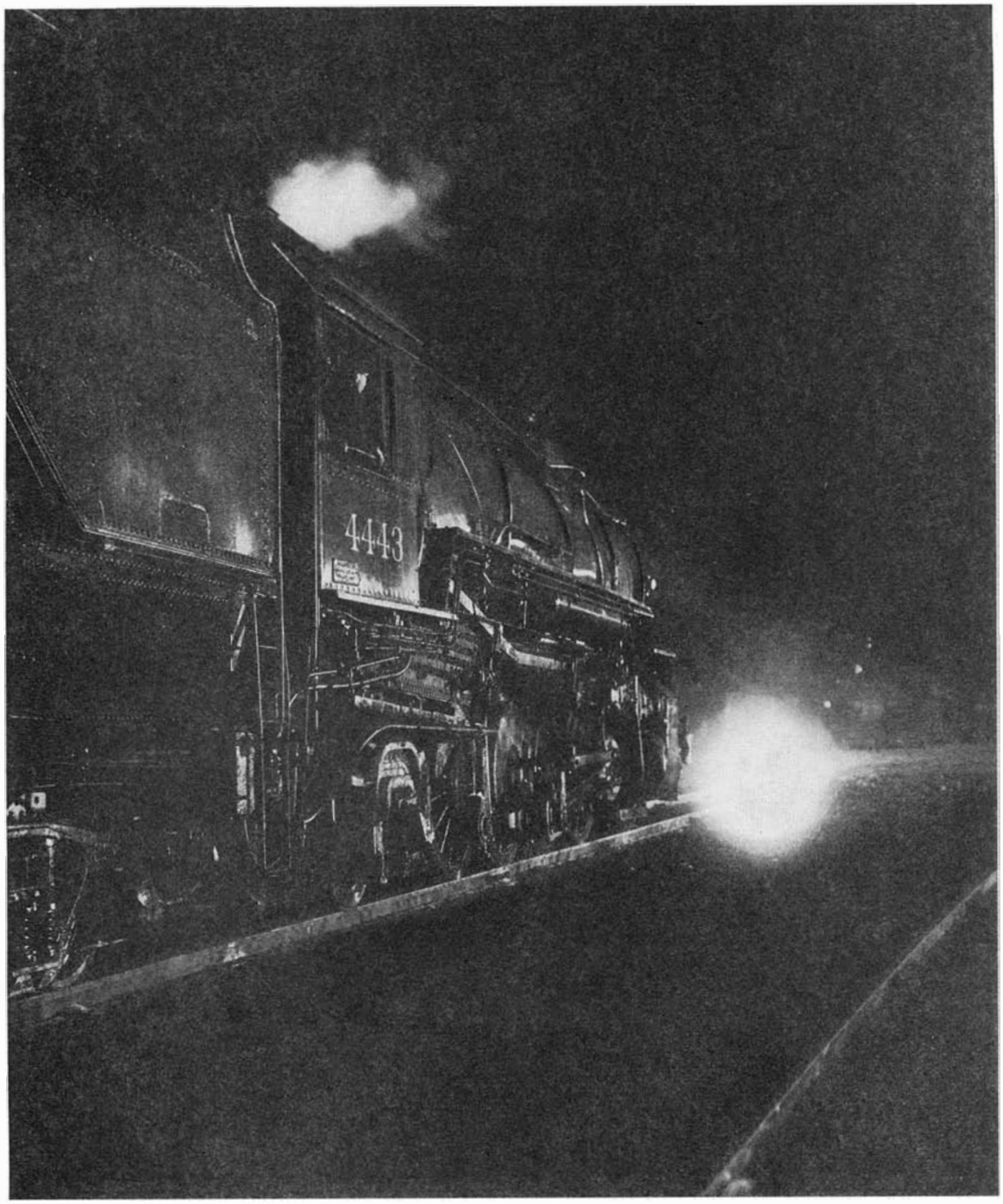


ALVAN MACAULEY

OCCASIONALLY there is a young man who just can't seem to be kept within the confines of one job. He masters many problems and incessantly reaches outside his regular job for more. Such a one was Alvan Macauley when, as a young man of only 23 years, he was patent attorney for the National Cash Register Company.

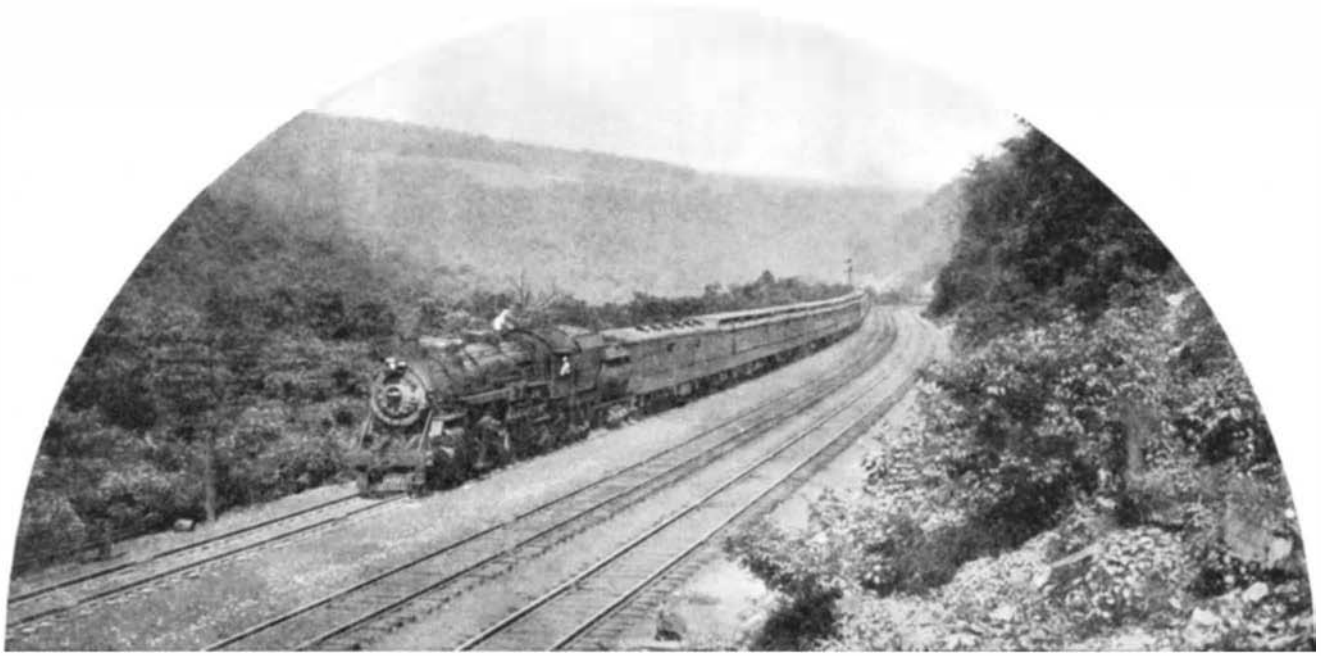
Mr. Macauley was born in Wheeling, West Virginia, in 1872; and was educated in the public schools of Washington, D. C., and at Lehigh and George Washington Universities. He was only 20 years of age when he took his degree of LL.B. from George Washington. For five years he practiced law in Washington, specializing in patent law. He did such a good job of one patent case for the National Cash Register Company that John H. Patterson hired him as the company's patent attorney. He could have become lost in the mazes of patents surrounding cash registers—as intricate as the machine itself—but he didn't. Within three years he had grown out of the patent job entirely and for a time had complete charge of the engineering and development work of the company. In 1901 Mr. Macauley became General Manager of the Burroughs Adding Machine Company, where he faced trying executive problems from the first day.

Directors of the Packard Motor Car Company had been watching the progress of the General Manager of the Burroughs company and in 1910 Mr. Macauley accepted the position of General Manager of the Packard Company. In 1916 he was elected President and General Manager, which position he holds at present as well as that of Director.



THE RED FUSEE IS A SIGNAL TO STOP

AT night, red-burning fusees, sometimes called flares, afford a splendid means of warning to railroad men. The fusee is the counterpart of the torpedo in daylight. They are not, however, used together. The fusee's crimson light is effective on dark and foggy days and in tunnels. Flares are an essential part of the brakeman's equipment, along with his lantern and supply of torpedoes. To protect his train, if necessary, the brakeman lights his fusee and sticks it in the ground or throws it off. The engineer on a train following sees the signal, extinguishes the fusee, and proceeds with caution, having been fully warned of the train ahead



THE EYES AND EARS OF THE RAILROAD

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

WITH a quarter of a million miles of railroad track in this country —enough to circle the globe ten times—thousands and thousands of passenger and freight trains follow, pass and re-pass each other every day. Daily they carry tens of thousands of people and millions of marketable tons from place to place. Is it not amazing, when one stops to think of it, that this enormous activity is carried on with apparent ease, that these trains are all kept on rigid schedules and reach a high average of on-time performance and safety? What is the source of this efficiency?

The answer lies chiefly in the perfection of railway signaling. By night and day, the twinkling lights the traveler sees along the route and shining in the yards, are so many faithful guides to guard the path of each train.

The modern complex art of railway signaling, in which the swift, sure power of electricity is taking a more and more prominent rôle, had its beginnings in the necessity for avoiding confusion and collisions in freight and passenger traffic and in the desirability of giving certain trains precedence over others. One of the first major developments, applicable on a large scale, was the manual block system, the chief principles of which are still in use. The lines of the railroad are divided into sections, or blocks, each section protected by signals, and the operators, located in strategically placed stations, control the necessary signals by hand through the manipulation of levers. Such signals are usually of the semaphore type and are operated in three positions: Horizontal —means "STOP"; Diagonal—conveys the message, "CAUTION"; Vertical—the way is "CLEAR."

The manual block system does not permit a passenger train to enter a block that is occupied, and no other train is allowed to enter a block occupied by a passenger train. A freight train, however, where the rule provides, may follow another freight train, but the diagonal position or the "proceed with caution" signal is then displayed.

A torpedo is clamped to the rail and is detonated by the locomotive

The blocking operations are handled independently between adjacent stations (see manual block system diagram). Station B gives information to stations A and C; stations B and D are notified by station C. When a train approaches station A, it is not permitted to pass toward station B until communication is made between stations A and B, when the word is passed along that the block is clear of trains coming from the opposite direction.

UNDER the manual block system, the issuance of many train orders, accompanied by "Form A" clearance cards, is necessary. The uses of these are too numerous and involved to recount here, but one example may be stated by way of illustration. In this case a meeting point is to be fixed by train order. Train No. 1 and train No. 2, let us say, are approaching from opposite directions on a single stretch of track. Where are they to meet? The answer is given to the engineers and conductors through train orders at a telegraph station advising them that they are to meet at intermediate non-telegraph station B. When train No. 1 arrives at station A and No. 2 arrives at station C, they are again reminded by a train order that they are to meet at the middle station B. The signals at stations A and C, however, are at

The Baltimore and Ohio Railroad Co.
CLEARANCE CARD
FORM A.

a Station Aug 1st 1930
Conductor and Engineman No 2

(X) 1. I have no orders for ..... Have been delivered and there are no further orders for
2. Orders Nos. 10
3. Proceed. Block is Clear to B
(X) Preceding train ..... Departed at ..... M.
(X) All trains due at ..... M. have arrived and departed except .....

(B) Signal is at stop for train No 2 to meet 1 at B order.....
..... at ..... order.....
..... at ..... order.....

(X) ..... may ..... out. Proceed as per line 3, part (A).
(X) Signal is inoperative. Proceed as per line 3, part (A).
(X) Unable to communicate. Proceed at restricted speed.
(X) Unable to ascertain the arrival of preceding train. Proceed at restricted speed.
(X) Train ..... has arrived at ..... Correctly repeated. Proceed.

Time 2.10 P. M. Smith Signalman

EXPLANATION OF USE
(A) 1. To clear a train for which there are no orders.
2. To clear a train for which there are orders.
3. If block is clear insert the word "clear;" if not clear, the word "occupied." (An occupied block necessitates running at restricted speed.)
4. Time block.
5. Notification of the arrival and departure of trains.
(B) For trains meeting at intermediate closed block, non-telegraph and advance sidings.
(U) For trains moving from sidings.
(S) When signal is inoperative.
(Y) When unable to communicate.
(Q) When unable to ascertain the arrival of the preceding train. Rule 110 (C).
(Z) Maintain absolute block behind trains carrying passengers.
Manifold copies of this form must be written for the conductor, engineman and signalman. The signalman must mark "X" across each unused lettered part.
This form does not supersede or annul any train order, nor confer superiority.

A clearance card is necessary for use with the manual block system

"stop," in accordance with railroad rules for train order stations, and trains cannot pass these signals without being authorized by a "Form A" clearance card. The engineers and conductors are therefore supplied with clearance cards, at stations A and C respectively, stating that certain orders have been delivered to them, that there are no further orders, and that they may now proceed, the block being clear to station B, their meeting point.

While the manual block system provides protection, it is supplemented and improved by the next step in the evolution of train operation by signals—the automatic block signaling system, which has the added advantage of detecting, electrically, such things as a broken rail, a car in a siding but too near the main track, a switch not properly closed, and other accidental hazards that formerly could not be discovered ahead of time. This ingenious invention is superimposed on the manual system, as shown in the automatic block signaling system diagram. Closer train movements are allowed because trains *following* one another are spaced *automatically*; that is, through contact of the locomotive wheels with certain electrical connections in the track. Trains moving in the *opposite* direction, however, are protected by the manual block system, although the automatic system acts as a check on the former, giving double assurance of safety.

For the operation of trains on a single track, there has been invented another

All illustrations courtesy Baltimore and Ohio Railroad

The manually operated lantern target signal switch is a familiar sight to all

system, styled the controlled manual block (see diagram). When trains are scheduled to meet on a single stretch of track, one of them must, of course, go on a siding to let the other pass. The engineer knows whether or not he is to go on the siding by the rules governing the superiority of trains, some of which are allowed precedence over others, or he may receive train orders to tell him what to do. But under the controlled system he is governed entirely by signal indication and train superiority is cancelled. This is made possible because the towerman can himself control passing siding switches instead of depending upon someone else to throw them as under the ordinary manual block system. These passing siding switches, even though in some instances a mile from the central control or block office, are electrically operated by motor-driven apparatus controlled from the tower.

The controlled manual block system diagram shows the siding switch thrown and the signal properly set for the westbound train to enter the siding, while the eastbound train may advance as far as the "stop" signal east of the block office. Here it is held until the opposing train has entered the siding and the switch has been thrown back to allow traffic to proceed again over the main single track.

A tower-operated mechanical lantern dwarf signal is easily seen by engineer

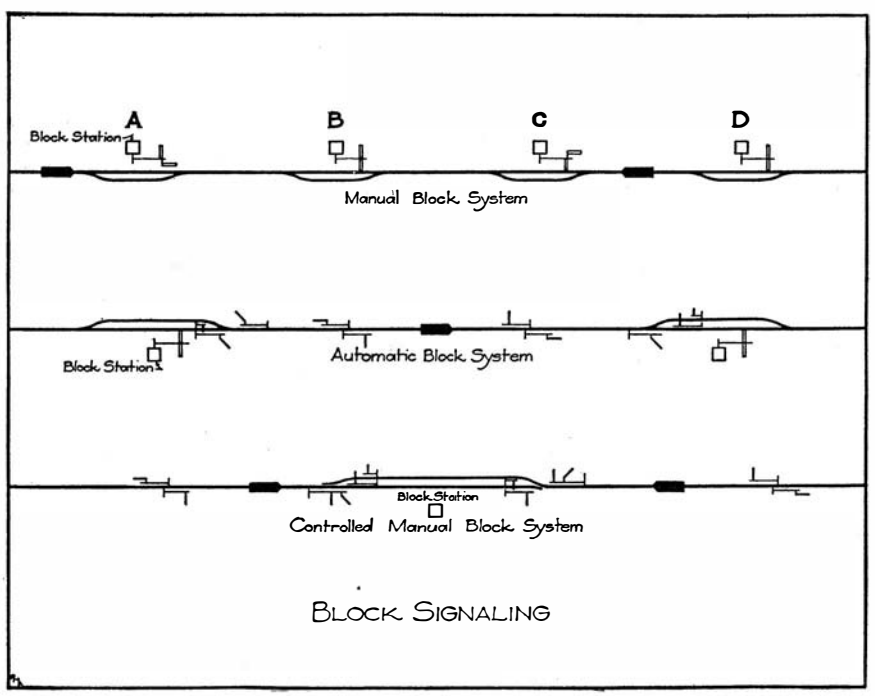
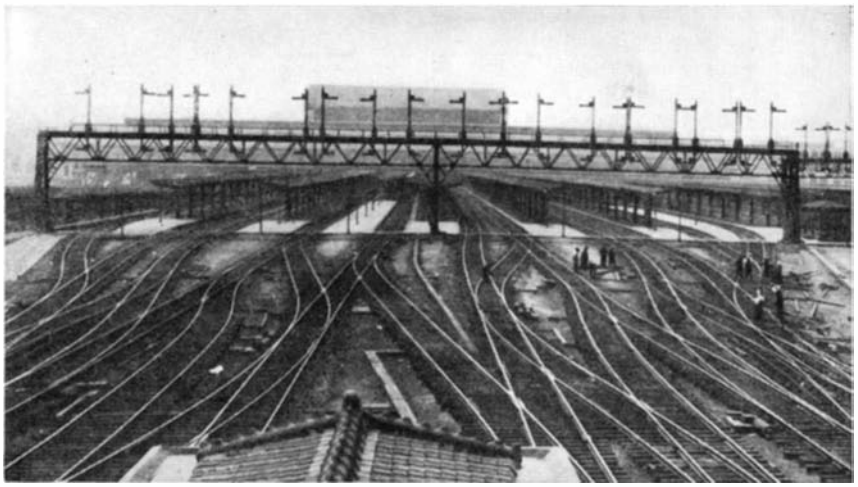


Diagram of the manual, automatic, and controlled manual block signals

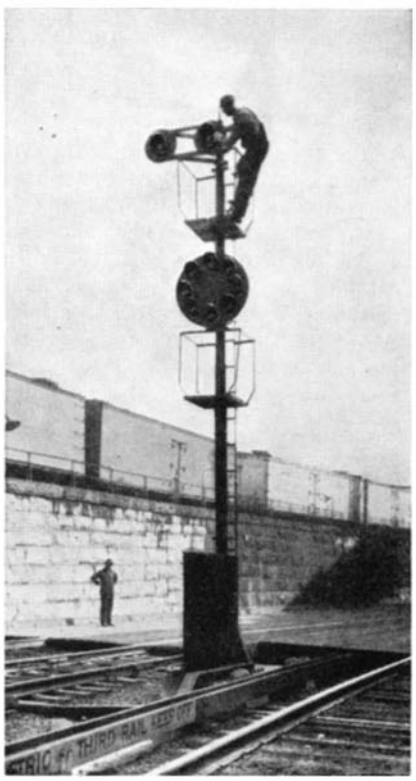
Outside the passing siding limits, that is, the single track section extending from the double track at one station to the double track at the next station, dual protection is provided for opposing directions. First, electrical connections in the control circuits are so arranged that the operator can not manipulate the controlling machine levers to permit reversal of traffic until all track circuits throughout the single track section are unoccupied, all hand operated switches closed, and an unlock given by the towerman at the next station. This "interlocking" of signals through the use of electrical instruments is one of the most important safety features in modern signaling. Secondly, when the route is set in one direction, signals for trains coming from the other direction are caused to indicate "stop." Protection is therefore provided both by means of traffic locking and through the automatic signal.



Signal bridge, Washington terminal, where incoming trains receive final signals and outgoing engines signaled to proceed. Interlocking station is in foreground

THE telegraphers in the towers handle directly the interlocking machines controlling the switches and signals for single or lap passing sidings, and work under the supervision of the dispatcher. The term "lap" is used where two sidings, one located on one side of the main track and one on the other side, overlap each other so as to permit two trains to pass in opposing directions without stopping. Automatically, the approach of trains is announced to the respective towermen, who inform the dispatcher. This operation does not require more than 15 or 20 seconds. Then the dispatcher directs whether the train shall be permitted to advance onto the main track or take a siding; if the latter, the switch is thrown, the signal set and the train is not brought to a stop until the last car of it is clear of the main track. The operator closes the main switch and other trains are signaled to pass. But if the dispatcher gives the word for the train to stay on the main track, the towerman, co-operating with the next station, sets the route, clears the signal or signals, and the train continues on its way at normal rate of speed.

An electric dwarf signal with eight lights can give many instructions



The signal maintainer is cleaning the lenses of a color position signal

The engineer protected by interlocking systems gets his orders to leave the Washington terminal

In large passenger terminals, a great many signals are concentrated in a comparatively small area, and the result is a highly involved pattern of switches, tracks, and signals which appear hopelessly interwoven and baffling to one unacquainted with the mechanical intricacy of the terminal.

Consider Union Station, at Washington, D. C., for example. The Washington terminal property covers a ground area of over 18 acres, includes 60 miles of track, and an interlocking network of signals and switches requiring the use of over a million feet of electric wiring. The track arrangement entering from the North consists of three double track lines converging at the New York Avenue interlocking plant and diverging into ten parallel tracks which run through to the point where they again diverge to 32 station tracks at the K Street interlocking plant.

Trains on all these tracks are operated by signal indication and without train orders, or superiority rights. Each track is operated in both directions. This is made possible through the use of interlocking machines designed to safeguard every movement by apparatus interconnected so as to compel proper sequence of manipulation controlling the many switches and signals. Each lever is electrically governed to insure correspondence between itself and the apparatus it controls.

A MAJORITY of the scores of trains entering the terminal daily are turned on "Y" tracks and backed into any one of the 32 tracks in the station. During this operation, four large interlocking towers are passed; an 80-lever all-electric plant at 12th Street; an 88-lever all-electric plant at Rhode Island Avenue; a 71-lever electro-pneumatic plant at New York Avenue; and a 191-lever electro-pneumatic plant at K Street.

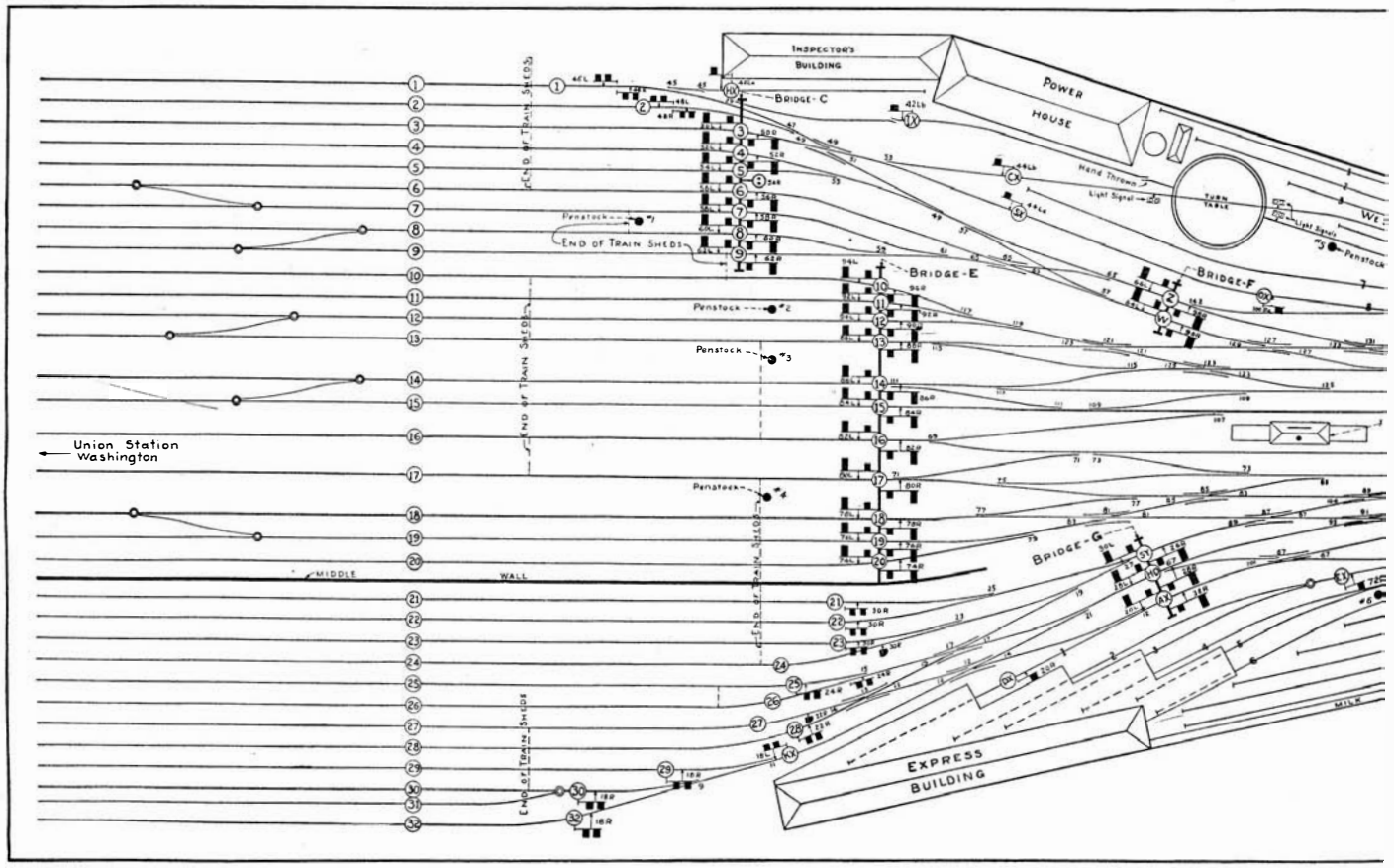
Tower K is the largest control plant in the terminal. To aid the train operators and the levermen in their important work, a large illuminated track chart, supported on one wall, shows by the extinguishing of lights the exact location of all trains approaching or those within the interlocking limits. Above the heads of the train directors are numerous miniature signals; tiny semaphores, indicating the close proximity of trains approaching the plant; numbered circles, giving immediate information as to the starting of trains from the station; and four large circular dials registering the passage of a train from K tower to the other towers and the destination of the train. Through this elaborate system, no matter what track a train is on, it can be led onto any other track.

The hand or flag is moved the same as lantern. Here the signal is "Stop"

Picture yourself, for example, on one of the trains nearing the terminal. The tower train directors are informed of the approach of the train and its routing is planned. Assuming that it will be received on track 34 (see extreme upper right of K-interlocking diagram) but is to occupy station track 32 (extreme lower left), the director calls route US at Bridge J to shed-track 32 and gives the lever combinations 171-169-167-165-163-97-95-93-91-21-14-170L. Taking the opposite direction, if a train is reported ready to leave track 1 (extreme upper left in diagram) to move to track 43 (extreme lower right) the director orders the route set and calls combinations 49-133-135-137-139-185-187-189. In both cases, the governing signal or signals will properly indicate the desired route and all switches in advance of the train will be electrically locked until the last car has passed.

ONE of the most interesting developments in the mechanics of signaling is the color-position-light block signal, first employed on the Baltimore and Ohio Railroad six years ago and now in use on over 400 miles of road.

These signal lights, which can be seen clearly in the daytime through the improvement in electric lighting, instruct engineers and trainmen unmistakably by color and the position of lights on the circular dial what they are to do or not do. Vertical green indicates



At the Washington terminal the trains enter the yard at the right and are passed

two or more blocks ahead of the train are clear. Diagonal yellow, from right to left, tells the engineer that the immediate block is clear but the second block ahead is not clear and that he must "proceed, prepared to stop at next signal." Diagonal lunar white (white with a bluish tinge) from left to right, gives the word, "permissive," or "proceed with caution." Horizontal red says, "stop." The first color-position-light signal was the joint invention of the late signal engineer of the Baltimore and Ohio Railroad, Frank P. Patenall, and his first assistant, George H. Dryden, who is now signal engineer.

The increasing use of the color-position-light signal is attributed to several important advantages it has over the semaphore. These signals are controlled by continuous track circuits, that is, electrical connections with the tracks are so arranged that the passing of a locomotive over a signal zone automatically and instantly sets the lights.

Supplementing the signals for general operation are the hand, flag, and lamp signals. Consider, as an example, the picturesque sign language of the lantern or lamp. When the trainman swings his lantern across the track, it means "stop." Held horizontally at arm's length when the train is moving, the lantern says to the engineer, "reduce speed"; or in the same position, when the train is standing, sends the message, "ready to leave." Raised and

Trainman signaling "Stop" with flag. Night signal on opposite page

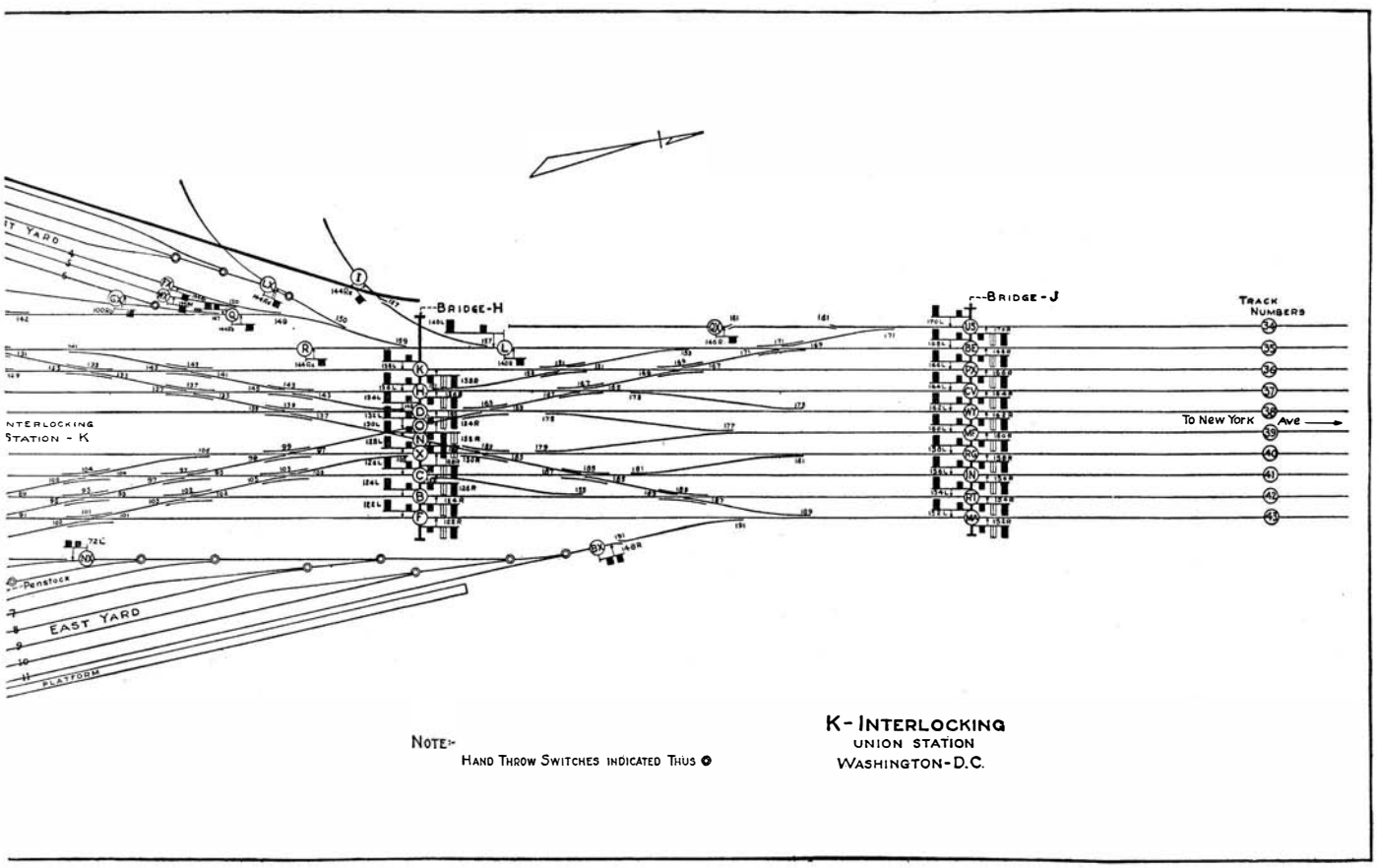
lowered vertically, the word is flashed to "proceed." Swung vertically in a circle at half-arm's length across the track when the train is standing, the signal is to "back." But when the train is running and the lantern is swung in a circle at arm's length across the track, the code of the railroad tells the engineer that "the train has parted." If the trainman swings his lantern horizontally above his head when the train is standing, the engineer is told to "apply the air brakes." When the lantern is held at arm's length above the head while the train is standing, the message to the engineer means "release the air brakes." The flag or the hand, used in these ways, conveys the same messages as the lantern. Another signal recognized by all engineers is an informal but very familiar and urgent one, and it is not necessary to be a railroad man to give it. When the engineer sees someone waving any object violently on or near the track, it means to "stop."

THESE signs are for the eye, but there is another means of communication in railroad signaldom which appeals to a different sense. There has been developed an ingenious system of sound signals, using the locomotive's vociferous whistle. To the uninitiated, these blasts are unintelligible. Apparently, they are sounded at random, but in reality every series of whistles has a meaning, and to these shrill messages every railroad man within earshot listens subconsciously and understands them.

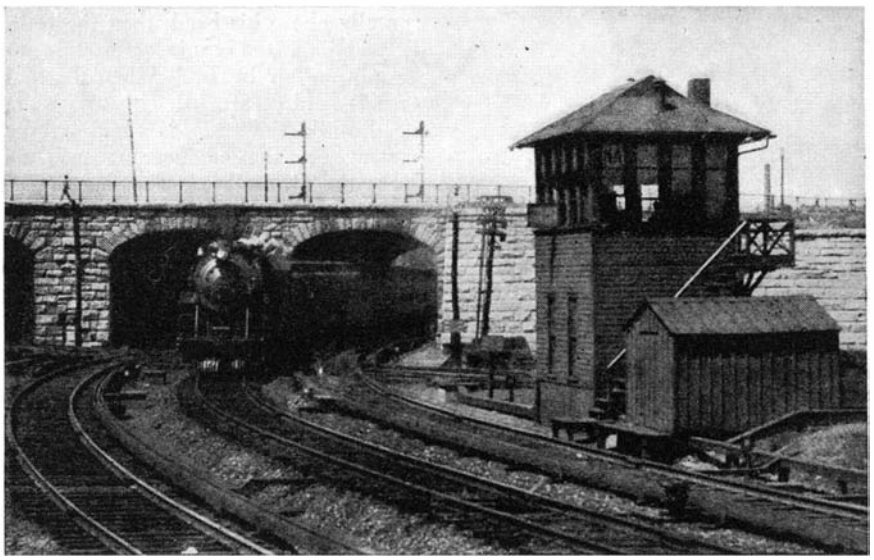
For the benefit of those who have listened to the language of the locomotive and felt curious to understand what it says, these are the messages that come from its steel throat:

One short: apply brakes. Stop.

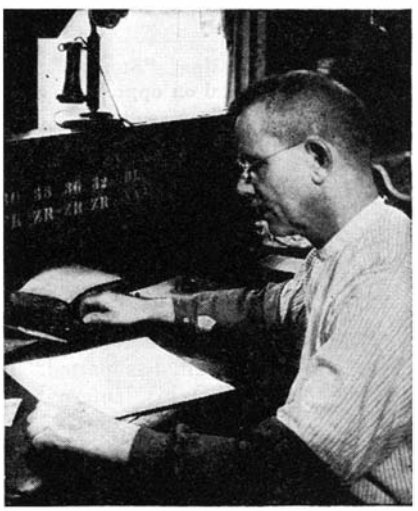
Two long: release brakes. Proceed.



to the train shed at left by signals on bridges all controlled by interlocking



Above: **Train passing a tower at Baltimore. Nearby signals and switches are controlled from tower.** *Right:* **A tower operator on duty**



One long, three shorts: flagman protect rear of train.

Three shorts, one long: flagman protect front of train.

Four long: flagman may return from West or South, as case may be.

Four long, two shorts: flagman may return from West or South, under certain conditions.

Five long: flagman may return from East or North, as case may be.

Five long, two shorts: flagman may return from East or North, under certain conditions.

Three long: when running, train parted; to be repeated until answered by the trainman's signal.

Two shorts: answer to any signal not otherwise provided for.

Three shorts: when train is standing, back.

Four shorts: call for signals.

One long, two shorts: to call the attention of yard engines, extra trains, or trains of the same class or inferior right to signals displayed for a following section. Also to be given when passing track or bridge gangs.

Two long, two shorts: approaching public crossings at grade.

One long, continuous whistle: approaching stations, junctions, and railroad crossings at grade.

One short, one long: inspect train line for leak.

Succession of short sounds: alarm for persons or live stock on the track.

Two shorts, one long: answer to flagman's stop signal.

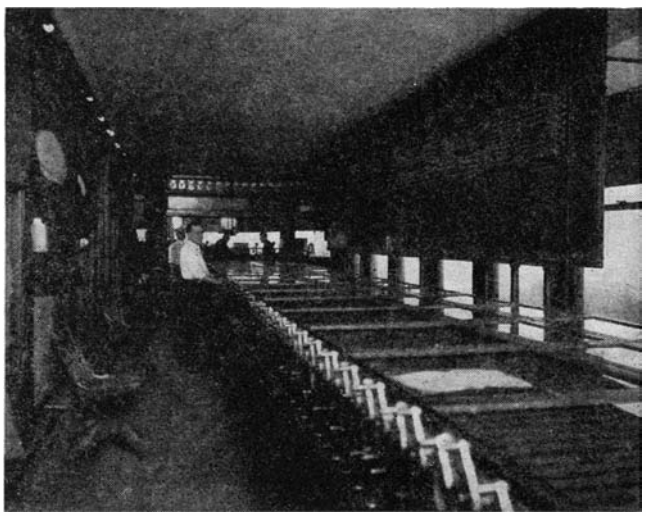
THE ringing of the locomotive's bell, which tolls a warning in the yards and on the right-of-way, might also be called part of the signal system.

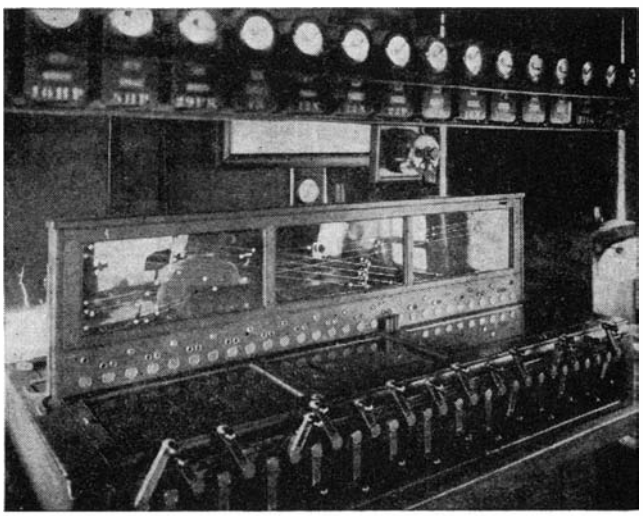
The torpedo plays a loud and efficient part in sound signaling. The explosion of two torpedoes is a sharp warning to reduce speed and look out for a train ahead or obstruction. The explosion of one torpedo will indicate the same as two, although the use of two is required. Trains move with caution after torpedo explosions until a signal is received that the way is clear. At night, fusees are sometimes used as signals.

When the conductor wishes to get in touch with the engineer to notify him to stop, to start, to reduce or increase speed, as the case may be, he pulls the bell-cord and passengers hear the familiar "psst-psst" of the signal.

Still another group of signals to be assimilated by railroad men is that which takes in the numerous flag and light displays on the rear-end of a train or the front of a locomotive, or the rear of the tender or caboose. Each color, light, or flag has a different meaning.

All of these carefully worked-out signaling systems and methods have been gradually built up and perfected along with the development of the railroad. The layman might find the various mysteries of the art explained in the railroad's Book of Rules, but when signals are flashing and sounding the railroad man cannot stop to thumb the little book to look up the rules. They must become second nature to him. He has to know the signals by heart, for they are "the eyes and ears of the railroad."





Left: **Levermen in the great tower "K" at the Washington terminal are operating the machine levers of which there are 191. The train directors are in the background.** *Right:* **Electro-pneumatic signal tower, track diagram, and levers**

OUR POINT OF VIEW

An Awakening Due

STRANGE—and inexplicable—how the American people wax enthusiastic over some subject or theory for a while and then promptly forget all about it! Having been most emphatic that we be allowed naval parity with Great Britain and our demands having been granted by the London Conference, we are now apparently willing to drop the subject although we are still far from measuring up to it.

The Navy League showed in a recent analysis that "the Administration proposes to begin building less than 16 percent of our naval deficiency in the fiscal year and, therefore, leaves more than 84 percent of it to be undertaken in the fiscal years 1933 and 1934—or later." The Administration program makes provision for: aircraft carriers, 13,800 tons although allowed by the treaty 55,000 tons; small-gun cruisers, 17,500 tons although allowed 73,000 tons; destroyers, 16,000 tons although allowed 150,000 tons; and submarines, 4,400 tons although allowed 26,000 tons. No provision whatever is made for large-gun cruisers, of which class we are allowed 30,000 tons.

In 1922 at Washington we surrendered an existing superiority in capital ships in order to set an example. From then until 1930 we built but little while other signatory nations built heavily in categories not affected by the Washington Treaty, as shown by the following:

	U.S.	*Gr.Br.*	*Jap.*	*Fr.*	*It.*
Submarines	3	19	35	67	32
Destroyers	0	22	47	48	37
Cruisers (1922 to 1929 only)	8	15	15	8	6

Passage of the 15-cruiser bill by the United States in 1929 gave us at the London Conference in 1930 the support of an authorized fleet of these vessels; we had an ace in hand although on the whole we led from weakness, and our efforts at the Conference almost came to naught. At the rate we have started authorizing the tonnage allowable under the London Treaty, it rather looks as though in 1936, when that treaty expires, we shall be confronted with the problem of leading from a more deplorable weakness than ever before. Already there is a hint that Great Britain may exercise her Treaty right to build more than the tonnage allowable, because of Italy's avowed purpose to build ton for ton with France. If Great Britain does build to keep ahead of this particular race between non-signatory nations, our inconsiderable efforts will be hopelessly eclipsed. Naval limitation by example has been proved absolutely unworkable and that ideal is out of the question; to achieve any results at all, we simply must have not one but several aces in our hand.

In Washington there are a number of men who are supposed to be representatives of the people, but who play politics, squabble among themselves over all manner of trivial things, and ignore major issues. It is about time the people realized that these men are their elected servants in government and as such should see that the nation gets what we have bargained for: naval parity or what-not.

Arthur G. Halfpenny

IN recording the death on February 12 of Mr. Arthur G. Halfpenny, we pay just tribute to a man whose work as Circulation Manager of Scientific American for more than a quarter of a century touched the lives of all our readers. His death was due to heart failure following pneumonia from which he was apparently recovering. For a year or more he had suffered intermittently from heart trouble, grippe, and general weakness but because of his indomitable spirit few realized how ill he was.

Born in County Mayo, Ireland, Mr. Halfpenny early joined the merchant marine and after years on the sea settled in New Zealand where he became a ship's reporter and later held a master's license. Following several years in the English army, he settled in America where he married a New York girl. He learned the magazine circulation business with *Harper's* and 27 years ago became Circulation Manager of Scientific American. He numbered among his friends many men of high rank in the publishing business; and so sound were his principles and judgment that they constantly sought his opinion on matters affecting magazine distribution. During his years with us, his duties held paramount importance in his life as is attested by the sound circulation he built up.

Lopsided Progress

MAN'S primary physical needs are three—food, shelter and clothing. Since the beginning of the Age of Science he has made essentially no gains in the art of clothing himself, modern clothes being about as inefficient as clothes were in the Dark Ages. In the art of sheltering himself from the elements he has made some good gains, though it seems probable that our descendants will regard the houses of our own time with genuine horror. It is in the category of foods that we have made our greatest advances. The largest slice of our food progress is the discovery, not very old, of ways to preserve foodstuffs in seasons and years of plenty, in order to provide a uniform supply in seasons and years of dearth; also ways to move foodstuffs economically from one place to another in order that supply may balance demand. We have practically abolished and forgotten the seasonal aspects of food availability and it is no longer extravagant to have foods out of season.

Most of us accept these advantages over our forefathers as if they had always existed, but it doubtless would prove illuminating if a committee of moderns could drop back into earlier times and send us a report on the food situation. It is a safe guess that the committee would not like the board.

In the science of housing we shall undoubtedly make heavy gains, while in the matter of clothing, unless some miracle alters human nature the indications are that we shall stay in the Dark Ages. But in the art of nourishing our bodies we are moving rapidly along the broad shining road from here to somewhere.

A good example of this rapid advance is described in a short article in the present number, entitled "New Light on Old Foods." Other important developments are in the laboratory stage, and, as soon as they appear to be commercially practicable, they will be described in these pages.

International Affairs

The Soviet Economic Menace

WE have been regaled at length with the danger to our economic position from the Five Year Program of the Soviet government. People, who should be better informed,

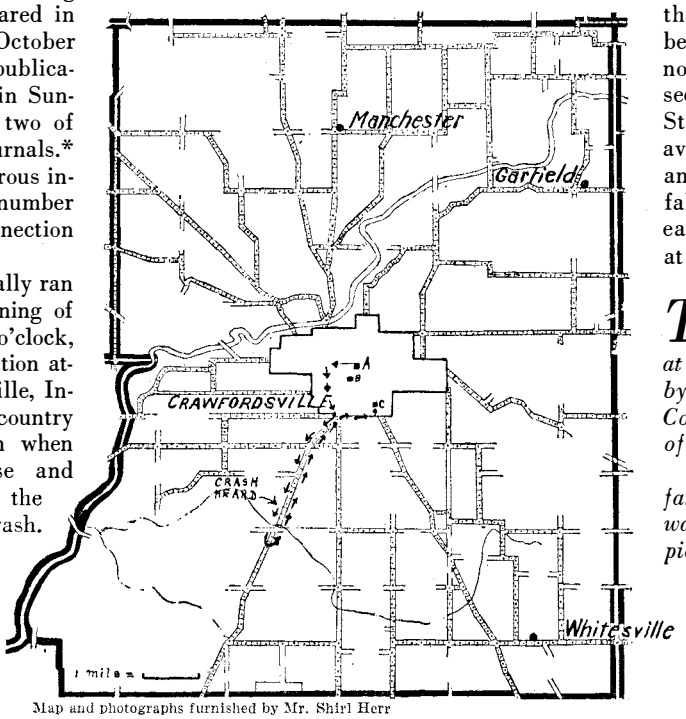
(*Please turn to page* 282)

DID A METEORITE STRIKE THE CRAWFORDSVILLE FORD?

By CHARLES CLAYTON WYLIE
President of Midwest Meteor Association,
Associate Professor in Astronomy, University of Iowa

MANY, if not most, readers of this publication doubtless have seen the recent story of a meteor going through the hood and radiator of a Ford car in Indiana. The account, which has been given nation-wide publicity through many periodicals, was usually accompanied by a picture of the damaged Ford with the owner, Lawrence Swank, standing beside it pointing to the hole. This story appeared in newspaper despatches in October and later in certain weekly publications. It has since appeared in Sunday features and in at least two of the more popular scientific journals.* The writer has received numerous inquiries, perhaps a greater number because he was quoted in connection with some accounts.

As published, the story usually ran about as follows: On the evening of October 10, 1930 at about ten o'clock, Lawrence Swank, a filling station attendent living in Crawfordsville, Indiana, was driving in the country about four miles from town when he heard a whizzing noise and saw a fiery object strike the hood of his car with a crash. He drove the car home, and found embedded in the generator, a piece of stone which was pronounced meteoric by professors at Wabash College. Examination of the pavement showed a dent made by the meteorite, and a farmer living nearby found a strange stone which was also thought to be meteoric. The picture of this stone sometimes accompanied the picture of the Ford, and some illustrations showed a streak of fire passing through the hood and radiator of the car.



Map and photographs furnished by Mr. Shirl Herr

The famous night ride of Lawrence Swank. At *A* is the filling station, at *B* the garage, and at *C* the home of Swank's aunt

AT the request of the writer, Mr. Shirl Herr of Crawfordsville, and Professor G. E. Carscallen of Wabash College, each made a very thorough and careful investigation of this story in an attempt to get at the facts of the case as nearly as possible. They agree that no one questions the veracity of the Swank boy. His story has been checked as carefully as possible, and no reason has been found for doubting that he is telling the truth as nearly as he can recall. There are, however, several inaccuracies in the published account of the happenings.

No whizzing noise was mentioned in the boy's first story. After the meteor version had been suggested, he thought he recalled hearing a humming noise before the crash, but the investigators suspected that this might have been imagination. Accounts of spectacular meteors often include the hearing of a swishing or whistling noise at the time the meteor is seen, but such reports are heavily discounted by the fact that the person who hears the noise usually is in a motor car or in some place where other noises interfere; while the trained observer sitting on a porch where everything is quiet in the same neighborhood hears nothing. Further, real sounds from the meteor, due to the relatively low velocity of sound as compared with light, must be heard after the disappearance, just as thunder is heard after the disappearance of lightning.

No streak of fire was seen by the boy at the time of the crash and no meteor which can be associated with the damage to the Ford has been reported seen by anyone. We may add that, even if the damage had been caused by a meteoric stone, no streak of fire would have been seen passing through the car. Stone meteors disappear at an average height of about 15 miles, and any stones which survive fall from that elevation to the earth as dark bodies invisible at night.

THE piece of stone found under the generator of the car at Crawfordsville was examined by Professor Howell, of Wabash College, and pronounced a piece of Carborundum.

The stone brought in by the farmer and pictured as meteoric was examined and pronounced a piece of cinder.

The striations, or scratches, in the hole in the pavement do not run in the right direction to have been made by a projectile passing through the car.

At the time of the incident the meteor idea did not occur to the boy; this story was started by a man at the garage to which the car was taken.

The inaccuracies are, however, no greater than those commonly found in reports of a real or supposed meteoric fall. Such stories usually are added to, often without intentional dishonesty on the part of anyone. In one case the writer received his first notification of a supposed Iowa fall in the form of a clipping which included the report that he had pronounced meteoric a piece of metal found, of which he had not even heard. In the case of a recent report on a supposedly meteoric fall near Champaign, Illinois, a story received by the writer included a report that professors at the University of Illinois had

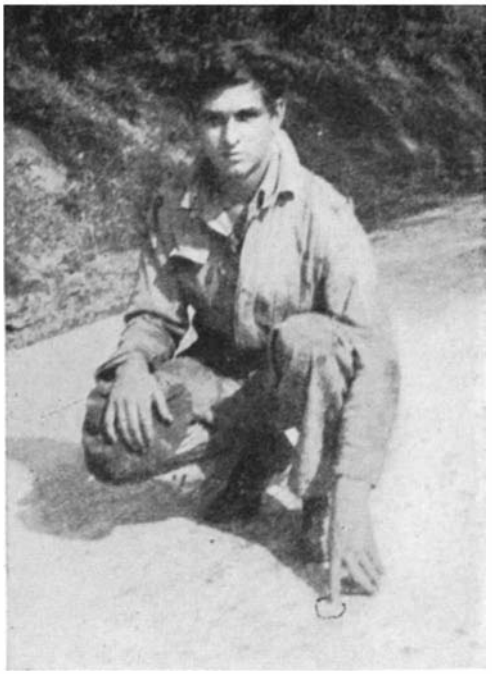
**Popular Science Monthly,* January 1931; *Science and Invention,* February 1931. Feature articles appeared in the *Chicago American,* December 21, 1930 and *New York Journal,* January 3, 1931. An account was published in *The Pathfinder* in November 1930. An account by Mr. Jack Cejnar was submitted to the *Scientific American* in mid-November, rejected on scientific grounds and appeared in *Literary Digest,* November 29.—*The Editor.*

pronounced meteoric a stone found on that occasion, of which they too had not even heard. The inaccuracies are, therefore, only what is found in average reports on such an incident. News writers can not take time to investigate all the details of a story, but the scientific man should. (Incidentally, making such an investigation means that his report must appear long after the story of the news writer has been sent out).

THE correct version of the Crawfordsville incident, from the investigations of Mr. Herr and Professor Carscallen, is about as follows: On the evening in question Lawrence Swank was driving his car at a distance of about three miles from Crawfordsville and in a direction away from town (see sketch map), when he heard what he thought to be the report of a gun. He assumed someone was shooting at him and, being rather badly frightened, he turned around at a point, perhaps a half mile beyond, and drove back to town as fast as he could. He was staying with an aunt and it was at her home that the damage to the car was discovered. The aunt and her daughter saw the holes immediately after his return. The car stood on the street over night and the next morning was driven to the garage from which it had been purchased. *Here was made the first suggestion that the damage was due to a "shooting star".*

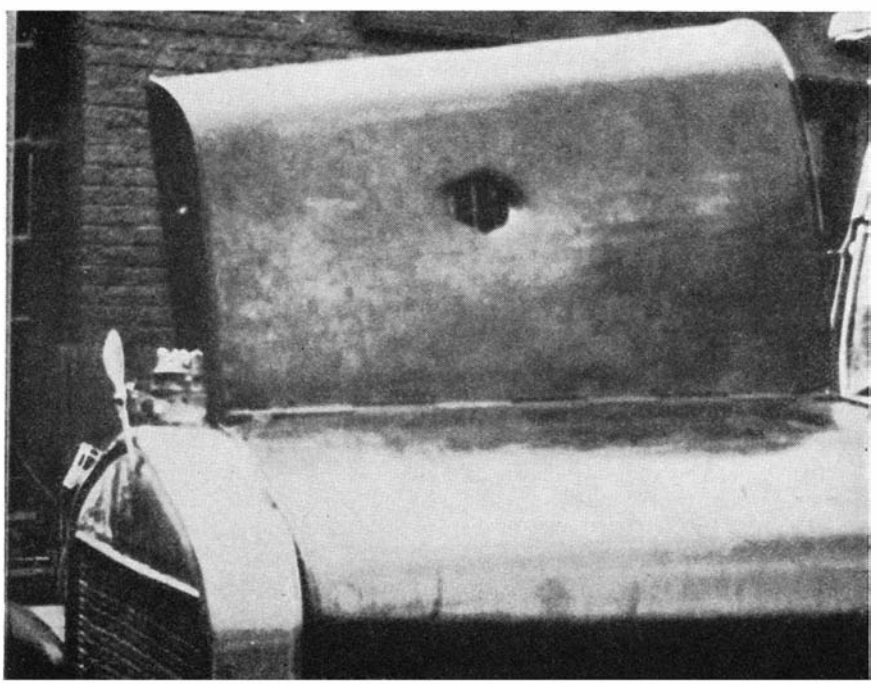
The car was then put on display at the filling station where young Swank was working, and the piece of stone (Carborundum, an artificial product) was discovered under the generator. As there was no other obvious explanation of the incident nearly everyone seems to have accepted the meteor theory; excepting that the Wabash College professors have continued to be skeptical. Some time that forenoon Mr. Herr and others drove out with the Swank boy to the place where he had heard the crash, and a fresh dent found in the pavement *was attributed* to the missile thought to have passed through the car.

In deciding whether or not the damage was caused by a meteor several facts must be considered. First, a meteor large enough for its stones to survive rapid passage through the upper atmosphere and drop to the surface of the earth should have been very brilliant and conspicuous in spite of the moonlight, not merely in Indiana but in the adjoining states. We know the weather was clear on that night, as several fairly bright meteors were seen, one by residents of Crawfordsville, Indiana, and others in Wisconsin, Iowa, and Minnesota. However, there has not been a report on any meteor which can be associated with the damage to the Ford. Professor Carscallen states that the one seen in Crawfordsville can not be so associated, and those seen by residents of the other states were not in Indiana. This fact —that such a meteor was not reported— must be considered strong evidence that there was no such meteor, as many letters generally are received concerning spectacular objects. For instance, a brilliant meteor which fell on the afternoon of Monday, December 8, 1930, not far from Vandalia, Illinois has been reported to us from Iowa, Illinois, Indiana, Kentucky, Tennessee, Arkansas, and Missouri. More than 200 letters have been received concerning it.



Lawrence Swank pointing to the small hole afterward found in the pavement

Again, a meteor which drops stones to the surface of the earth is almost always, if not invariably, accompanied by detonations or explosions usually louder than the most severe thunder. The first blast of a detonating meteor is followed by a roar which crashes back into the distance, and such a noise would not be mistaken for the simple report of a gun. No such blast was heard at Crawfordsville, the only explosion heard being that which young Swank took for the report of a gun. This also must be considered strong evidence against the meteoric theory.



The upper one of the two holes in the car. "The suggestion favored by most persons is that the incident was put across as a clever practical joke"—on Swank

STILL further observation and calculation agree that as meteoric stones approach the earth the direction of fall approaches the vertical, and the velocity approaches a velocity such that the pull of gravity on the stone is balanced by the resistance of the air. Even the large stone of the Paragould fall (SCIENTIFIC AMERICAN, February, 1931) which weighed about 800 pounds, was falling in a practically vertical direction when it struck, although in the upper atmosphere the meteor had been traveling at a very low angle. Where small and large stones are recovered from the same meteor, the evidence is that the smaller stones have dropped even more perpendicularly than the large. A stone small enough to go through the holes in the hood and radiator of the Swank boy's car should certainly have been falling in an almost vertical direction, and should not have had sufficient

velocity to do nearly that damage. The only possible way in which a meteoric stone of that size might have struck at an angle of approximately 45° and with such a velocity would appear to be in case it had fallen attached to a quite large stone until it was very near the surface of the earth, then broken off at that point and, because of its irregular shape at the time of breaking and

Lawrence Swank pointing to the upper hole. Note other hole in radiator. A meteoric stone of this size would normally not penetrate the hood. Despite the high velocity of meteors when seen aloft in flight, small ones quickly slow down on encountering the atmospheric cushion. When the acceleration of gravity is balanced by air resistance they reach a practically uniform "terminal velocity" which is not high. The probable joke played on Swank rebounded to half of the nation, for it can be demonstrated that millions of persons were given the meteor explanation through the combined circulation of the numerous periodicals which accorded publicity to the original account, despite its unscientific earmarks

because of the relatively high velocity at which the large stone was falling, had fallen away at the angle of about 45° and with the velocity at which the big stone was falling. However, such an explanation appears to be quite impossible in connection with the Crawfordsville incident, for a stone nearly as large as the Paragould meteor would have been required, and the detonations accompanying the fall at Paragould, Arkansas were so loud that they awakened sleepers in three states.

FINALLY, a simple computation shows that the chance of a car being struck by a meteorite is exceedingly small. Meteoric falls are now being recovered in the United States at the rate of about one every 16 months, using an average for the past 30 years. We know, however, that only a small fraction of those which fall is now being recovered. From those which fall close enough to farmers working out of doors to be seen it is possible, assuming uniform distribution, to make an estimate of the total number which fall in the United States per year, and a computation just made by the writer indicates that we are recovering not more than 1 percent of the total. On this assumption a meteorite should strike a car somewhere in the United States not oftener than once in 500 years and, in the long run, an authentic report of any sort of damage to a car by a meteorite should appear only once in that number of years.

A peculiar feature of the widespread story is that after hearing the report Swank drove several miles at as high a speed as the car would travel without knowing that anything had struck it. Garage mechanics consider this unusual. With a hole of that size in the radiator one would assume that so much water would immediately be drained out as to heat the engine. This causes us to wonder whether the holes actually were made at that time, or perhaps earlier or later. If made earlier the broken tubes must have been plugged with wax or fixed in some way to prevent the water draining out too rapidly.

Aside from the meteoric theory, the suggestions most commonly made are that the damage was caused by a slug from a shotgun; that a wrench or bolt fell from an airplane; or that the holes were made as a practical joke. If, as Mr. Herr and Professor Carscallen feel, the Swank boy is telling the truth, the slug from the shotgun, at least at the time of the report, is ruled out. No one was in the car with him; and from the direction of the holes a man seated on a tree or telephone pole beside the road could not have caused the damage. A shot from an airplane seems wildly improbable. A wrench or bolt dropped from a high-speed airplane might, in the opinion of the writer, have made the holes, but this appears very unlikely.

The suggestion favored by most persons is that the incident was put across as a clever practical joke. A letter received in November included the comment, "it looks funny, perhaps phoney." The Carborundum obviously was put there as a joke. The holes through hood and radiator, in a line to indicate that the missile had passed close to the head of the driver, are just what one would expect as a joke, although the angle almost rules out stones from a meteor or objects dropped from an airplane. The writer considers a deliberate attempt to put across the meteor story more unlikely than a simple, but premeditated, attempt to frighten young Swank by making him believe some one was shooting at him. Perhaps two friends who knew he was planning a drive in the country after work, rammed the holes, and partially plugged the broken tubes in the radiator. When, as they had hoped, he drove away without noticing the damage, he was followed and a gun was fired.

THE meteoric theory was advanced, and has been accepted by many, merely because no other suggestion appears probable; but this very natural but illogical form of reasoning by exclusion nearly always leads to erroneous conclusions. Workers in the field of meteors and meteorites regularly receive stones which the senders are sure must have fallen from heaven, as "no other explanation is considered possible." But in 99 out of 100 cases these specimens are quickly identified as ordinary terrestrial rock. The meteoric explanation of the Crawfordsville incident must therefore stand or fall on its own merit and the mere improbability of other suggested explanations should have practically no weight in making the decision.

To summarize: A report of damage of any sort to a car by a meteorite should appear not oftener than once in 500 years. Next, only large and spectacular meteors drop stones to the earth. Such meteors are well reported (more than 200 letters on one of December 8, 1930). The fact that, with all the publicity given this incident, we have no reports from persons who saw or heard such a meteor is strong evidence that there was no such meteor. The writer knows of no instance where it has been established that a meteoric stone has fallen at an angle very far from the vertical. A meteoric stone the size of an egg would normally not penetrate the hood of a car. The angle of striking, and the damage done, are therefore, like other points, against the meteoric explanation.

NEW LIGHT ON OLD FOODS

EIGHT and one half years ago it was discovered that ultra-violet rays would convert something in foods into vitamin D, the bone-forming, sunshine-health vitamin. A way has now been found to do the same thing controllably. This is a big advance. Until very recently the artificial methods of equipping foods and pharmaceuticals with vitamin D could not be called controllable. They consisted, as they still do, in irradiating the substances with ultra-violet rays, but not enough attention was given to the wavelength of these rays and some of the results therefore proved to be oddly contradictory. For example, the rays actually destroyed the largest portion of the vitamin they had created. A subsequent event in food science concerns the solution of this puzzle and sends us to the city of Cincinnati.

At about the time the original discovery was made that ultra-violet radiation creates vitamin D, a young student of electrical engineering at the University of Cincinnati, whose name was George Sperti, became interested in the electrical aspects of the production of ultra-violet rays, and from that his interest was diverted to the effects of these rays on the living substance and to other problems in biophysics and biochemistry. What followed not only "reads like a romance" but is one.

THE originative student Sperti soon attracted the attention of Herman Schneider, president of the University, who was a scientifically trained man, and the upshot was that these two agreed there was immediate need of a biophysical laboratory. As there was no such laboratory at the University of Cincinnati and no easier way to acquire one, Sperti took off his coat and cleared the junk and cobwebs out of a small space in an attic and installed one. This did not take long because there was little available apparatus to install. Sperti's motive, and that of President Schneider too, was to test certain ideas concerning the application of some of the laws of physics to living matter—specifically the action of light, which includes in its full scope not only ultra-violet rays but X rays and other forms of radiation, on the living substance.

Sperti did most of the labor, while his superior backed him up with ideas and encouragement. Money was scarce but this situation—the meagerness of material resources and the tiny garret laboratory into which two could scarcely fit themselves at the same time—need arouse no sympathy. Some of the best work in science has been done under similar stress. If you would kill a research worker's initiative, give him every luxury money can buy.

The world soon made the proverbial "beaten path" to Sperti's door because it found he was making a "better mouse-trap" than anyone else. He had already found something decidedly worth looking into. Funds for further research began to move in his direction. Today

Left: **Professor George Sperti who "started something," and, at the right, President Herman Schneider who stood behind him with help and encouragement as he worked**

Sperti is Director of the "Basic Science Research Laboratory," no longer under the rafters, and at 30 is a professor. A quarter of a million dollars has been paid, it is said, for patents on his discovery of the basic principle of the "selective irradiation" of foods.

What had chiefly interested Sperti was the problem of untangling a snarl in ultra-violet wavelengths in connection with organic matter. Different wavelengths seemed to have different effects. The whole range of the ultra-violet could not be lumped together as had been done previously—it must be unscrambled. Many other research workers had approached the same problems but mostly by cut-and-try methods—empirically. Sperti approached it from another direction. He, with President Schneider's help—always generously given—sat down and attempted to think of possible causes lying behind this confusion. They invoked something seldom or never brought to bear on organic matter, the quantum theory.

According to that theory, today virtually a principle in physics, radiant-energy is liberated in separate pieces or "bullets," instead of in a continuous stream. These bullets of light are larger as the wavelength becomes shorter. It requires a bullet of a certain size to produce a given physical effect—for example, to convert a substance into vitamin D—and a larger bullet (shorter wavelength) ought, it seemed theoretically, to undo the same effect. This looked like an explanation of the strange making and unmaking effect of ultra-violet rays on vitamin D. The longer waves were making the vitamin, the shorter ones were unmaking it. The answer which Sperti worked out was to isolate and use the ultra-violet waves of a certain length, 2960 Angström units.

Experiments fully confirmed this form of reasoning, and this is the "selective irradiation" principle for which Sperti received the small fortune—which, by the way, he at once turned over to the University for further basic research in science. If men of science could cultivate the necessary amount of financial dickering instinct to sell some of their basic finds for hard cash and do what Sperti did, it seems possible that larger returns for basic scientific research might be acquired by themselves than are acquired now through the attempt to convince rich men that pottering over laboratory apparatus is likely to bring to light vast new sources of riches if only these men will finance the pottering.

THE University of Cincinnati and the General Foods Corporation, which acquired the patents, organized a joint holding company, and a new laboratory is to be erected at the University from funds accruing to it from the discovery just described and from other discoveries made in the Basic Research Laboratory.

One of these other discoveries is likely to prove as significant as the first. Foods can also be sterilized with light. Milk, for example, can be sterilized. This fact, as such, is not new. For years it has been possible to sterilize milk with ultra-violet rays but it always has had this disadvantage: it spoiled the taste of the milk. It was found by the Cincinnati workers that this effect was due to the inclusion of the wrong wavelengths with the correct ones when the milk was irradiated. But now selective irradiation sterilizes milk without making it unpalatable, and adds vitamin D to it into the bargain. Foods which are not transparent to ultra-violet rays—which means virtually all foods, for the rays do not penetrate most solids—are sterilized with X rays of long wavelength—soft X rays or "Grenz" rays.

It is altogether probable that these advances in food science will begin to affect what you eat within a comparatively short time.

Southern Pacific's 5603-foot double-track bridge across Suisun Bay in California. Costing a total of 12,000,000 dollars, it was completed in the fast time of eighteen months

UNIQUE SOLUTIONS OF BRIDGE

By C. R. HARDING
Assistant to the President, Southern Pacific Company

THREE methods of bridge construction that differ considerably from the practices usually followed were adopted by the contractors who sank the foundation piers and erected the super-structure for Southern Pacific's 5603-foot double-track bridge across Suisun Bay in California.

These unusual features were: 1. Creation of artificial islands of sand on which concrete piers were built in sections above water and gradually sunk to bedrock; 2. Use of a deep-sea diver, as low as 140 feet under water, to examine all pier foundations; 3. Temporary use of one of the permanent deck spans as falsework during construction of the other permanent through truss spans.

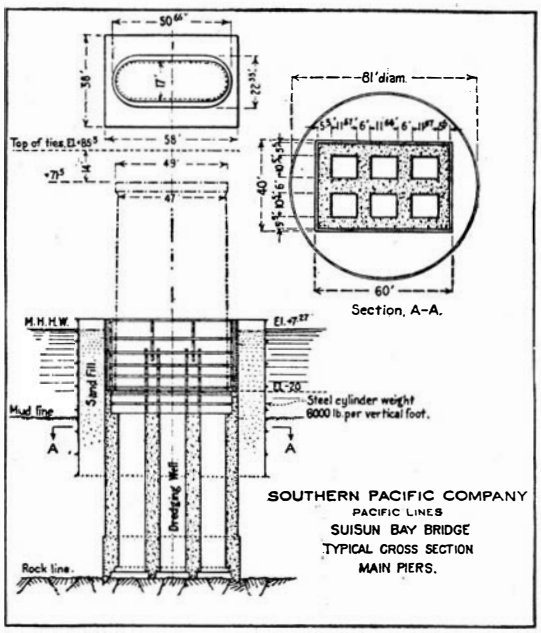
The structure is the longest and heaviest railroad bridge west of the Mississippi and is not exceeded in its load-carrying capacity by any bridge in the country. Its piers are designed to withstand a given intensity of earthquake shock and the span can support the almost incomprehensible weight of a train on each track extending the full length of the bridge, consisting of locomotives and cars twice the maximum weight of a present-day train load.

THIS Martinez-Benicia bridge, as it has been named, is 35 miles from San Francisco, spanning a body of water in the far reaches of San Francisco Bay. Opened for traffic on October 15, 1930 after 18 months of construction, it caused the retirement of the two car-transfer steamers, famous as the largest ferry boats in the world, which had for years been a fascinating phase of transcontinental travel in carrying whole trains across Carquinez Straits between Benicia and Port Costa.

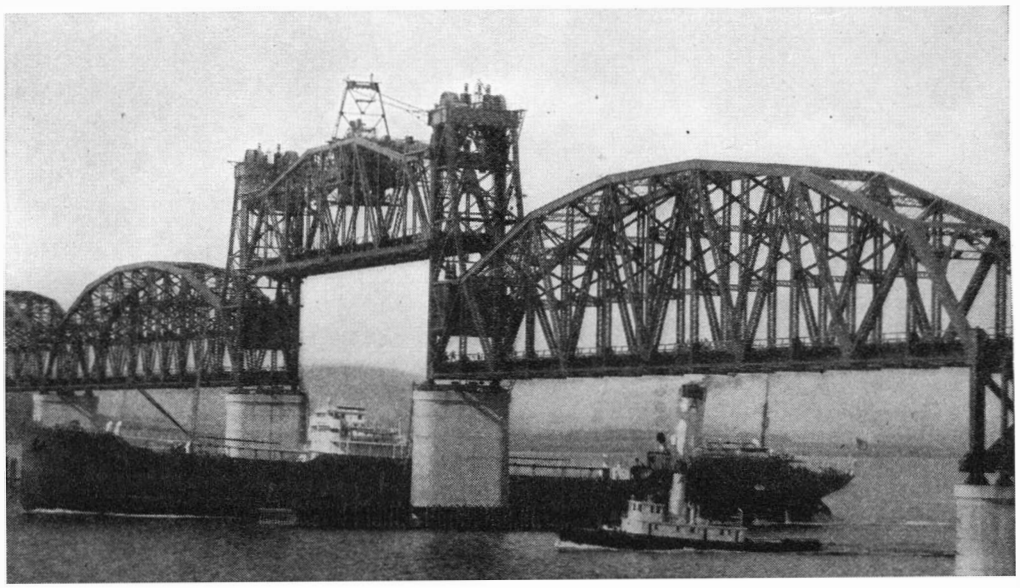
The bridge consists of seven 526-foot through truss spans, two deck spans 264 feet and 504 feet in length, one 328-foot, 1580-ton, through vertical lift span (the heaviest and most massive in the world), and two end viaducts, one 560 feet long and the other 220 feet long. The super-structure rests on 10 main piers and 22 pedestal piers, the deepest of which is 207 feet from bedrock to bridge seat, with a 40 by 60-foot base. The entire bridge project, including six miles of track approaches, cost approximately 12,000,000 dollars.

Construction of that portion of the sub-structure on land followed the usual method of excavating to suitable rock foundation. The viaduct pedestals in water, the maximum submergence not exceeding 13 feet, were constructed by driving cofferdams of Wakefield sheet piling. Two of the deep-water piers were constructed within open cofferdams of interlocking steel piles 65 feet in length, which were driven inside a timber falsework. One of these piers is probably the deepest ever constructed using a cofferdam consisting of a single row of steel sheet piling, the distance from high water to rock foundation being 58 feet.

The bridge engineers faced a difficult problem in constructing the eight piers across the channel where water reached a depth of 55 feet with an underlying stratum of mud, sand, gravel, and clay varying in depth from 60 to 100 feet before bedrock was encountered. Neither the open cofferdam nor pneumatic methods could be used in such depth of water. Also, the sinking of caissons by the open-well dredging method was precluded because the deep water, a maximum tidal fluctuation of about 10 feet, the swiftness of the current during winter floods and at ebb tide, and the softness of underlying deposits, made the launching and sink-



Drawings showing method of construction of the piers



The heaviest lift span in the world, weighing 1580 tons, in the new bridge. The bridge proper has a clearance of 70 feet, but the great lift span can be opened to a clearance of 135 feet in only 85 seconds

CONSTRUCTION PROBLEMS

ing of a timber crib impracticable.

The first step in the unique method adopted involved the driving of 90 110-foot Douglas fir piles, on which was constructed an octagonal wooden platform. Eight equally spaced, 45-foot steel hoisting towers, with winches, were erected on the platform. Under each tower was a steel girder, tied down by steel rods bolted to the piling. Provision was also made on the platform for a stiff-leg derrick with 40-foot mast and 84-foot boom framed with its cross-section diagonal placed vertical.

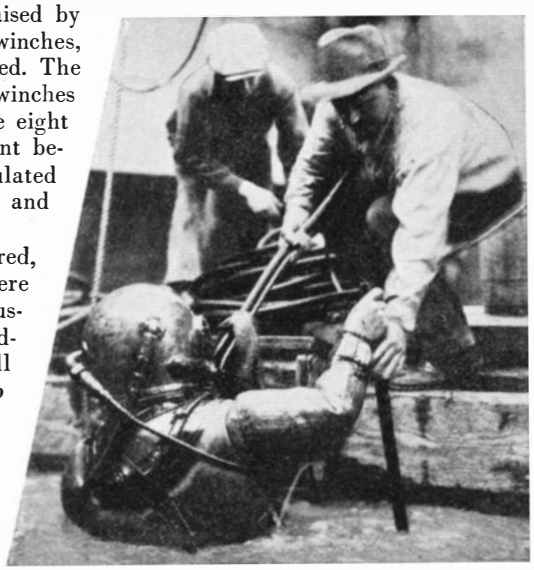
Upon the working platform was then assembled a cylindrical steel shell 81 feet in diameter, of ½-inch plates, reinforced by 6 by 3 inch angles, and laid out in eight segments. The shell was assembled in 10-foot sections upon cribbing, three sections being bolted together as a unit. When the 30-foot unit was completed it was suspended from the eight steel towers, being raised by blocks and tackles to hand winches, while the cribbing was removed. The shell was then lowered by the winches operating simultaneously at the eight towers, the downward movement being carefully watched and regulated so as to keep the shell level and perpendicular at all times.

When the first unit was lowered, the inside ends of the girders were bolted to the shell and the suspension cables were removed. Additional 30-foot units of the shell were assembled, then bolted to the previous unit, and the lowering operation repeated. This procedure was continued until the shell had sunk into the mud and sand a sufficient distance to be self-supporting. Jetting and dredging assisted in sinking the shell to greater depth. Removable trusses 60 by 40 feet long braced the inside of the shell horizontally to prevent distortion or collapse while being lowered. When the shell was settled these trusses were unbolted by a diver and removed.

The shell was then filled to mean low water level with sand dredged from a point one-half mile upstream, barged to the pier site and unloaded by clamshells. Approximately 9500 cubic yards of sand were required. The top of the sand was leveled with clamshell buckets and by jetting, after which the cylinder was unwatered to a depth of about 12 feet below high water.

Upon this artificial island was then laid out the steel cutting edge of the caisson that was to be sunk to rock. Walls six feet thick divided the caisson into six dredging wells each 11 feet 8 inches by 10 feet 6 inches. Removable steel forms were used for the outside of the caisson above the cutting edge and for the dredging wells, they being loosened and raised by derrick for each successive pouring of concrete.

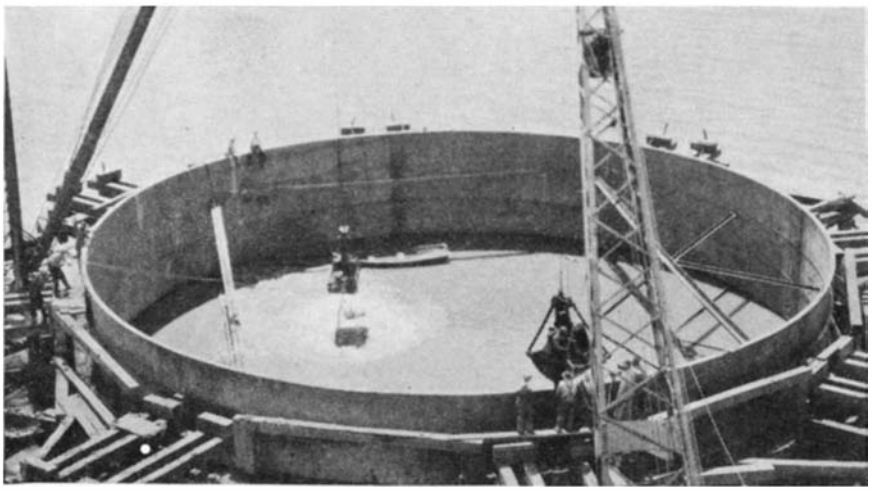
After the reinforcing steel had been placed, the first 15-foot lift of concrete was poured. Successive lifts were 10 feet in height. All of this work was done above water and enabled the working crews to pour concrete of desired quality and strength; it also permitted them accurately to center and orient the concrete mass as it settled toward bedrock.

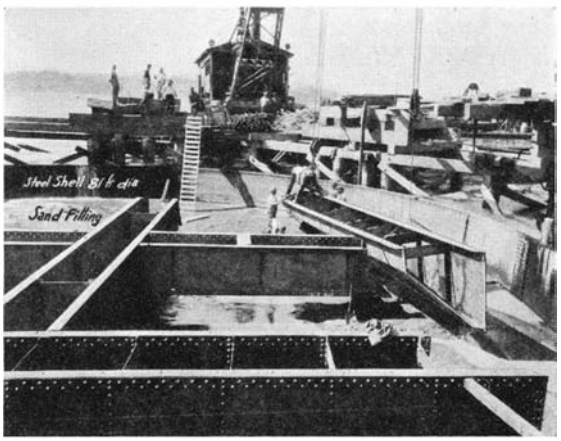


The deep-sea diver who was used to inspect all pier foundations under water

WHEN 35 feet of the caisson had been poured, clamshell excavators operated from floating derrick barges began the removal of sand from the six dredging wells, permitting the caisson to sink gradually under its own weight. Extreme care was taken in the dredging to keep the caisson level, check measurements being made about every two hours during the sinking operations.

At the time of starting the concrete caisson, four test borings were made on the longitudinal and transverse axes of the shell by means of which the exact elevation of the bedrock was determined at four points conforming to the four sides of the caisson. This information determined the proper height of the caisson prior to sinking and the elevation at which to commence the construction of a timber cofferdam that extended from elevation −20 to well above high water. The cofferdam was later used in pouring the distribution block and in erecting the pier shaft from a depth 30 feet below high water. Reduction from the large section of the caisson to the





Above: **Steel shell, 81 feet in diameter, sunk into mud and filled with sand to form an island on which to construct the caissons.** ***At right:*** **Construction of a caisson, showing the end of one of the cutting edges**

smaller section of the pier shaft effected a saving in the amount of concrete used and created a temporary bridge seat or shelf that was later used to support the steel bents of a falsework bridge span.

When the caisson was landed at or near bedrock, and after the greater part of the material immediately above bedrock had been removed by hydraulic jetting and clamshell excavation, a deep-sea diver was sent down one of the dredging wells to explore the bottom. He telephoned the conditions existing within and under the caisson, which enabled the contractors to direct jetting operations accurately so that the foundation area was put in a clean condition. The diver gave accurate information as to the penetration of the cutting edge of the caisson into the foundation rock and brought to the surface samples of rock encountered, which furnished helpful information. The inspections assured that the bridge piers were actually resting on bedrock, that the full bearing had been secured, and that an interlocked connection was established between the steel cutting edge and foundation rock. It is believed this is the first time that a deep-sea diver has been used at such great depth of water in open-caisson work.

THE foundation was then sealed by depositing tremie concrete through the water in the dredging well by means of a 10-inch pipe to a depth of about 30 feet. When the concrete had set, the remainder of the dredging well was unwatered. A thin covering of mud and laitance was then removed from the surface of the concrete and pouring was resumed in the dry. The six wells were filled in succession. The next step was to pour the distributing block—a huge mass of reinforced concrete 10 feet thick, 50 feet long and 33 feet wide—after which the pier was completed by the pouring of the pier shaft to bridge-seat elevation in 10-foot lifts, using wooden forms held in position by being bolted to the concrete section immediately below the one being poured.

Another unique feature of construction was involved in erecting the steel spans in the super-structure. Various methods were considered, but it was not deemed possible successfully and economically to use timber piling owing to the depth of water, softness of mud, water current, and height of piers above water. It was finally decided to use one of the steel deck spans as falsework for the erection of the other spans. This span finally took its place as the most northerly span in the bridge. It was erected on piling sunk in the shallow water at the south end of the bridge, and on completion was floated on two steel barges to a position between the first two deep-water piers. The span was brought to rest on shoulders of each pier which had been provided for in construction at elevation –20. When in position, the falsework span had its top chords at an elevation permitting the laying of erecting tracks and the placing of the blocking upon which the permanent span was erected. The falsework span was floated between successive piers as the work progressed.

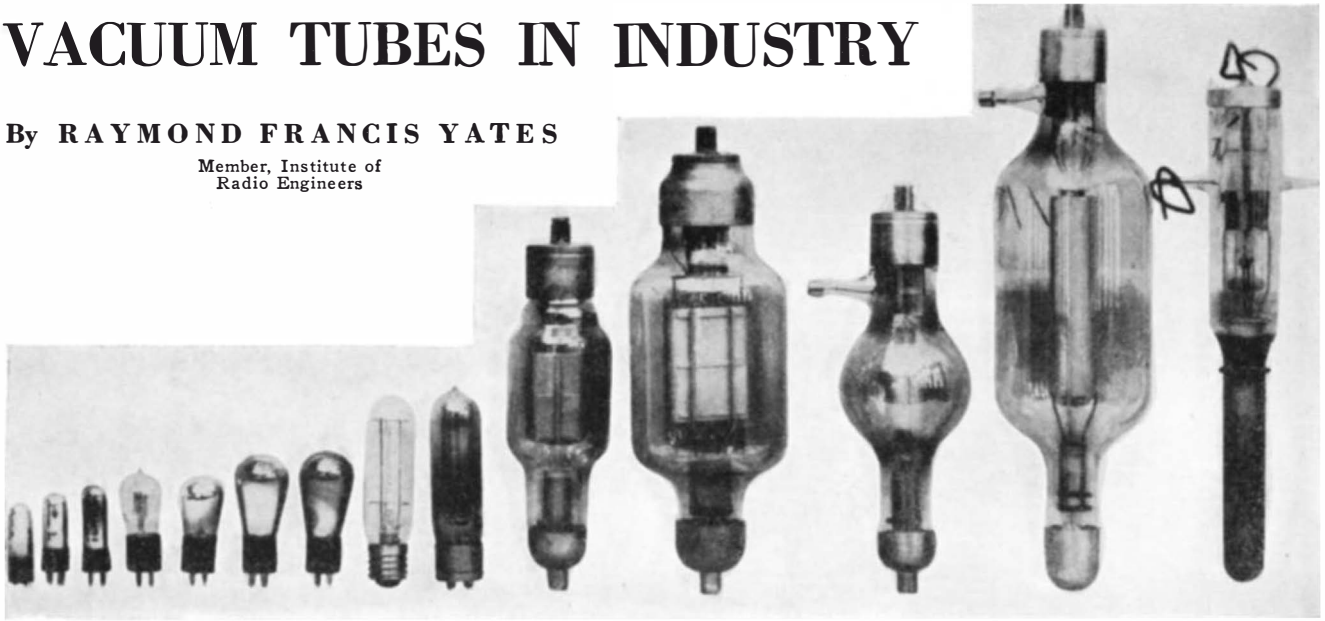
THE contractors and engineers of the railroad were highly pleased with the result of the unusual construction methods. The particular advantages were that concrete was placed in the dry; no timber was left in the pier; reinforcing steel could be properly set; and the work was carefully inspected at all times, insuring the highest grade of reinforced concrete in the piers. Labor, material, and time were saved in using the deck span as falsework, instead of attempting to use piling.

Total weight of steel in the superstructure of the bridge is 44,000,000 pounds, including 25,000,000 pounds of silicon steel, 5,500,000 pounds of heat-treated eyebars, and the remainder of carbon steel. The piers required 105,000 cubic yards of concrete and 1500 tons of reinforcing steel. An average clearance of 70 feet is provided. The 1580-ton lift span can be raised to a clearance of 135 feet in 85 seconds.

Deck span being floated into position between piers. It served as falsework for construction of the permanent through truss spans between each pair of piers

VACUUM TUBES IN INDUSTRY

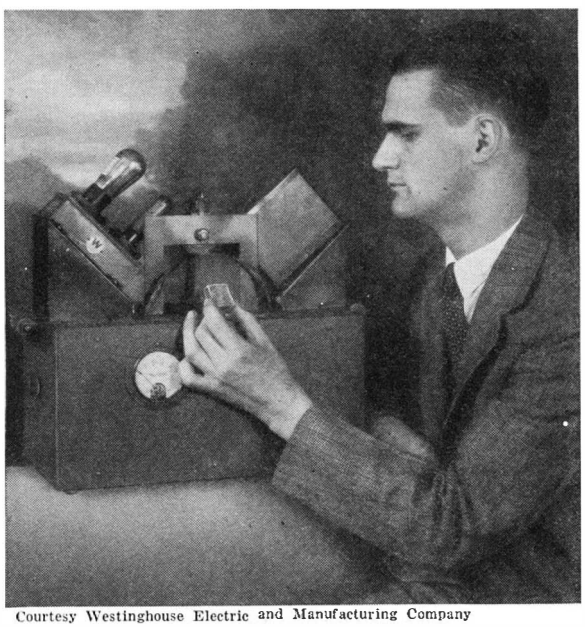
By RAYMOND FRANCIS YATES
Member, Institute of Radio Engineers



DURING the past five years the vast amount of research work done by radio physicists has resulted in the successful application of vacuum tubes to highly diversified industries; the manufacture of glass, wire, steel products, cigars, chemicals, paper, and canned goods are but a few of the industrial arts that have been greatly aided by the flow of electron streams made sensitive to light, to changes in capacity, and to sound. Although the science of vacuum tubes is still young, it has asserted itself and we now find that they have been taught to do no less than 200 chores that lie outside the quite ordinary job of radio transmission and reception.

Electronic control involves the use of three different types of tubes: the ordinary amplifying vacuum tube such as that employed in radio receivers, the photo-electric cell, and the grid-glow tube. The first mentioned is always used to amplify the effects of the latter two, although it is also used independently in many instances in detecting small effects and measuring small distances.

In a way, these devices operate to supplant the human sense organs; the detecting and amplifying tube is capable of "hearing," the photo-electric cell is capable of "seeing," and the grid-glow tube is capable of "feeling." In each case, the devices are far more sensitive and more accurate than the human senses which they are being called upon to replace. We shall be more greatly impressed by this fact when we learn that an electron tube has been found capable of measuring a current of only 63 electrons a second. This infinitesimal whiff of energy amounts to only 10^{-17} amperes. Even the human eye is not sensitive enough to detect this small amount of energy should it be translated into terms of light. What is more, even though electronic devices are capable of detecting and measuring these extremely small effects, they operate with surprising stability and reliability. Little wonder that so many things have been found for them to do. Still greater will be the wonder, if our physicists and engineers do not find many other things for them to do within the course of the next few years.



Courtesy Westinghouse Electric and Manufacturing Company

The photo-electric cell in this unit "spots" unwrapped yeast cakes, whereupon they are removed

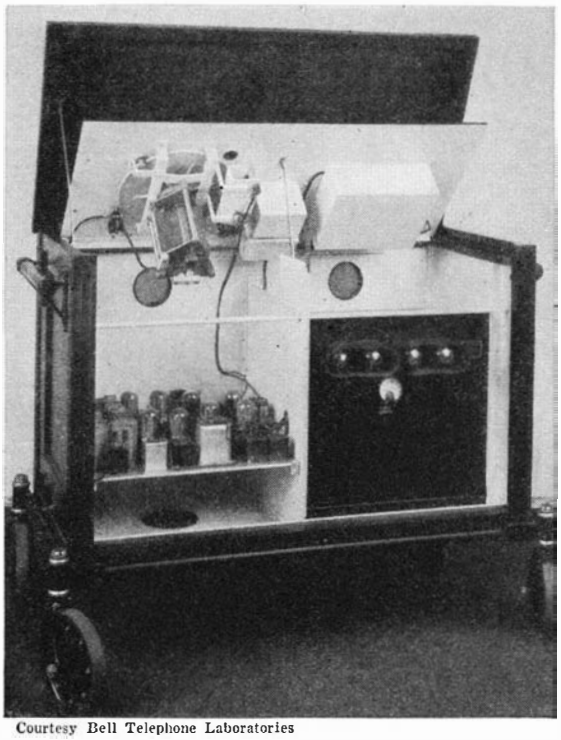
In the operation of a wire mill, the problem of keeping the product at a uniform diameter has been a rather trying one due to the failure of drawing dies, and other technical considerations. There is in use at the present time an automatic caliper which keeps a constant check on the diameter of the output. The circuit used is a modification of the ultra-micrometer circuit invented by Dowling. This particular circuit has been made sensitive to small changes in capacity and the measuring unit takes the form of two condenser plates, their movement being translated into electrical effects that may be made visible on a milli-ammeter in the output circuit. Some idea of the amazing sensitivity of the ultra-micrometer circuit may be had when it is stated that the bend in a table top caused by the weight of a 25-cent piece may be measured with it.

PRECISELY the same method of measurement has been successfully applied to paper making in keeping a constant check on the thickness of the product. In this particular instance, the paper issuing from the mill passes between two condenser plates and very small variations in thickness are easily detected.

When glass bottles are blown by machine, molecular strains often develop and these strains cause weak glass very susceptible to small changes in temperature. The shock brought about by hot water from a faucet will shatter such bottles. Consequently, it has been one of the problems of the glass industry to prevent such strains from forming. Only the most expert eye can see anything but the most obvious imperfection. During the past

year, a way has been found to apply the photo-electric cell to this problem and now such flaws may be found automatically. (See page 120, February, 1931, SCIENTIFIC AMERICAN. *Ed.*) Ten years hence the glass blowing industry will set down the figures and determine its indebtedness to a few billion electrons being sucked across a vacuous space to the positively charged grid. Photo-electric cell circuits have been developed to a point of efficiency where they permit this tube to see things that are far beyond the limits of human sight. It sees more, and sees it more accurately.

In chemistry, the vacuum tubes (both the thermionic tube and the photo-electric cell) are rapidly assuming the importance of the beaker, the balance, and the distillation apparatus. Such a highly specialized job as the measurement of viscosity (the degree of "thickness" or fluidity) is already being turned over to the vacuum tube. A click heard in the telephone receivers connected to an oscillating circuit permits the chemist to determine viscosity with a new degree of accuracy. But that is only one job that the electron tube is learning to do in the chemical laboratory.



Courtesy Bell Telephone Laboratories

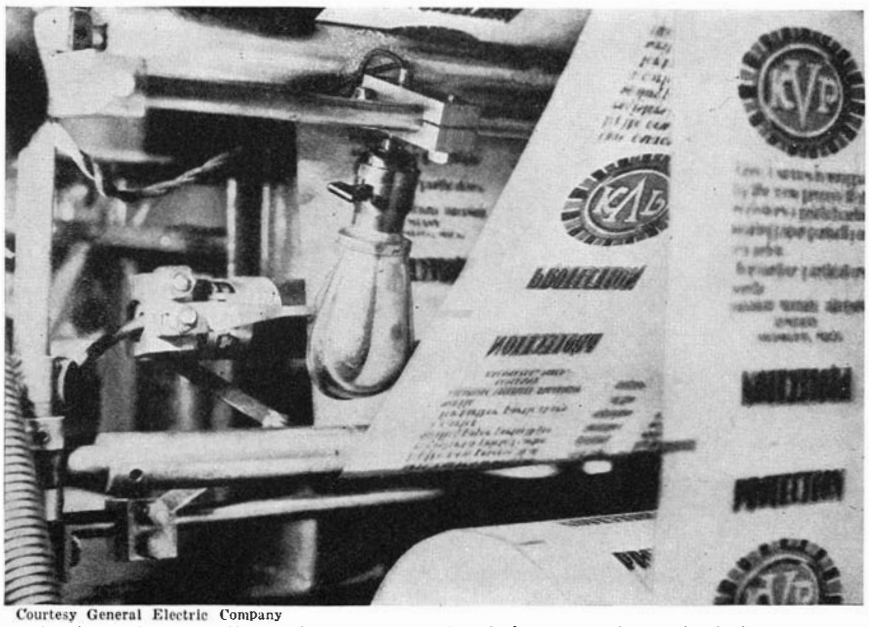
The vacuum-tube amplifier plays a vital part in the audiometer, which measures noise levels

AN astronomer uses a series of vacuum-tube amplifiers in connection with a thermo couple to measure the heat of a star a thousand light years distant. The chemist may measure the temperature of a reaction by practically the same method. And he may do many other things with the thermionic tube and the photo-cell. If he is an organic chemist he may exercise a new degree of control over such processes as nitrations, brominations, and chlorinations. If he is an inorganic chemist he will be assisted in titration. By watching the color produced by the indicator, the photo-cell can call a halt to the process at just the correct moment. It not only does this, but it rings a bell to report its findings.

Human illness and death abide between the rather narrow limits of 7.25 and 7.40 pH (acidity) units. Also, fish die in water that does not have the proper hydrogen ion concentration. These two rather divergent facts are simply mentioned to give the reader some idea of the importance of properly determining acidity, a job which thermionic tubes do with nice precision. The measurement of acidity in the chemical research and industrial routine analysis laboratory is everyday work of a highly necessary character. It must be done rapidly and accurately. The vacuum tube has learned to do it that way. This and the many other things that it is capable of doing in the chemical laboratory leads us to ask the question: "Will automatic analysis put the analytical chemist in the ranks of the bartender and the hansom cab driver?"

In a dark and murky smokestack, a photo-cell intercepts a beam of light from a source on the opposite side of the flue. The amount of light striking the cell will depend upon the intensity of the smoke and the intensity of the smoke will, in turn, depend upon the condition of the fire under the boiler. Draft is the big question and the fireman has only to look at a small meter to know just what his next job is and when to do it. The meter is connected to the ever-watchful cell perched high in the stack where a human would quickly be snuffed out by the death-dealing carbon monoxide. Photo-cells take digits from industrial coal bills.

A few years hence and "Watch your step, please" will be a forgotten phrase in elevator traffic. The photo-cell is now operating an automatic car-leveling control in vertical travel. It is used on all of the new button-controlled cars in the newer buildings. Silence, efficiency and dependability are its characteristics.



Courtesy General Electric Company

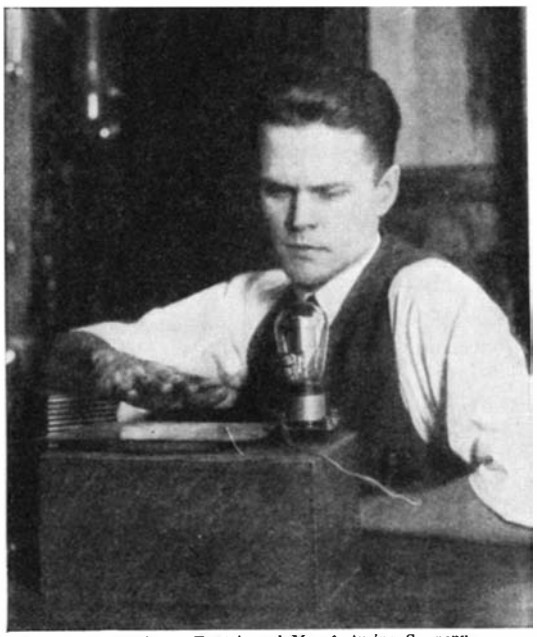
A photo-electric cell, on the opposite side of the paper from the light source shown, controls the "register" of the wrapping paper on this packaging machine

ALTHOUGH we are not at war, poison gas still kills many people every year. Certain gases are less transparent to infra-red waves than is air and a photo-cell is able to take advantage of this difference. Indirectly, it is made to "smell." Working on practically the same principle, it can detect a fire and start a sprinkler system or flood the room with carbon dioxide.

The door of the hospital operating room was opened to the thermionic vacuum tube some time ago and here it promises great things in the alleviation of human misery. A special surgical knife or scalpel is so constructed as to be heated by high-frequency currents generated by vacuum tubes. This is not the kind of heat with which we are familiar. In a sense, it is cold heat which acts to seal the capillaries as fast as the knife cuts. Cauterization becomes automatic and bloodless operations are now possible. Not only this, but we find the larger vacuum tubes generating high-frequency currents to produce artificial

fevers that assist the body fever in killing the microscopic invaders.

We humans are shell-shocked every day in the street, in the office, and in the factory. The pathological effects of noise on the human is becoming a subject for grave study in this day when neuroses are so prevalent. It is being found that there is a distinct limit to the noise that human beings can bear as a steady diet. The vacuum tube cannot prevent noise, but it can measure it with a new kind of yardstick and find the critical value wherever it may exist. That is already being done with the audiometer, a device which permits us to see in black and white just how much punishment we are taking in noise. At least some of our industrialists are taking the matter seriously enough to have measurements made with the view of protecting their workers from the ultimate pain of unnecessary din and racket.



Courtesy Westinghouse Electric and Manufacturing Company

The grid-glow relay (the vacuum tube on the end of the box) and D. D. Knowles, its inventor

Electron tubes hold out a great deal of promise in the steel industry where they are already used in rolling mills. The photo-electric cell is arranged at the end of the mill in such a way that a billet of steel interrupts a beam of light striking the cell. This, affecting the resistance of the cell, operates relays and finally circuit breakers and switches that reverse the mill, carrying the billet back into its cycle.

ONE of the more obvious applications of the photo-cell is that of counting objects by so arranging a beam of light falling upon the cell, that it is interrupted by the objects to be counted. This is done by simply amplifying the resultant effect and closing a relay, which in turn, energizes an electro-magnet connected to a mechanical counter. Such circuits may be designed to operate at great speed and they are capable of counting much faster than a human can count. Not only that, but they never miss a count.

Sorting operations, when they involve different degrees and shades of color, may be carried out by photo-electric cells. It is now part of the every-day work of the photo-cell to sort out bad beans or peas, or to grade cigars according to the most delicate differences in color, a job that was once entrusted to only the most highly trained experts. The principle used is a very simple one. It depends entirely upon the amount of light reflected by an object and this, in turn, depends upon the color or shade of the object. The circuits developed for this purpose have been so highly perfected that shades may be distinguished and classified that could not be so arranged by any other method, if it had to meet the test of speed.

The method of color and shade classification outlined above has also been used in the preparation of wrapped package goods. Boxes that are improperly wrapped are detected and removed from a traveling belt. In such cases, the photo-electric sentinel replaces one or more workers and its work is done at very small cost. The upkeep for such equipment need not run over 25 to 50 dollars a year. A good example of this type of photo-electric cell operation is illustrated on page 239. Here the application is to a yeast-cake wrapping machine.

Perhaps one of the most valuable services performed by the all-seeing cell is that of keeping watch over the generating equipment in large power plants. Disastrous and costly flash-overs in high-voltage systems not only cause interruptions in electric service but also do great harm if they are not promptly extinquished. Photo-electric cells placed at points where flash-overs are most likely to occur now make it possible automatically to cut off the power source at the instant the flash-over develops. The brilliant light caused by these accidents to power equipment is "seen" by the cell which promptly closes a train of relays and opens circuit breakers to prevent further damage.

PHOTOMETRY and pyrometry have supplied two legitimate fields for the photo-cell. In the photo-cell the illuminating engineer has found an invaluable aid in the measurement of light from direct and reflected sources. Research in connection with the design of electric lights has found a tool of vast importance in the photo-electric cell. Not only this, but it also supplies a valuable check on the manufactured article. Greater perfection has also been possible in the art of pyrometry, advantage being taken of the intensity of light as an index to temperature. In such apparatus, a milli-ammeter connected to an amplifier output circuit of a cell is re-calibrated in light units.

And so runs the story of electronic devices in art and industry, a story that has made only a modest beginning when the adaptability and versatile nature of electronic devices are taken into consideration. There are many things still to be done and it may be many years before vacuum tubes have been introduced to all of the jobs they are capable of doing.

The radio knife operates at a frequency of three million cycles. By its use, it is possible to perform operations which formerly could not have been attempted

A NEW USE FOR RADIUM[1]

By ROBERT F. MEHL, Ph.D.

Superintendent of the Division of Physical Metallurgy
Naval Research Laboratory, Washington, D. C.

ONE day, early in September, 1916, several scows floated down the St. Lawrence River bearing the last section of the mammoth new cantilever bridge, the Quebec Bridge. The scows were carefully guided into place and the last section, a span of 640 feet, attached to lifting girders which were to hoist it by steps into place. This technique was new in bridge building, but a highly capable corps of engineers had laid its plans with great care, and as the section rose slowly from the scows the task seemed successfully accomplished.

Without forewarning the section broke away from the lifting girders and sank into the river. Subsequent study disclosed the fact that a steel casting, an integral part of the rocker-joint support between the span and the lifting girders, had given way.

No one was at fault. The casting had been made by a reputable company, it had satisfactorily passed its inspection tests for chemical composition, strength, and ductility, yet it contained hidden defects and failed, and its failure resulted in the destruction of 11 lives and in the loss of a million dollars.

LATE last year a 10,000-ton cruiser was built for the United States Navy in one of the country's finest shipyards. It had installed upon it a nine-ton steel casting known as the stern-post casting. This casting was just forward of the rudder and bore at the bottom the bending moment, though not the weight, of the rudder. It also appeared to be a perfect casting upon leaving the foundry. During first trials of the ship, however, two cracks opened in the casting, which were promptly welded when the ship went into drydock. The welds were excellent in appearance and it was fervently hoped that they corrected the only defects present in the casting. Naturally this could not be certain and it was important to have some real assurance on the point. Accordingly representatives of the division of metallurgy at the Naval Research Laboratory were requested to apply the radiographic method, newly developed at the Laboratory, to the questionable piece. In all, 24 areas measuring 10 by 12 inches, were photographed, but the information obtained concerning the inner condition of the casting was far from reassuring. Besides a number of sections exhibiting voids and general porosity at least 20 cracks were found, from an inch to 20 inches in length.

The ship put to sea for its final trials and during the tests the casting split nearly in two, with the direct result that the ship is now laid up in drydock and about 200,000 dollars will have to be expended in replacing the casting.

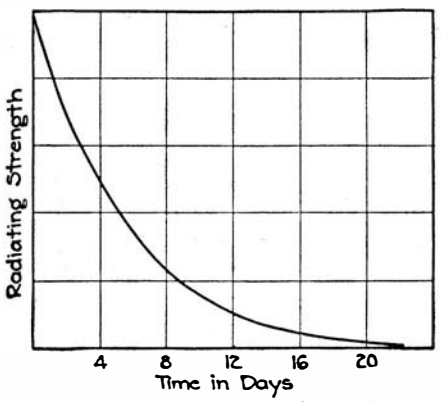


Figure 1: **Decay curve for radon**

These two examples are chosen because they illustrate in a striking way the thesis of this article: it is highly probable that neither of these two misfortunes would have occurred had the castings first been subjected to radiographic inspection.

The art of taking shadow pictures through opaque objects, the art of radiography, is very nearly as old as X rays, for Roentgen himself practiced it somewhat shortly after discovering the X ray. It makes little difference, so far as the X ray is concerned, whether the object to be radiographed is an arm with a broken ulna, a tooth with a suspicion of an abscess, or a steel casting of questionable quality; the result is always the same in principle. Those parts which absorb the ray the more strongly—with a higher absorption coefficient—leave upon the film a light area outlining the peripheral characteristics of the parts, while voids or less absorbing parts leave dark areas on the film. The result is a photographic film or plate delineating the internal (absorptive) characteristics of the object, a *radiograph* from which may be read the necessary information.

Medicine immediately recognized the importance of radiography, and industry followed soon after. The industrial application of radiography is the concern of this article, particularly by the use of—not the X ray—but the gamma ray from radium. Before itemizing the distinguishing characteristics of gamma-ray radiography the field of industrial application should be viewed briefly.

Metal structures are designed by the engineer to withstand calculated stresses. The uncertainty of calculation and of unseen exigencies lead the engineer to design with a "factor of safety"—the structure is made to withstand stresses several times those calculated. Such a procedure is permissible if the strength of the materials used is known. But for all metal structures some uncertainty in the dependability of the material obtains. This uncertainty is relatively unimportant for forged and rolled structures, such as structural members, I-beams, rails and so forth, but is especially acute for welds and steel castings. Both of the latter may contain hidden defects which dangerously diminish their strength. The welder does not always produce a solid weld, nor does he always get perfect fusion between the object and the metal from the welding rod. The foundryman does not always produce a steel casting of solid metal,

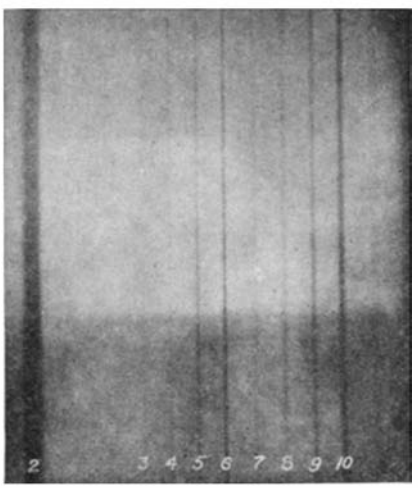


Figure 2: **Radiograph of steel plates, one of which contains slots. The upper part of the film has been protected from gamma rays striking objects to the rear of the film and reflecting back to the film by a lead sheet which absorbed them. This part of the film is accordingly considerably lighter than the other**

[1]Published by permission of the Navy Department, Washington, D. C.

free from gas holes, shrinkage cracks, and sand inclusions.

In such cases a non-destructive method of test—a method which does not destroy while it tests—is of great importance. Magnetic and electrical methods have been very satisfactory for materials in rod or sheet form which exhibit an approximately constant cross-section, but for welds and castings the radiographic method holds the preëminent place. It permits the manufacturer to ascertain the quality of his product, but—more important—it also permits him to study his method of manufacture by the intimate record of hidden faults it provides, so that the method may be improved to eliminate the faults.

X-ray radiography is now used in industry in both of these ways. It has been a constant guide in the development of welding technique, which bids fair to become one of the industrial triumphs of the present decade. It is now regular routine in the inspection of cast aluminum pistons in the shops of America's largest producer of aluminum. It has been successfully applied to detecting mis-alinement in the elements in radio tubes and eccentricities in the cores of golf balls. It has clearly pointed the way toward improvement in steel castings practice, especially in the hands of Dr. H. H. Lester at the Watertown Arsenal.

THIS latter application is perhaps the most important and deserves a few comments. The problem of casting a complicated shape in steel is immensely difficult. The designer of the pattern and the workman who makes the sand mold have accumulated a great amount of valuable experience on the ways and means of producing a casting of good appearance. But it is hard to find a better example of the old adage that appearances are deceptive, for a steel casting might, and usually does, display an excellent surface which promises solid and strong metal beneath, a promise which radiography too seldom vouchsafes. The many and obvious advantages in fabricating structures of steel castings hardly permit the conclusion that castings should therefore not be used. Rather than this, radiographic methods should be used to instruct the designer and foundryman in the correct technique to procure sound castings; this has been the conclusion of many engineers, and we may confidently expect to see a rejuvenation of the industry upon this basis.

The most powerful X-ray bulb now used industrially operates at a maximum voltage of about 250,000. It produces X rays—rays of light—with an effective wavelength of about 0.12 Angström units (10^{-8} cm). By its use excellent radiographs may be taken through steel objects ranging in thickness up to about three or three and one half inches. Beyond these thicknesses the time of exposure becomes intolerably prolonged, so that for a thickness of six inches calculation indicates an exposure time of roughly 500 hours.

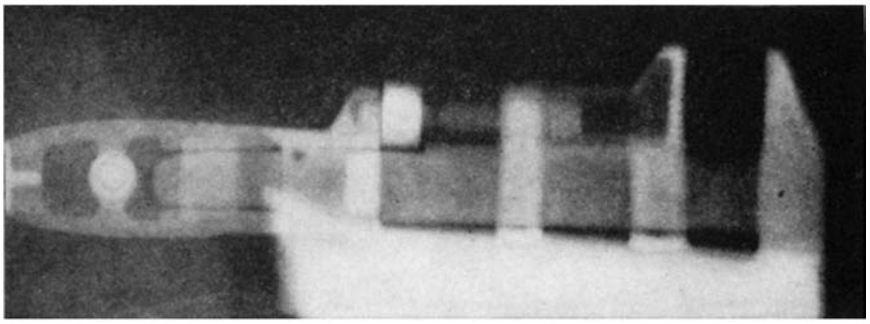


Figure 3: **Radiograph of a monkey-wrench, showing the definition obtained**

Late in 1928 the author made arrangements to study the use of the gamma ray from radium for radiographic purposes, and this study was carried out in the summer of 1929 in collaboration with Dr. G. E. Doan, assistant professor of metallurgy at Lehigh University, and Dr. C. S. Barrett of the division of physical metallurgy at the Naval Research Laboratory.

The gamma ray from radium is also a light ray, similar in nature to the X ray and differing only in its much shorter wavelength. The ray emerging from an X-ray bulb, or that emerging from a radioactive substance, is a *band* of light waves, that is, it contains a range of wavelengths. There is no difference in these two rays except that of wavelength. Nor is there any other difference between these two rays and other more familiar light waves, the ultraviolet light of much interest to the medical profession, blue, green, yellow, and red light of the ordinary variety, heat radiation, and radio waves. They

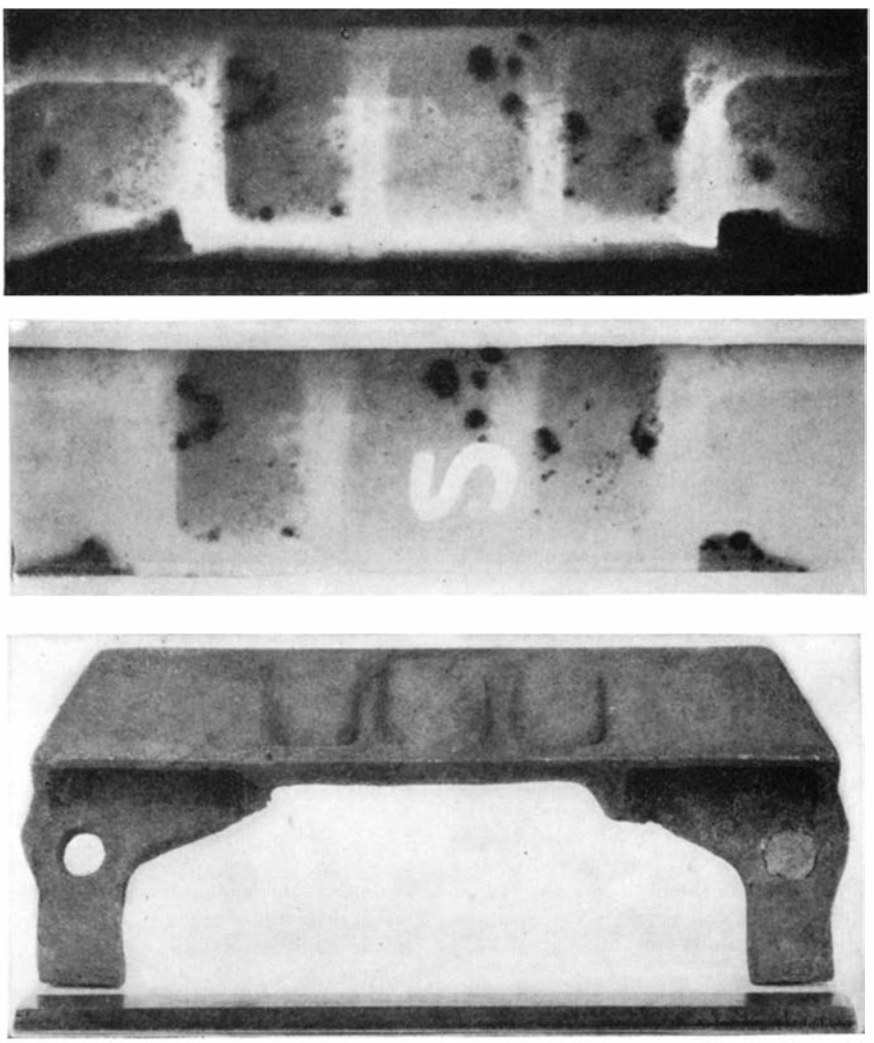


Figure 4: Top; **Radiograph of a steel casting (the one shown at the bottom) made by gamma rays and,** *center,* **the same one by X rays, showing sand inclusions**

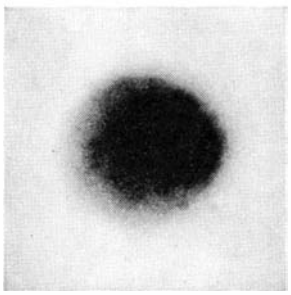
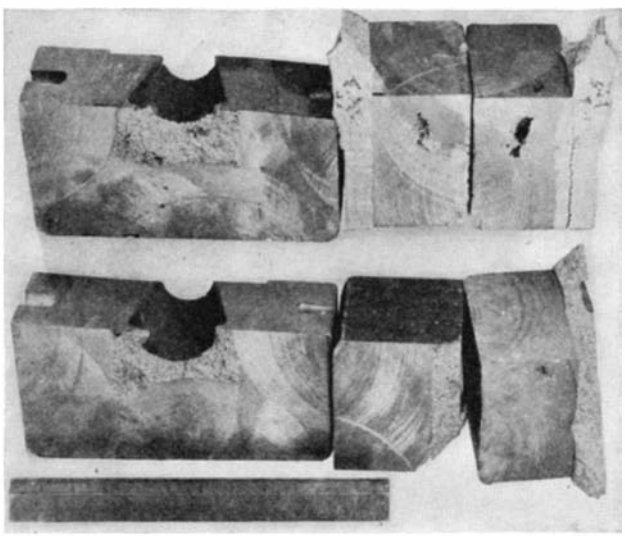


Figure 5: Above; **Block of cast iron with large hole leading off one face. Assembled after cutting.** *Right;* **Radiograph of casting shown above.** *Below;* **Cast-iron block cut to show hidden defects described in the text**



are all light waves, or, as the physicist has ordinarily labelled them, "electromagnetic vibrations in the ether."

X rays of very short wavelength, or gamma rays, are designated as "hard" in contrast to X rays of greater wavelength which are designated as "soft." These terms are used to denote the loss in strength or intensity of the ray in passing through material objects, the hard ray suffering the smaller loss in intensity. The loss in intensity is thus dependent upon wavelength, and for this reason the gamma ray suffers the least diminution in intensity of any of the above named rays in passing through matter. It is obvious, then, that gamma rays should be useful in radiographing thicknesses of steel beyond the range of the X ray, provided satisfactory radiographs could be obtained with reasonable quantities of radium.

For the purposes of radiography either radium or its first product of decomposition, radon (radium emanation), a gas, can be used. It is now common knowledge that radium decomposes spontaneously and forms a sequence of chemically different elements of which radon is the first and lead the last. During these atomic transmutations three types of rays are emitted, the alpha ray composed of fast-flying helium atoms with a double positive charge, the beta ray composed of fast-flying electrons, and the gamma ray. So far as the gamma ray is concerned, radium and radium emanation are equally effective.

Practically there are some properties of the two elements to be borne in mind. Each radioactive element loses its radiating strength progressively with time, following a logarithmic law. (Figure 1). Since the *rate* of disappearance progressively decreases (Figure 1) and never reaches zero it is impossible to speak of the "life" of a radioactive element. The period of time during which the radiating strength of the element decreases to *half* the original strength, however, the "half-life", is known accurately for most of the radioactive elements. For radium the half-life period is 1560 years, for radon 3.85 days (Figure 1).

Radium, then, forms radon at a nearly constant rate. Radon in turn forms the next element in the sequence at a much faster rate. It is the custom among the doctors who use radon for the treatment of cancer to pump the spontaneously formed radon from the radium each day and to seal it in very small glass capsules. These capsules accumulate day by day, but lose in strength according to the curve given in Figure 1. Except for small losses in the pumping operation the radiating strength of the accumulated capsules is the same as that of radium from which the radon had not been removed.

Since only the gamma ray is of interest and since the alpha and beta rays have especially harmful physiological action, the latter rays are purposely cut off by a tightly fitting metal capsule surrounding the small glass bulb. Thus we may use capsules, roughly the size of a pea, containing either radium or radon, and expect equal photographic results when quantities of equal radiating strength—measured in millicuries[2]—are used. If radon is used some correction must be made upon the exposure times in order to account for the fairly rapid loss in strength of the radon with time. The gamma ray, like the X ray, also has a harmful physiological action, but if the radioactive material emmitting the gamma ray be kept in a lead box, handled only with tongs, and if the operator absent himself promptly when the exposure is started, no danger is incurred.

The apparatus necessary to take radiographs with gamma rays is gratifyingly simple; it consists merely of a small capsule containing the radiographic substance, and a film holder containing the film on enhancing screen to accelerate photographic action.

THE data necessary are those relating the strength of the radioactive source, the distance from the source to the film, the thickness and nature of the object to be radiographed, and the time of exposure. These data have all been obtained. It is frequently found that over-night exposures are the most suitable, and the following table has been prepared upon this basis, showing the initial strength of radium and strength of radon in millicuries required for an over-night exposure (15 hours) at a distance of 18 inches.

[2]Millicurie, the quantity of radon liberated from one milligram of radium.—*Ed.*

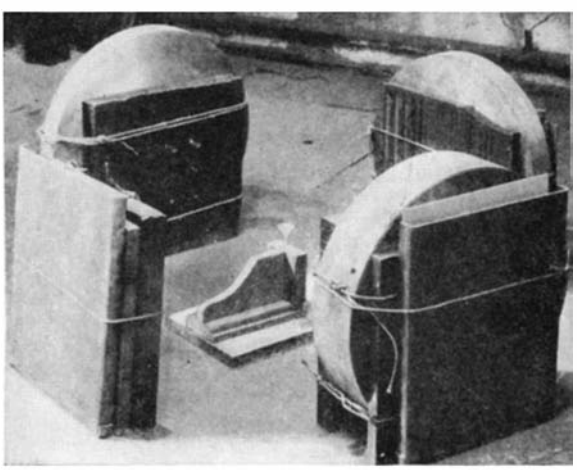


Figure 6: **An arrangement for multiple radiography. Where circumstances are suitable still more work can be done simultaneously from one capsule**

Thickness of Steel in Inches	*Strength*	
	Radium	*Radon*
1	12	13
2	28	30
3	66	70
4	142	150
5	298	315
6	667	704

These may be taken as basic data from which any other desired may be calculated. If one inch of steel is to be radiographed, 120 millicuries of radium will accomplish it in one tenth the time of 12 millicuries, and so on. If the distance from source to film is other than 18 inches, the intensity will vary inversely as the square of the distance.

These data refer to a film density of 2.20—a density sufficient to bring out defects—voids—of only two percent of the total thickness of the piece. Figure 2 is an illustration of this sensitivity. This radiograph was prepared from a pile of six steel plates each 12 inches square and approximately 5/8 inch thick standing perpendicular to the gamma-ray beam with the film behind them. One of the plates, inside the pile, carried a series of slots of varying depths and widths. The smallest of these slots, shown by the shadow "3", was 1 millimeter wide and 2 millimeters thick, 2 percent of the total thickness.

THE definition obtained by the use of gamma rays may be seen in Figure 3, a radiograph of a wrench 8½ inches in length.

The contrast obtained on gamma-ray films is not so great as that on X-ray films. This does not constitute a disadvantage, as we may see from Figure 4, which shows two radiographs of the small steel casting shown at bottom taken by X rays and by gamma rays. Each small defect visible upon the X-ray film may also be found upon the gamma-ray film. But a new advantage appears in the gamma-ray film; the irregular sections are all correctly exposed, whereas to accomplish this with the softer X ray requires doctoring the specimen with lead sheets, special plasters, or liquids, to reduce the effective irregularity.

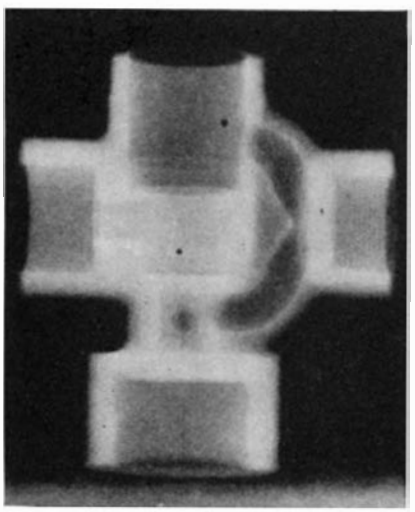


Figure 8: **Radiograph of a bronze valve casting nine inches high, free from defects. Note shadow of threads**

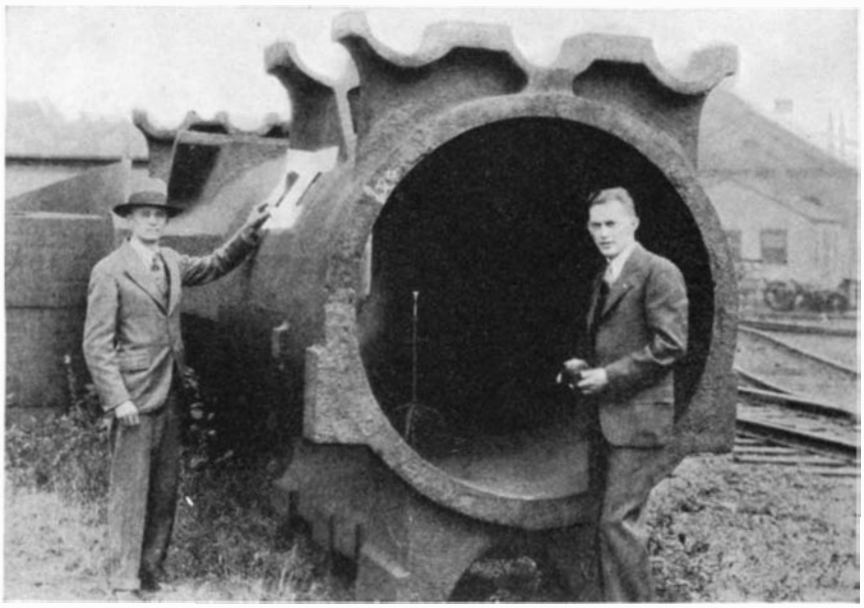


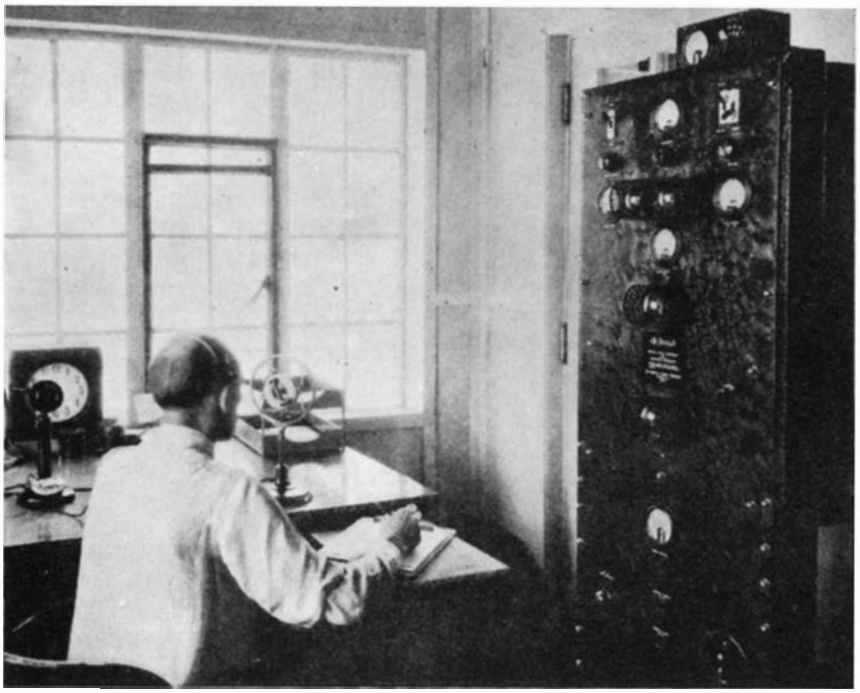
Figure 7: **Arrangement for radiographing a large cylindrical casting. The radium is held on a stand inside and the films fastened outside around the circumference of the casting in two parallel belts. See text in the column below**

The table of exposure data does not list thicknesses greater than 6 inches. Quite satisfactory radiographs have, however, been taken of thicknesses up to 10½ inches of steel and even thicker sections could be handled, given sufficient radium and a sufficiently long exposure time. Figure 5 shows a cast-iron block 8 by 10 inches, and its radiograph through the 8-inch section. The large hole apparent in the photograph is clearly shown in the radiograph, but besides this we may discover a cloud-like effect floating over this large dark circle. This proved to be caused by a large void near one side of the casting, as shown by the photograph of the cut-up block.

With X rays but one or, at the most, very few objects may be radiographed at one time. Furthermore, a large object must ordinarily be transported to the X-ray apparatus. With gamma rays an entirely different technique is possible. The radioactive source radiates in all directions, spherically, and a large number of objects may be placed around the radiating source for simultaneous radiography. This feature tends to equalize the exposure time characteristic of the two methods, since the exposure times are longer in gamma-ray radiography. Figure 6 shows an arrangement for taking four radiographs simultaneously, but this number could easily be greater. In addition the apparatus for gamma-ray radiography is entirely portable and therefore useful in many applications where X rays are not. Figure 7 shows a typical arrangement for the radiography of a very large casting "in place," that is, not disturbed in its original position. This feature of portability made possible the radiographic inspection of the stern-post casting mentioned at the beginning of this article.

Radiography finds no application in industry more important than that of the inspection of valves and pipe fittings for the construction of modern high-temperature high-pressure steam power plants. The failure of an important part of a steam line might result in the loss of tens of thousands of dollars, in the stagnation of the community source of power, and very probably in a loss of life. In such an application the cost of inspection is hardly an item to be reckoned, and quality is paramount. The pressures used in such plants are steadily being increased, and have already reached the point where the valves and pipe fittings required are so thick that X-ray radiographs can not be taken of them. It is a fertile field for the use of gamma ray with its greater penetrating power. A radiograph of a small casting of this type is shown in Figure 8.

ALTHOUGH the use of gamma rays in radiography is new it has already found some practical use. It is at present rather difficult to say what the extent of its industrial use will be. At first sight it may seem to be expensive, but it must be remembered that radium has an extremely long life, its half-life period being 1560 years regardless of how many radiographs are taken with it, and it therefore shows practically no depreciation in value with time. A study of the costs of the method shows that they are much the same as those of the X-ray method.



Telephone messages relating to criminal activities are relayed by radio to other stations of the Michigan state police force through this remote control panel

RADIO GOES MAN-HUNTING

By WM. J. BARKLEY
Vice Pres., DeForest Radio Company

THE present country-wide crime wave is old enough. It has had plenty of time to die but, unfortunately, it has not done so. Perhaps the fact that the crime wave started soon after the termination of the World War caused many to regard it as a reaction of the conflict or caused by the depression and unemployment of 1920 and '21. Had the crime wave been in reality a transient affair, we might have had reasons to pay little heed to it. Perhaps our American optimism has been to blame for the lack of any constructive methods to combat this crime and the continued feeling that it would blow over despite the fact that it has continued to grow for almost ten years.

Radio is a new science. It began to blossom forth just about the time that the crime wave did. Since then it has entered many activities of human concern, and so it was not unnatural for radio engineers, some months ago, to seek means to assist in abolishing the present crime wave with the aid of radio. A thorough investigation of the crime situation revealed several startling facts. Fortunately, these facts proved beyond a doubt that radio could be an even greater aid to the police than was previously thought.

In the first place it was learned that crime can be minimized by two methods. One is by stringent punishment of criminals. However, the most severe penalties are of no avail if the criminals are not caught. Any sort of punishment presupposes the capture of the guilty parties. The second method is by making captures so swift and punishment so sure that the potential criminal will consider capture not as an unlucky break but as the natural aftermath of any crime which may be committed by him.

The matter of punishment is in the hands of our courts and legislative bodies. The matter of capture is in the hands of the police.

A fully equipped police car ready for any emergency. A radio transmitter at headquarters serves to increase greatly the effectiveness of such mobile units

THE DeForest radio engineers recently set out to find the greatest factor in the escape of criminals after the crime with a view to lessening this factor by radio. It was found that almost every crime, especially in our larger cities, is witnessed by at least one person. Sometimes that person is the victim himself. Unless killed or seriously wounded, the victim is in a position to notify the police immediately after the criminal has departed. Often, he has had a chance to learn the appearance of the criminal, perhaps the make and color or license number of his car. Or, the witness might be a passerby, in no way connected with the crime and in an excellent position to notify the police without physical danger to himself. Or, if the crime is committed in a bank or other such institution, an automatic alarm notifies headquarters that something is amiss; consequently, police headquarters is almost always aware of the crime within at least a few minutes after it occurs.

The next step, however, is the faulty one, the one by which the criminal so often escapes. We are saying nothing new in remarking that the greatest element in escape is time. Usually the crime is known immediately. Usually also, there are people in the path of the criminal's escape. The greatest factor in escape is the time taken for those who know of the crime to impart that knowledge to those in the path of the criminal, who are in a position to give chase. We might say that the first half hour after a crime is more important to the criminal in making his retreat than the fol-

lowing ten hours. Once the police lose the trail, it is extremely difficult to pick it up again. It is this time difference which makes for escape. It is this same time difference that the radio engineers have tried to cut to a minimum.

Before the development of police radio, it was the custom of headquarters, on receiving information of a crime, to phone precinct stations and police booths. Since the modern criminal uses such speedy carriers as automobiles, trains, and airplanes, it is imperative that the chase be commenced quickly and police departments notified not only in the immediate vicinity of the crime but for many miles around. Often it takes several hours for headquarters to communicate by telephone to all the local and sub-stations. And these stations, furthermore, have until recently been unable to get in touch with patrolmen, either on foot or in cars, until they communicated with their local stations, either in person or by phone. It is seldom that the active pursuit of criminals takes place sooner than several hours after the crime has been committed.

NOW, however, through the instrumentality of police radio, the hunt may be begun even before the criminal leaves the scene of his activity, and may be intelligently controlled from headquarters while the chase is on.

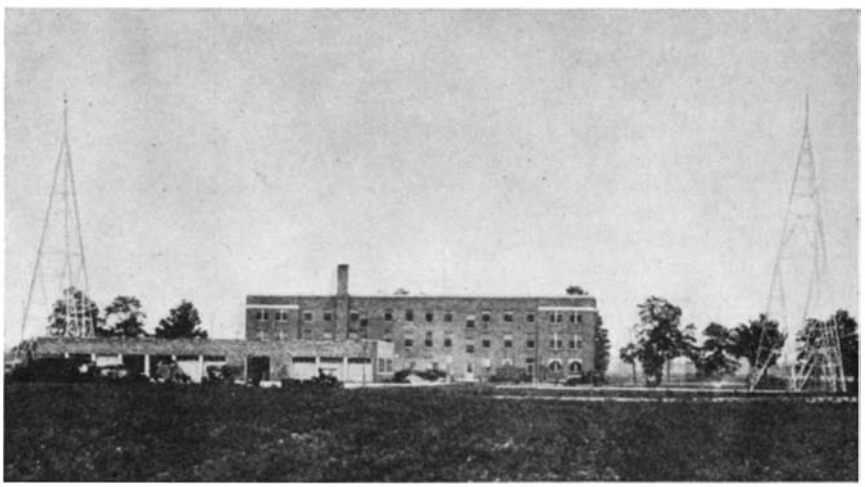
The police radio system is both simple and efficient. Essentially, it consists of a transmitter and police car and station receivers. The power of the transmitter depends on the area to be covered. In the case of the DeForest police radio system installation for the state of Michigan, the power was exceedingly high to cover many hundreds of miles. However, for a system involving but one city or a small group of villages the power can be reduced accordingly. Likewise, the number of receivers to be used is dependent on the number of police officers in the community or communities to be served.

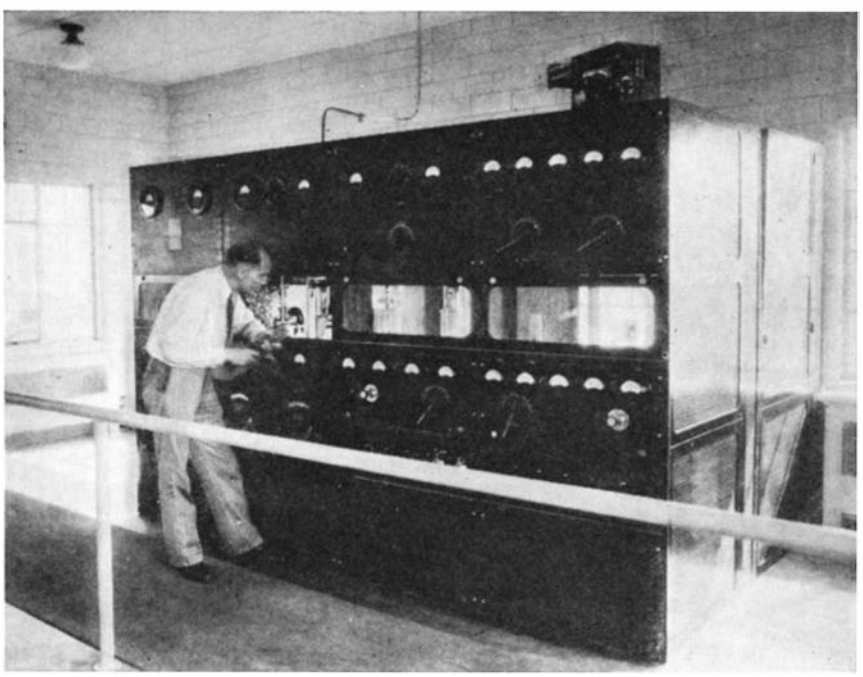
The transmitter is installed in police headquarters. The transmitting vacuum tubes are constantly kept at half glow so that they will always be warm and ready for use within three or four seconds. If an operator is on duty in the transmitting room the microphone will be on hand there. Usually there is another microphone on the headquarters desk so that the messages may be transmitted as received over the phone from witnesses of a crime. The receivers are placed in precinct stations, police booths, and police cars. The transmitter is tuned to a short wavelength, outside the usual broadcast band. The police signals in no way interfere with broadcast programs nor do the latter conflict with police reports. It is impossible for the short wavelength signals of the police transmitters to be picked up on the usual home receivers. Thus, there is little fear of police information reaching those for whom it is not intended. The police receivers are tuned to the wavelength of the transmitter and locked there so that no other signals may be picked up.

Test signals are transmitted at frequent and regular intervals, usually every 10 or 15 minutes. During these transmissions such information as missing persons, stolen cars, and the like is given.

With the use of the police radio system the former half hour or several hour gap between the acquisition of information at headquarters and its dissemination to patrolmen is now closed to within several seconds. For as the desk man receives information of the crime over the phone he speaks into the microphone at his desk and immediately all precinct stations, police booths, and police cars are notified. Policemen in the precinct stations may be immediately dispatched to the scene of the crime or give chase. Those in the police booths may commandeer passing cars and the police automobile may cut short the retreat of the criminal.

The use of police radio has resulted in the capture of criminals at the very scene of the crime—even while committing the crime. At other times they have been apprehended a short distance away. In any case, the trail is hot and the chase is on from the very moment that the crime is known. The first vital half hour is no more at the criminal's disposal. Prompt capture makes for easy conviction and imprisonment. If, in the criminal's mind, a crime is associated with sure and speedy arrest he will think twice before plying his nefarious trade in communities equipped with police radio. And his underworld friends will take heed from his arrest and cross such communities off their lists.





Upper: **Headquarters of the Michigan state police at East Lansing.** ***Lower:*** **The 5000-watt transmitter installed there for communication with police receivers over a large territory. It is controlled from the panel shown on opposite page**

NEW TEMPERATURE MEASUREMENTS OF THE SUN, MOON, MARS

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

THE "cold moonlight" is so familiar a phrase that we almost forget that it belongs to science as much as to poetry. So far as our human senses go the moon's light carries not a trace of warmth. One might as well be in the shadow as in its full glare. But may we then speak of the "cold moon"? This is quite another question and the resources of the modern observatory must be used to answer it. The latest word on the subject comes from Mount Wilson where Pettit and Nicholson, working with the great telescope, have secured some very interesting results.

HOW their measures are made has been told long since in these columns (May, 1929—*Ed.*). The great reflector concentrates the heat as well as the light which comes from a star, into its focal image. By placing there a very delicate thermo-electric couple this heat, minute as it is, sets a current flowing in the circuit which is measured by a galvanometer of great sensitivity. The heat from stars too faint to be visible to the unaided eye has been measured in this way.

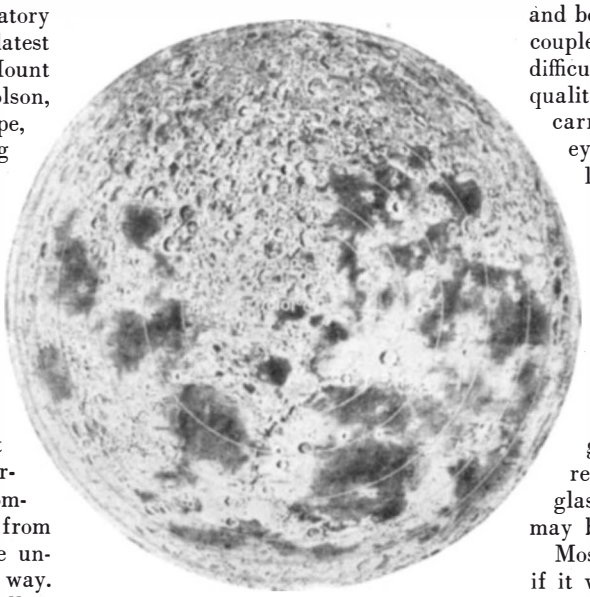
The moon's heat, though too small to feel directly, is 100,000 times as great as that from the brightest stars and there would be no need of such delicate apparatus if it was desired only to measure its whole amount. But with the large image formed by the telescope it is possible to study the surface in detail, finding out how much heat we receive from any particular spot and how this changes as the sun's rays strike the moon at different angles.

To find the temperature of these various points on the moon is a harder job, for the radiant heat which our instruments record is composed of two very different parts. Of the sun's rays which fall on the moon's surface a part are reflected (otherwise we could not see them) and these reflected rays carry with them heat as well as light. The rest of the solar radiation is absorbed by the moon's surface and warms it up. As the lunar day advances toward its noon the surface must get hotter and hotter. What limits this rise? The outward radiation of heat from the moon itself. All bodies, even those that we ordinarily call cold, tend to lose heat by radiation into the depths of space—faster, of course, the warmer the air—and the moon's temperature will rise till the rate of loss balances that at which heat is absorbed from the sunlight.

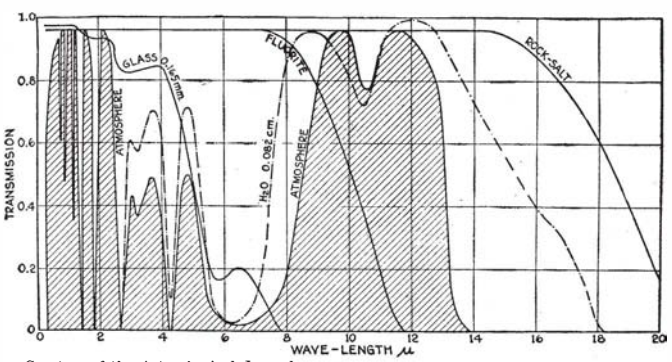
This radiated heat is collected by our telescope, along with the reflected heat, and both together influence our thermocouples. To separate them is not so difficult, for the reflected heat has the quality of the original sunlight. It is carried by the short waves which our eyes can see, and those a little longer, while the radiated heat comes almost exclusively in waves 10 or 20 times as long as those of visible light. A suitable screen, for example a microscope cover glass only 1/150th of an inch thick, transmits practically the whole of the reflected rays and but a very small part of the long-wave radiation which the moon gives out on its own account. By repeating the measures with the glass in place the two components may be distinguished.

Most of the work would now be over if it were not for that bane of all observers, the earth's atmosphere. The air above our heads is very imperfectly transparent, especially to the longer waves. The water vapor in it causes most of the trouble and unfortunately this varies in amount with weather conditions almost from hour to hour. There is only one spectral region, containing waves from 15 to 25 times as long as those of green light, for which the path is tolerably clear. Fortunately these waves are given off in considerable proportions by bodies at the temperatures of the moon and the planets.

For a standard body, or "perfect radiator," at any given temperature the amount of heat radiated is accurately known, and a straightforward though rather tedious calculation



Lunar lines of equal temperature



Courtesy of the Astrophysical Journal

In making the measurements described, astronomers take advantage of the fact that different radiation filtering media —glass, air, water vapor and others—will transmit previously known percentages (vertical scale of the diagram) of the available radiation at different wavelengths (horizontal scale) that reaches them. As its curve indicates, the atmosphere's transmission at various wavelengths is very spotty, and so is that of water vapor (marked H_2O). The "tolerably clear path" Professor Russell mentions is the big hump in the curve between about 8μ and 14μ. Glass, however, cuts off the same range. The sun's spectrum, not itself indicated here, begins at 0.3μ and ends at about 5μ. This is the author's "reflected heat" which glass does not cut off (curve for glass)

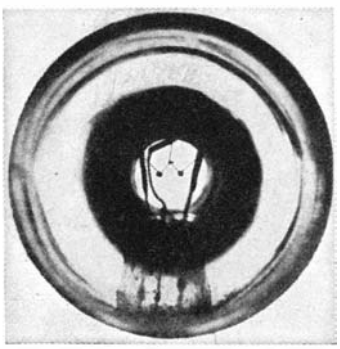
shows how much of this heat will run the gauntlet through the earth's atmosphere past the cover glass and reach the measuring apparatus. Our measures tell us how much heat we actually receive from a given apparent area of the moon's surface and by comparison we can find how hot the surface is. The reader may have been alert enough to add, "provided that the moon acts like a standard radiator," and this is a fair criticism. There is good reason, however, to believe that for these long waves a surface of rock such as the moon doubtless possesses would behave pretty nearly in the standard fashion. Less trouble is likely to arise here than from uncertainty as to the exact amount of heat that is lost in coming through the air. The average amount of water vapor in the path of the rays, even in the dry California climate, is enough to make a layer of live steam 50 feet thick (at ordinary atmospheric pressure) and the best existing laboratory measures of the absorption have been made for only a small fraction of this amount.

WHEN the measures were made and reduced the Mount Wilson observers found, as Langley had done many years before, that the surface of the moon under a vertical sun is hotter than boiling water. Their first calculations indicated a temperature of 118° Centigrade but a little more arithmetic showed them if this was the fact the heat reflected from the lunar surface, added to that radiated, would come to about 20 percent more than the whole amount received from the sun. The latter is accurately known, and they concluded that their original allowance for the loss caused by water vapor in the air had been too big. Correcting it they found that everything balanced if the temperature was taken to be 101° Centigrade, or 214° Fahrenheit.

This is the hottest part of the moon. When the sun's rays fall obliquely they are spread out and there is less heat received per acre, while the radiating surface remains the same. Where the sun's rays strike at an angle of 60 degrees instead of 90 degrees the temperature is 88° Centigrade. When the angle is reduced to 30 degrees the temperature falls to 40°, and when the sun is 10 degrees high it drops to −30° Centigrade or 22° below zero Fahrenheit.

Observations made during a lunar eclipse show that the surface cools very rapidly as the sun's rays are cut off. The part of the surface observed was illuminated at an angle by the sun and before eclipse its temperature was 60° Centigrade (101° Fahrenheit). One hour later, when the last rays of direct sunlight had just been cut off, the temperature was −100° Centigrade (that is, −150° Fahrenheit). During the two hours of totality there was a low decrease to −117° Centigrade (that is, −180° Fahrenheit). For a few minutes after the sunlight began to return the cold continued, then the temperature rose steadily and rapidly almost to its original value.

This very rapid cooling shows that the rate of conduction of heat into the moon's interior must be extremely slow. Otherwise the heat stored in the rocks below the surface before the eclipse would leak out again and delay the cooling. Calculations by Epstein show that the conductivity must be far greater than that of any known kind of solid rock, or even of loose sand. Only a very light and porous material such as volcanic ash or pumice would behave as the moon actually does. Though the actual surface gets as hot as boiling water the heating is only skin deep. A few inches down—perhaps only an inch—the temperature has the average value of the month, which is probably not far from the freezing point of water.



Courtesy of the Carnegie Inst. of Wash.

Eyepiece of the thermocouple (much enlarged), with its two tiny sensitive thermo-junctions

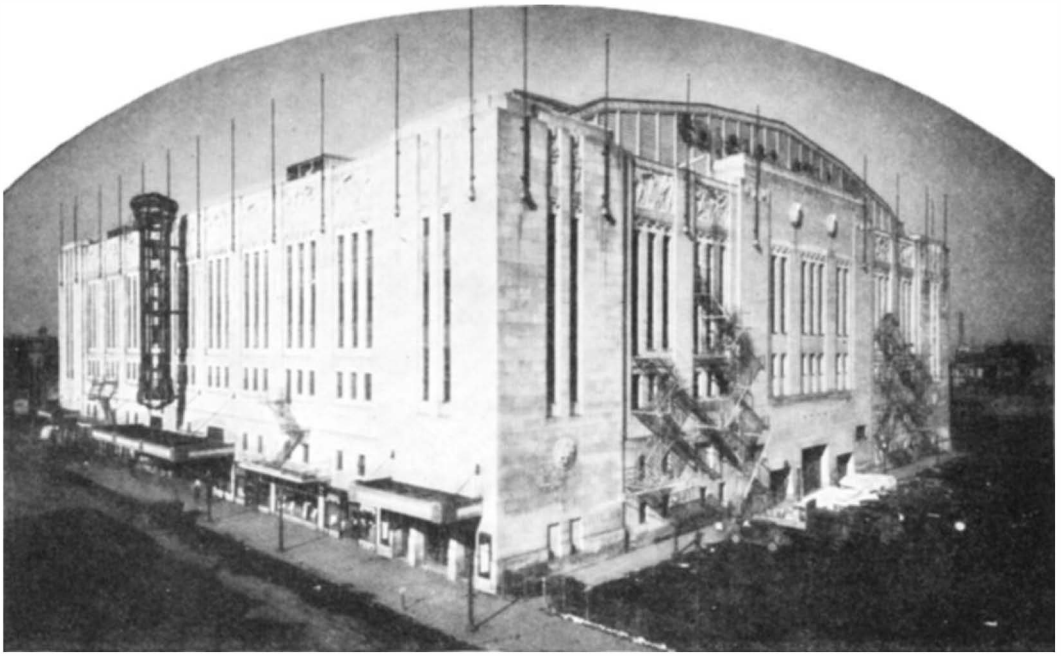
During the long lunar night the moon's surface must grow very cold. Eclipse observations show that within an hour or two of sunset the temperature falls far below the extremes in our worst arctic winters. Later in the long night it must be colder still. Some Mount Wilson measures show that the remaining radiation of heat is barely if at all perceptible, even with the most sensitive apparatus; from which it follows that the surface temperature is below −150° Centigrade, or at least 240° below zero on the Fahrenheit scale.

Exposed to this tremendous range of about 450° Fahrenheit every month, masses of solid rock on the moon's surface would split and scale off at the surface till they were buried in their own debris. There is abundant evidence that the surface is actually rough in detail, darkened by shadows except when we look at it right down the path of the sun's rays, as we might expect.

The new information about the transmission of heat through moist air, which is a by-product of the lunar observations, leads to some change in the temperature previously computed for Mars and the other planets. A new reduction of the observations indicates that the temperature at the surface of Mars, with the sun overhead, is 18° Centigrade or 60° Fahrenheit when the planet is nearest to the sun. The temperature at the pole, toward the end of the long summer, should be about the same. The conclusion that the polar caps are composed of snow and actually melt (or evaporate) in summer still stands.

PLACING a thermocouple behind a small pinhole, and mounting this in the focal plane of the tower telescope used for studies of the sun, the heat received from a small region in the dark center of a sun-spot could be compared with that from the undisturbed photosphere outside. It was found to average 47 percent of the latter, different spots agreeing closely. The total radiation from a standard radiator varies as the fourth power of the temperature, so the temperature of the spot should be 83 percent that of the photosphere. Taking the latter as 5955° K., or "absolute," (on the Centigrade scale, above the absolute zero) the spot comes out 4920°. This probably is a little too high, as some ordinary sunlight scattered by the sky and in the instrument is mixed with the radiation from the spot itself. Observations on the sky just outside the sun's edge indicate that this scattered light was about four percent of full sunlight. For a sun-spot which has bright photosphere all around it, instead of on one side only, the scattered light should be twice as great. This indicates that the real radiation from the spot is 39 percent that of the photosphere, corresponding to a temperature of 4700°.

Two other ways of determining the temperature were available. From observations of the percentage of spot radiation which was cut off by a water cell (which blocks the long waves) the temperature came out 4720°. From the spectroscopic study of the amount of energy in the spot spectrum at different wavelengths ranging from the ultraviolet far into the infra-red the derived value was 4750°. This is considerably higher than had previously been assumed but the excellent agreement of the three determinations inspires confidence in the result, and we are safe in concluding that sun-spots are about 1200° colder than the rest of the disk. The temperatures here given apply to the center of the sun's disk, where we are looking straight down into the gases of the atmosphere and can see deeper and hence to hotter layers on the average than when our line of vision is oblique. For an average of all over the visible disk we do not see down so far, and the photosphere temperature is 5740°. That for the spot is 4530°—still 1200° colder than the other.



The Chicago Stadium presents an imposing, beautiful appearance

CHICAGO'S 'MADISON SQUARE GARDEN'

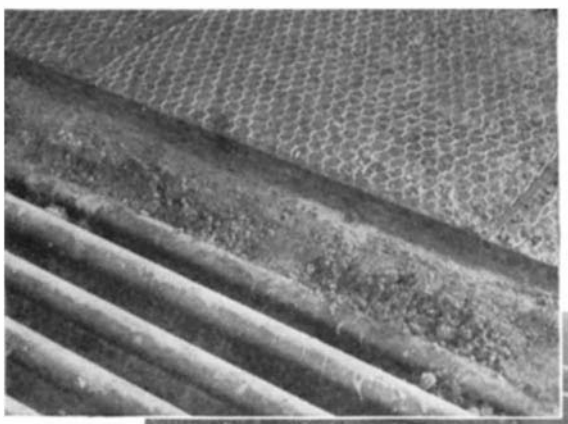
LISTED as the world's largest sports arena, the Chicago Stadium which was completed some months ago has several unusual features of construction which make it important from an engineering standpoint. This building, located about two miles from the business center of the city, is 300 feet long and 266 feet wide with a height of 117 feet, 6 inches at the high point of the roof. The arena is 245 feet long by 145 feet in width and has a clearance of 88 feet to the roof. The Stadium has a total seating capacity of 22,836 and after removal of temporary seats from around the first arena, there are approximately 16,300 permanent seats remaining.

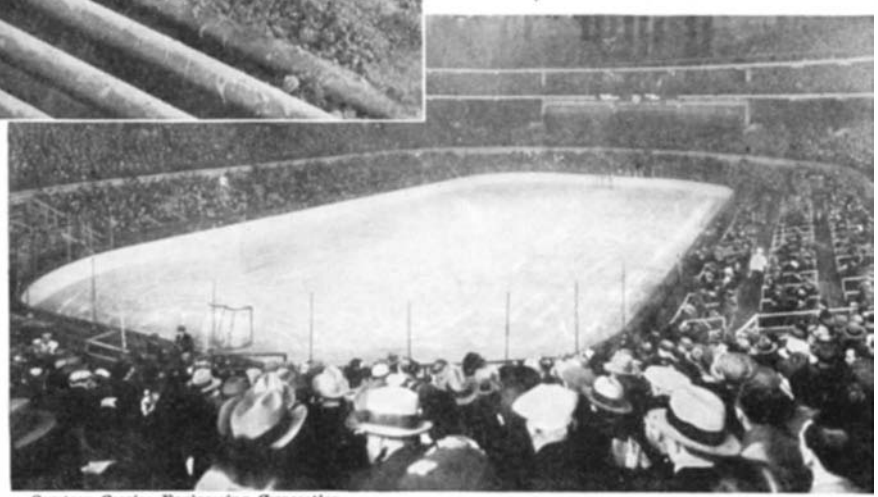
The most important structural feature of this building is the wide-span roof. It is made up of 13 huge steel trusses each having a span of 261 feet 9 inches from center to center. Each of the trusses is 26 feet deep at the center and 13 feet deep at the end. The two center trusses weigh 105 tons each and the remainder are each 90 tons in weight. The entire roof has a total area of 80,000 square feet. Its construction is of pressed steel insulated by a one-inch thickness of cork.

Above the main arena floor there is a mezzanine floor and a first and second balcony, the highest seat in the last named being 66 feet above the arena floor. The tiers of seats extend all around the arena and due to the special efforts of the architects to achieve a design that would permit perfect sight from any seat, there are no columns to obstruct the view. This is particularly important because of the nature of the exhibitions and performances which will be given in the Stadium.

Facilities to meet practically every demand have been incorporated in the Stadium. In the basement are a kitchen, and locker, dining, dressing, general storage, animal, and boiler rooms, and the refrigerating equipment. The area under the arena itself was not excavated.

While the structure in itself presented many problems, the mechanical equipment and the engineering entailed some very special considerations. In visualizing the heating and ventilating problems, the engineers had first to contend with the fact that this building has many diversified requirements in all fields of



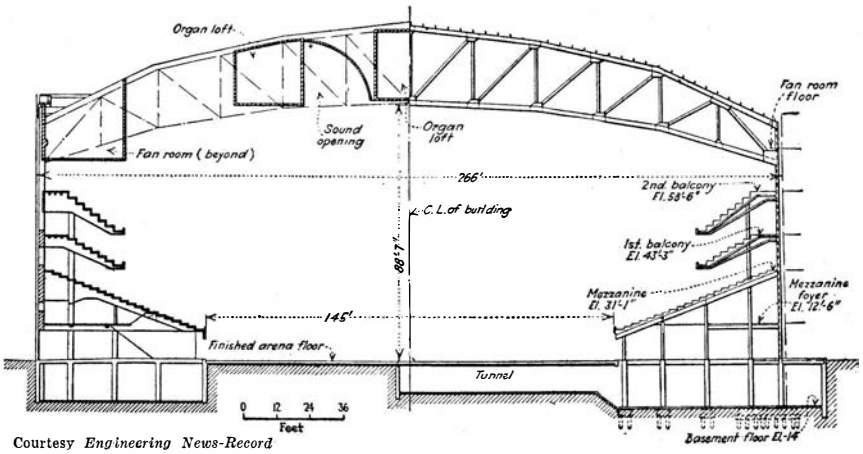


Courtesy Carrier Engineering Corporation

Center: **Brine piping covered with concrete fill, showing wire netting reinforcing ready for finished floor.** ***Bottom:*** **The house is packed for a hockey game**

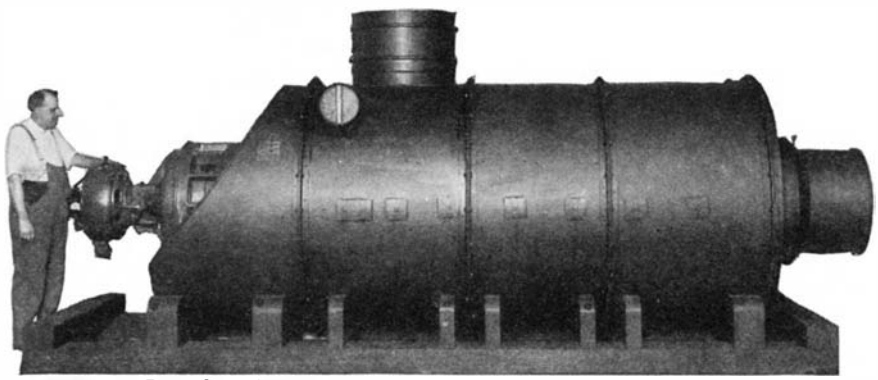
sport. There is, for example, the question of heating. For hockey matches the temperature throughout the entire seating area should not be above 60 degrees, while for other events such as a six-day bicycle race or a basket-ball game, the mean temperature should be 70 degrees.

The engineers solved this problem by heating and ventilating the entire stadium with four huge air conditioning units, one mounted at each corner of the building. Each of these supply units is fully equipped with spray type dehumidifiers, re-circulating spray pumps and motors, Aerofin heaters, tempering heaters, and automatic controls for both temperature and humidity. The general offices and other departments located on the street level are independently ventilated by separate supply and exhaust systems located in the basement and equipped with spray type system for air washing. Steam which is supplied to the direct radiation system and to the Aerofin is in reality exhaust steam from the two steam turbines which drive the centrifugal refrigeration machines.



Courtesy *Engineering News-Record*

A transverse typical section of the new building, showing the organ loft and sound opening, the "suspended balconies," and absence of interfering columns



Courtesy Maxcy-Barton Organ Company

The Stadium organ blower, the largest of its kind ever built. It is driven by a 100-horsepower electric motor and is located in a special fan room under the roof

The refrigerating equipment consists of two machines each having a normal rating of 120 tons when cooling brine to low temperatures. At higher temperatures they develop as much as 330 tons each. Provision has been made for the installation of a third machine later.

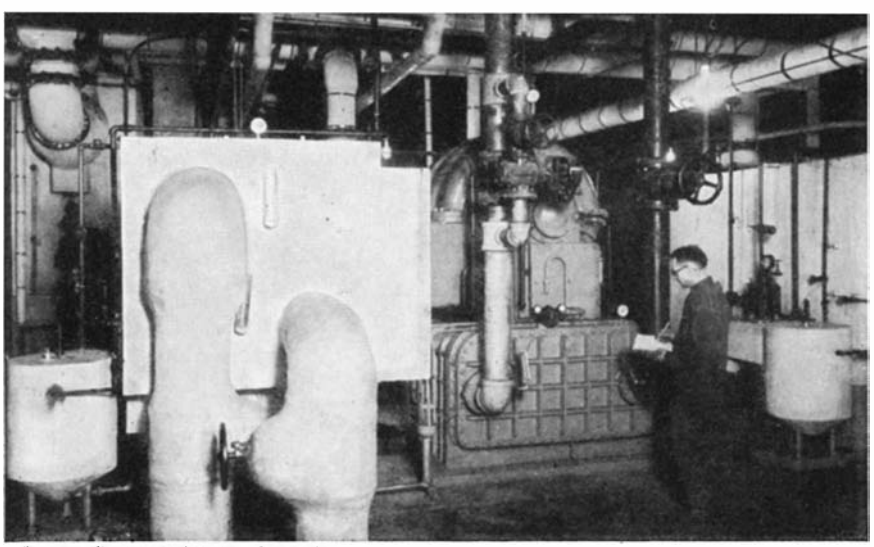
The refrigerating equipment is not only a necessary part of the air conditioning system, but also serves to freeze the ice surface on the arena floor for hockey matches. Underneath the terrazzo surface of the arena is imbedded a maze of 1½ inch brass piping totaling 85,000 lineal feet. These pipes are laid parallel to each other and across the floor on four inch centers and are entirely covered with metallic concrete and then the terrazzo. Beneath the piping there is one inch of sand and a solid four-inch layer of cork, all supported by a concrete foundation.

By forcing cooled brine through these pipes, the floor surface above is cooled so that as the latter is sprayed with water, a sheet of ice forms. Continued applications of water are then made until the ice is of the thickness required. The entire oval arena or any portion of it can be coated with ice in this manner.

After an exhibition requiring an iced floor, the ice is removed simply by warming the brine circulating through the floor pipes until the bond between the ice and the floor is broken. The ice is then plowed up and removed to a pit in the basement which is equipped with steam coils and a number of drains.

The Chicago Stadium is the first building of its kind to have a modern organ to provide a suitable musical background for all the varied entertainments. The full volume of this organ is equivalent to that of 25 complete brass bands of 100 instruments each, or a total of 2500 orchestral pieces.

A real problem confronted the Maxcy-Barton Organ Company in the design and construction of this great reproducing instrument. They realized that an organ of the capacity required had never been built anywhere in the world before. It was concluded that the tremendous amount of mechanism required for such an organ, together with the many thousands of pipes, would require the building of no less than five organ lofts, and it was decided to locate these in the very center of the auditorium, suspended from the truss work of the roof. These lofts were set in a circle surrounding a specially designed and constructed mixing chamber which, because of its acoustic qualities, blends the tones emitted from the instrument lofts before they finally pass on to the vast space beneath.



Courtesy Carrier Engineering Corporation

The two Carrier centrifugal refrigeration units for cooling the brine used for coating the arena floor with ice and for the air cooling and conditioning system

BUTTERFLY FARMING

By ADELINE TAYLOR

IN Iowa, where the tall corn grows, there is a young man who farms in a different line—he is a butterfly farmer. Irvin Schlesselman, an 18-year-old youth of Cedar Rapids, has hatcheries, traps, displays, and a well established butterfly business. And they are all products of his own ingenuity.

Butterfly farming consists of more than putting a caterpillar in a cage and then coming back two or three months later to find the butterfly. Irvin is raising 30 different species of moths and butterflies, each of them requiring a separate compartment in his hatchery.

THROUGH a hole in the floor of every caterpillar's home a branch of food leaves is inserted. Every worm has a particular menu, and requires his own kind of leaf for breakfast. Through experiment and observation this young farmer has discovered that the Luna moth prefers the walnut tree; the Yellow Emperor thrives on the box elder; the Cecropia likes cedar and lilac leaves; Polyphemus craves weeping birch; the Io wants willow leaves and the Promethea takes to wild cherry foliage. The leaves are kept fresh by standing in a glass of water which must be changed each day. The temperature of the nursery must be watched, so that it does not get too warm after the caterpillars have spun their cocoons—otherwise they will hatch prematurely. Among the cocoon-spinning varieties of moths that Irvin is now raising are the Polyphemus, Promethea, Cecropia, Io, and Luna.

Then, of course, there is the problem of catching the butterflies and moths of many kinds to begin these hatcheries. Again the ingenuity of this unusual farmer came to the rescue and he has designed a trap in which he can catch them. A female is put in a wire cage in the center of the trap, which has five entrances, each of them lined with tin. The male moth is attracted to this trap evidently by his sense of smell.

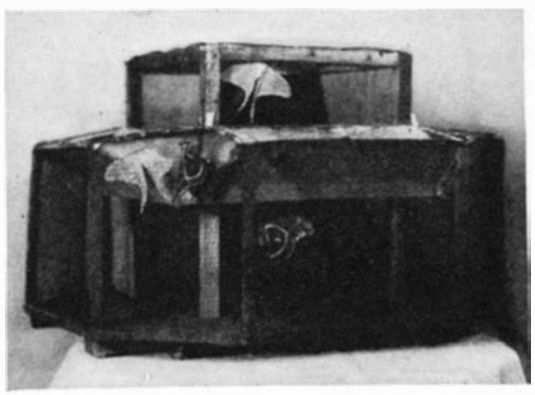
When the moths land on the tin troughs, their feet will not stick to the surface and they slide into the trap. This tin slide idea was developed by Irvin through a process of experimental elimination—aluminum and other metals, and even painted tin, were used with no success.

The youthful farmer has also attracted moths and butterflies to his traps by brushing a mixture of syrup and vinegar on nearby trees and by tying a female near a trap with a slender thread. He says this latter method often attracts as many as 30 adults.

One of the glass-topped trays made with butterflies raised by Irvin

His hobby competes with amateur astronomy in turning its followers into nighthawks. The Luna moth—that lovely green night traveler that looks like a fairy trailing a phantom train—can be caught about midnight. The same hour is the favorite for the Polyphemus, also, but he who catches the Cecropia must look for him about 3:30 A.M.

Sometimes these moths can be caught around street lamps at night. And a carnival is an ideal place for the moth collector, according to Irvin. The Yellow Emperor is particularly fond of the bright night lights. Butterflies belong to the sunshine and the collector finds them while on daylight walks through fields and meadows.



Crude but effective home-made trap with which the young butterfly farmer catches the adult insects

Irvin and one of the cases of the butterflies that he has collected

Occasionally the hunter goes scouting for cocoons rather than moths—according to the season of the year. He has learned in what trees to look for larvae and can distinguish between the gold-flecked, jade chrysallis of the Monarch, the brown cradle of the Cecropia, the hanging home of the Promethea, and the leaf-wrapped coat of the Luna.

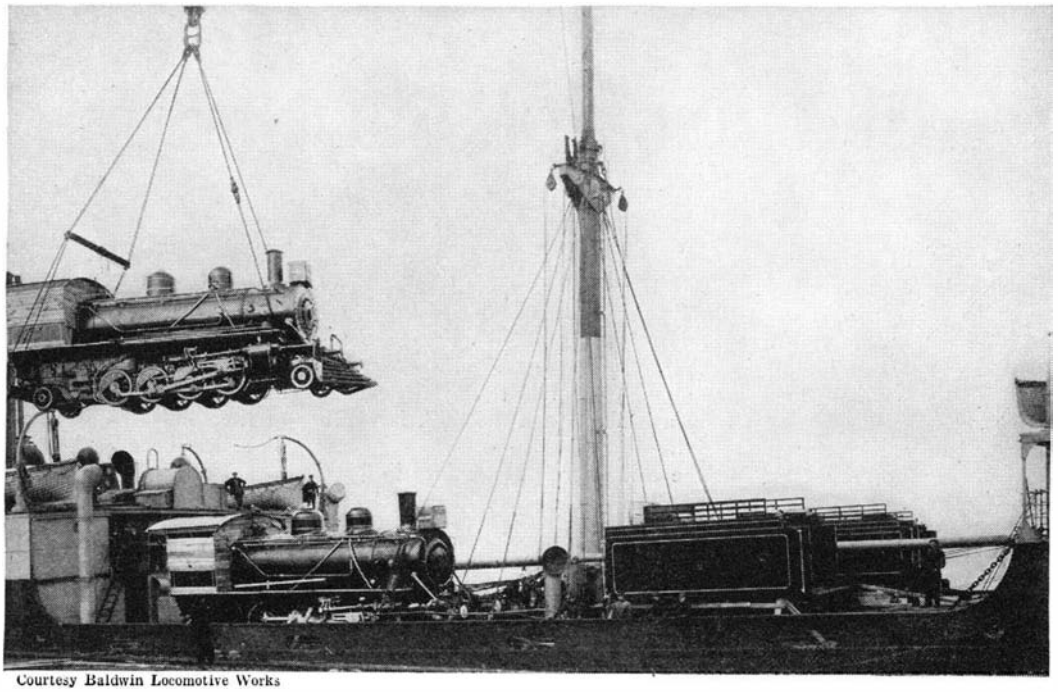
All of this leads toward the end to which all of these efforts have been made—that of having a collection to study and admire and display. And this butterfly farmer certainly has some remarkable results. Over 2000 butterflies and moths have been caught, trapped or raised and eventually mounted in his collection. They include 250 species from his native state alone.

THE case with which Irvin is pictured is one of his own design. The back of it is made of wall board which will not warp and there is a chamber in which to put camphor so that the specimens are kept insect proof. Care must be taken to keep these cases away from strong light so that the colors on the wings will not fade.

Irvin also designs individual specimen cases which are glassed on both sides, enabling the observer to see the under side of the wing.

Irvin has put his butterfly farming on a commercial basis by selling some of the products to other collectors who have been less successful in catching the rarer species. Teachers have been particularly interested in taking advantage of this unusual farm. Another market for these creatures is in making decorative trays and centerpieces, an art at which Irvin is quite proficient.

He is supplementing these displays of 2000 moths and butterflies of this section of the country, which has taken him seven years to collect, with exotic specimens procured from South America and southern India.



Courtesy Baldwin Locomotive Works

With boxed-in cab and headlight, a complete locomotive is loaded aboard ship

WHEN LOCOMOTIVES GO TO SEA

UNTIL a few years ago, ocean shipment of railroad equipment such as locomotives, passenger and freight cars, and the like, involved a system of dismantling and crating at the shipper's port and uncrating and assembly at the port of destination. This system was inefficient and particularly costly in the case of locomotives, large numbers of which are regularly built by American and European manufacturers for railroad companies in Latin-American countries, the Orient, Australia, and Africa.

When a locomotive, built for export, is ready for delivery it must be so complete in every detail that it can be given try-outs and certain prescribed acceptance trials at the manufacturer's plant in the presence of experts sent by the purchaser. If it is then necessary, because ships properly built for this service are not available or for any other reason, to dismantle the accepted locomotive, there is a delay in getting the shipment on its way and a very large expense involved in the crating operations and in loading the various parts separately. Added to this will be another item of expense at the receiving end where the crates must be removed and the locomotive made ready for service. And if, as so often happens, the facilities at this latter port are limited, this cost may be greatly increased due to the long delay.

The advantages of the newer system of shipping locomotives across the seas fully erected are thus immediately evident. Dismantling and crating are obviated but, what is perhaps equally as important, the locomotive can be fired up as soon as it is discharged from the ship and can be driven away under its own power without loss of time. Locomotives made in this country by the Baldwin Locomotive Works are shipped to many foreign countries in this manner.

TO handle locomotives fully erected, as well as other railway equipment and large machinery units, ships specially designed for the purpose are required. A fleet of such ships—the only one of its kind in service today—is operated by Christen Smith, a ship owner of Oslo, Norway. The ships of this line, while relatively small, have specially large hatchways to receive even the largest passenger cars and are considerably stronger and more substantially built than ordinary ships because it is necessary for them to withstand the strains imposed by such immense units of concentrated weight. In them there are no between-decks and no extensive fore-and-aft bulkheads. They are characterized by unusually heavy frames and deck and hull plates.

Since a substantial part of the cargo of these ships is normally carried on deck, their bulwarks, stanchions, and coamings have been made exceptionally strong to provide for the heavy lashings. Even so, the ships appear shell-like and fragile to the uninitiated and even top-heavy as shown in our cover painting; but it is asserted that some of them, fully loaded, have weathered the most severe hurricanes.

These ships are relatively short and broad, and due to their light draft can enter some ports that are inaccessible to vessels of ordinary type. All of them are equipped with derricks which have a load capacity up to 120 tons, some of which are operated by electric winches. Other considerations aside, these derricks play an important part in the efficiency of the system because they make possible the unloading of large unit loads in ports where crane capacity is limited or cranes are lacking altogether.

Since the ship's derricks are not very high in proportion to the bulk of a locomotive, ordinary lifting slings such as are used on land would not be satisfactory. Therefore beams of special design are part of the equipment of each of these ships. When one of these beams is placed between the cables of the lifting derrick, parallel to the top of the locomotive or coach, the load is balanced and the cables do not rub the sides of the load. A removable set of beams is provided for the larger ships so that two tiers of cargo may be stowed within the vessel; and provisions have been made for carrying two tiers on deck.

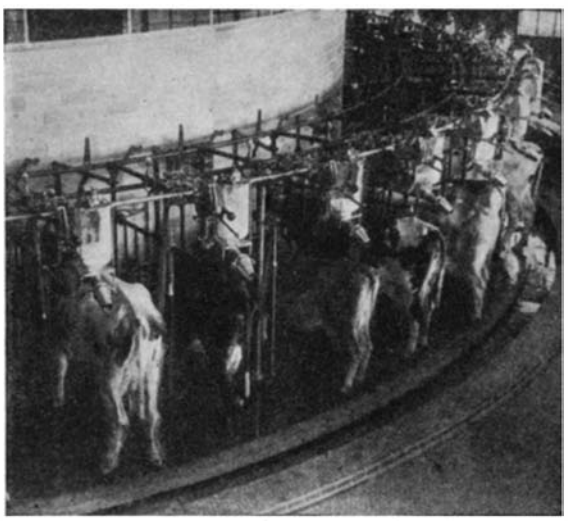
A load of locomotives, railroad coaches, or large units of machinery can not be stowed as simply as bags, boxes, or bulk cargo, so it is necessary to plan beforehand not only the order of loading the units but their exact position on the ship, the necessary lashings, and so forth.

A MACHINE AGE 'MILK MAID'

By JAMES A. TOBEY, Dr. P.H.

WHEN Thomas A. Edison pressed a button at his home in West Orange, New Jersey, on November 13th, 1930, he set in motion at Plainsboro, New Jersey, the world's first "Rotolactor," a part of the new rotary combine milking system which consists of an automatic device for the rapid, efficient, and sanitary milking of many cows at a central place. The rotolactor, which is the main feature, is an ingenious machine for the continuous milking of cows at the rate of 50 in 12½ minutes, or 240 per hour. By thus bringing the animals to the milker instead of taking the milking operations to cows distributed in many scattered barns, labor is saved, production costs are reduced, and, of great significance from the standpoint of hygiene, all possible human contact with the milk is eliminated.

The rotolactor is a circular platform, some 60 feet in diameter, with an outer concentric circle approximately 8 feet in width, which is provided with stalls and stanchions for 50 cattle. The machine is housed in its own new building on the extensive Walker-Gordon farm at Plainsboro, and is connected with the cow barns by covered passages. Above the central part of the rotolactor is a stationary gallery, hermetically glassed-in, where interested spectators may watch the entire proceedings. Also in this building are laboratories, record rooms, and offices, all open for public inspection, a system which is desirable on any dairy farm.

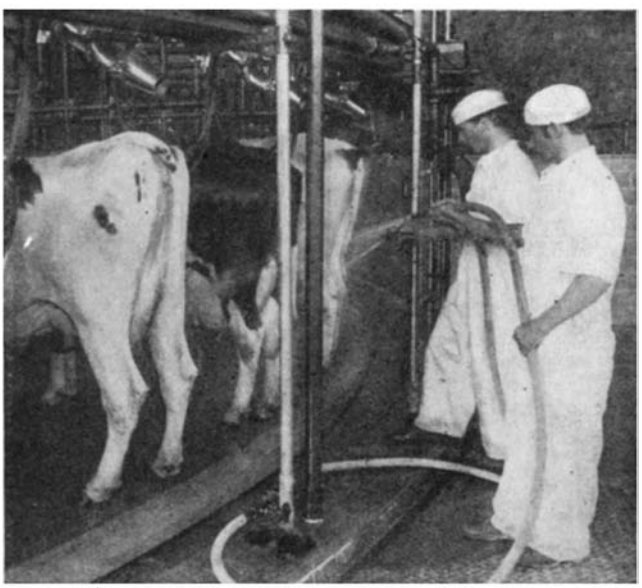


Cows on the rotolactor at the Plainsboro, N. J. farm. The cows are milked as the platform turns

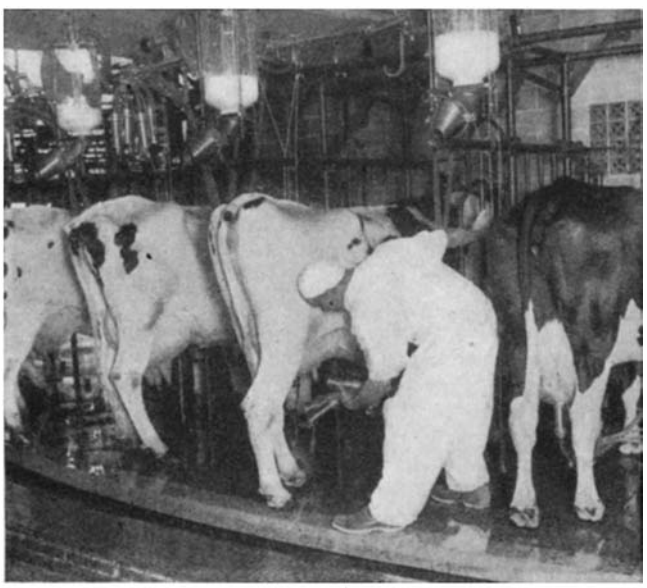
As the platform of the rotolactor slowly revolves in a clockwise direction at the rate of 15 feet a minute, the cows come from their stables and approach in single file through a runway, stepping on the platform, one after another, until all the places are taken. Even the stanchions work automatically, closing deftly about the cow's neck as she stands facing toward the center of the rotolactor. By the time the last place has been occupied, the first cow to enter has finished and her place is taken by the next animal in line, so that the operation is continuous.

AN automatic shower bath is the first item on the program. The cows are, in fact, thus bathed three times a day, as milking is conducted thrice daily. Supplementing this shower bath, an attendant washes and dries the udders with sterile cloths, using a fresh one for each cow. The whole ablution process consumes the first 2¾ minutes of the 12½ that the cow remains contentedly on the rotolactor. From the beginning, the animals have adapted themselves to the entire procedure and have displayed no excitement.

Following their baths and cleansing operations, the cows are dried by a current of warm air. A little foremilk is taken by hand for inspection, and then a milking machine, which has just been sterilized, is attached to the cow. By the time the rotolactor has finished its revolution, milking has been completed, with the milk collected in air-tight Pyrex jars. The machines are detached, the stanchion opens automatically, and the cow, realizing that she is finished,



Cows are milked thrice daily. The ablutions occupy the first 2¾ of the 12½ minutes that the cow is on rotolactor

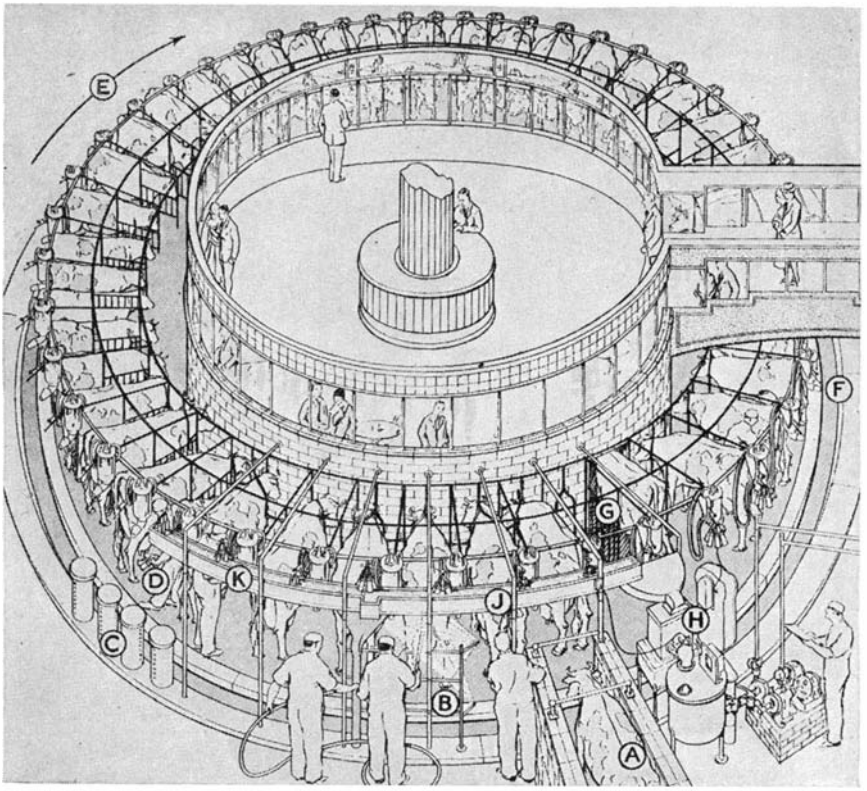


A sterilized milking machine is attached to the cow after the cow is dried by sterile cloths and a current of warm air

steps off, follows a runway leading off from the inner edge of the revolving platform (see drawing), and returns to her barn. The whole thing is so scientifically worked out that the cows even traverse a measured distance so that they get the proper amount of exercise walking to and from the rotolactor.

The milk is automatically dumped from the Pyrex jars into a weighing and recording machine and is then conveyed through sterile pipes to the bottling room in an adjacent building, where it is bottled by machine, and aluminum hood caps are automatically put on. At no stage in the whole system is the milk exposed to any possible human or atmospheric contamination. The air in the milking chamber is conditioned so as to give the proper temperature and humidity, as well as complete freedom from dust and dirt. After each use, the milking machines on the rotolactor are automatically rinsed in clean cold water, then sterilized in clean hot water.

PRIOR to admission to the milking line, the milk of each cow undergoes laboratory examination, as does also all milk cited by the foremilker. In addition, the whole milk supply is routinely tested once a week, and the cows themselves are examined at regular intervals by competent veterinarians. Before each milking, a careful inspection of the udders is made, and every animal gets a thorough physical inspection before being admitted to the milk line. The employees are likewise given complete periodic medical examinations, supplemented by the necessary laboratory analyses. A daily medical inspection is made of all workers, so that every possible precaution is taken to guarantee a safe, dependable milk supply unmarred by any possibility of contagion.

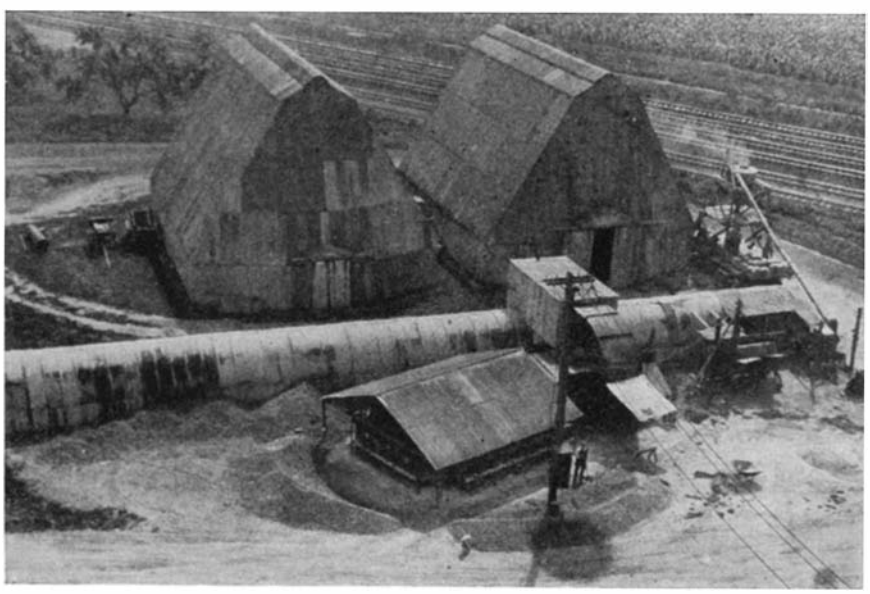


Operation of the device is as follows: A—Cow steps on platform; B—Cows washed in part automatically; C—Cows dried; D—Milking apparatus attached; E—Platform moves 15 feet a minute; F—Teat cup taken off; G—Stanchions released allowing cows to step off platform and return to the barn; H—Milk dumped automatically, weighed, and piped to bottling room; J—Milking apparatus washed with cold water; K—Milking apparatus sterilized in hot water and then cooled by cold water. Fifty cows are milked in the space of twelve and one-half minutes. Visitors view the operation through glass windows inside the circle

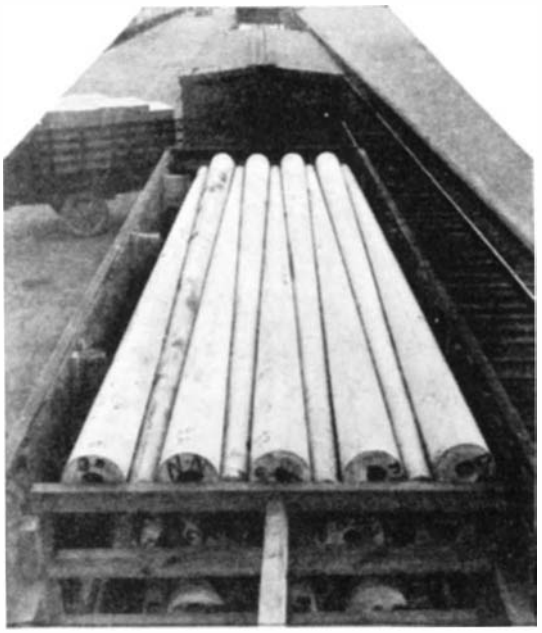
The rotolactor is not the only unique machine at the Walker-Gordon farm. Several years ago there was devised a feed dehydrator for drying and preserving the green feeds raised during the summer months. As now used, this dehydrator consists of a metal tunnel 40 feet in length and 7 feet in diameter, which is slowly revolved. At the receiving end, set about six inches higher than the discharging end, is an oil-burning furnace and heat chamber. Green forage is run through a chopping machine and then into the dehydrator, from which it emerges as dry feed. The temperature used does not adversely affect the nutritive properties.

This dehydrator is put to still another important use. When it would otherwise be idle at night, it is employed for the drying of the manure which is usually a serious problem on dairy farms. A separate platform and elevator are installed for this purpose and from it the manure comes out in a dry, pulverized form, free from odor, and valuable as a base for fertilizer.

The development of the rotolactor and of other machines is all part of a general system of centralized direction and decentralized unit operation, that has been evolved under the direction of Mr. Henry W. Jeffers, president of the Walker-Gordon laboratories. Mr. Jeffers himself is the originator of the rotolactor, although it was actually designed and installed by the engineers of the De Laval Separator Company. In the future operations under this general plan, the 1400 dairy animals are to be handled by individual farmers under expert supervision.



The dehydrator is 40 feet in length and 7 feet in diameter. Green forage enters at one end and emerges dry. At night or when idle it is used for drying manure



Compact loading of a railroad gondola with a shipment of the new hollowspun concrete piles

CENTRIFUGALLY-SPUN CONCRETE PILES

By L. R. NEED

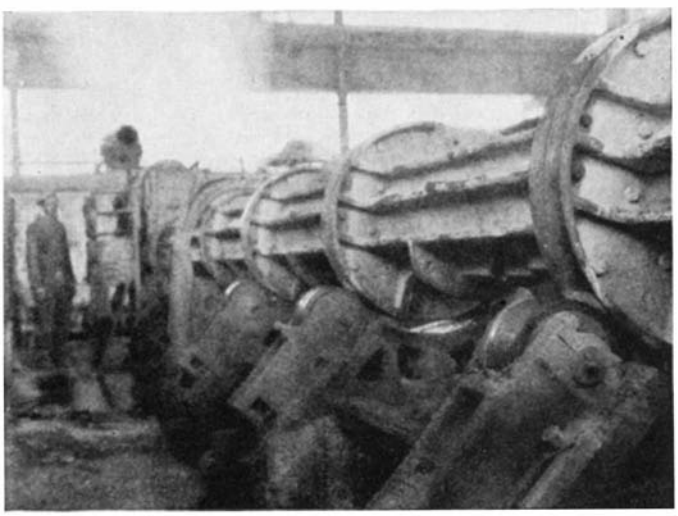
Westinghouse Electric and Manufacturing Company, Cleveland Works

PRESENT day engineers are constantly striving to improve on their handiwork. No sooner is one achievement announced before we hear of plans and projected developments to design and build something better to surpass all previous achievements. The idea seems to be to break all records as fast as they are made.

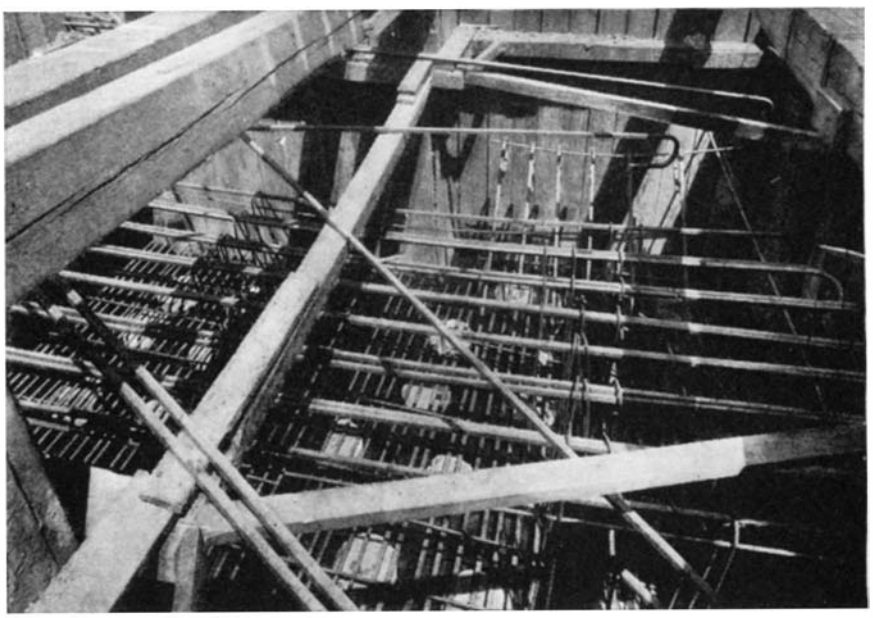
This is particularly true in connection with larger, taller, and more beautiful buildings; longer and more massive bridges to accommodate the ever-increasing traffic; and the like. Such modern structures introduce many phases of engineering which are not familiar or visible to the average layman. One phase is that concerning foundation requirements. Where conditions permit, excavations are made to bed rock which forms a firm foundation for the superimposed structure. But in cases where it is impractical to excavate to bed rock, some other supporting means must be provided. For this purpose various methods are in use, one of which is to support the structure on piles made of wood, concrete, or steel driven into the ground to such a depth that they form permanent supports.

The Westinghouse Electric and Manufacturing Company, who for several years have been making hollowspun granite street lighting standards and trolley poles, have now developed a hollowspun concrete pile. Their engineers have perfected this new pile after intensive research, study, and numerous actual field tests.

These piles are manufactured by the centrifugal process which insures a quality of concrete which is unexcelled as to strength, durability and resistance to fire, water, and atmospheric conditions. These desirable qualities are, of course, very essential in concrete for foundation work. In this centrifugal process, a cast-iron mold is used in which is first placed the necessary reinforcing steel consisting of longitudinal bars spirally wrapped with steel wire. The mold is then filled with concrete and the ends are sealed, after which it is placed in the spinning lathe and revolved at a speed of approximately 400 revolutions per minute for 10 minutes. This lathe consists of a series of rollers on which the mold revolves, the electric driving mechanism being located at one end. The process of revolving the mold is very similar to ordinary lathe operation except that a quick-detachable, flexible connection is maintained between the mold and the lathe face plate to provide an efficient method for setting up the mold and, also, to reduce the wear and tear on the driving mechanism.



This spinning process forces the concrete away from the center of mold and by centrifugal force compresses it against the inside surface thus forming a hollow structure of very dense concrete with the desirable minimum amount of water. All excess water is

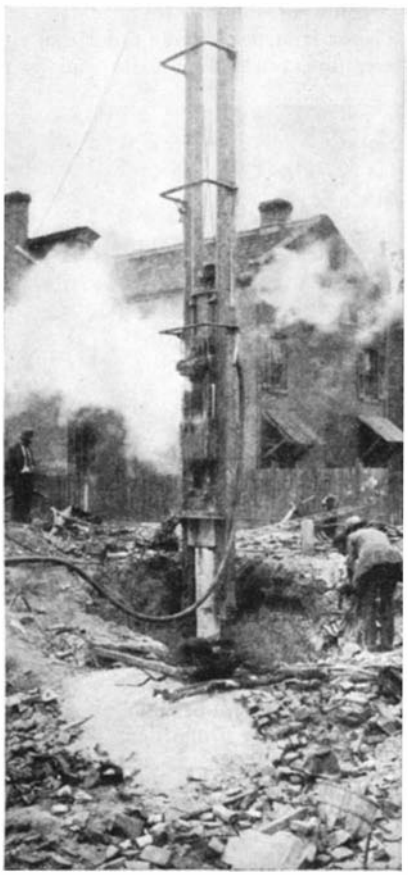


Center: **The concrete pile mold on its supporting wheels in spinning lathe.**
At bottom: **Concrete piles showing capping arrangement for pier foundation**

squeezed toward the center and afterward drained off. After removal of water, the mold is immersed in a curing tank of hot water in which it remains for three hours. At the end of this three-hour curing period, the mold is stripped from the pile and returned to the assembly department for use in making the next pile. The completed pile, if it passes inspection, is now ready for hydration or further curing in a saturated atmosphere. After this second curing process of 10 or 12 days duration, the pile is ready for stock or shipment.

Realizing the importance of obtaining actual data on the strength of hollowspun piles to withstand punishment of the driving hammer and to support the necessary loads, the company proceeded to make a series of tests before placing their piles on the market.

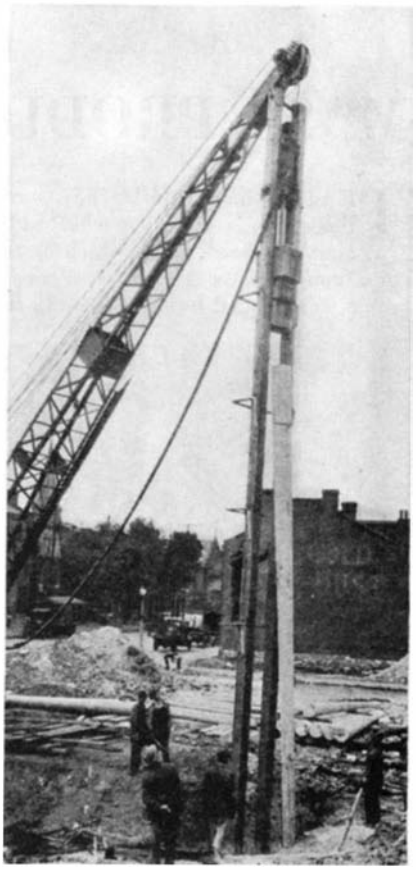
ONE test made at the time this company was having a building erected on its own premises, consisted of driving several hollowspun piles to refusal, that is to bed rock, after which they were removed to a testing laboratory and tested for compression strength. These tests show load values of 200 tons with the piles functioning as columns, that is as point-bearing piles. As the average specifications call for a maximum load of 30 tons per pile, it is evident that hollowspun piles give a high factor of safety when considered as point-bearing piles. When used as friction piles in which the load is carried by the surrounding earth, the supporting power depends to a large extent upon the nature of the soil into which they are driven. There are formulas in common use which determine the bearing power of piles. These are based on the various conditions under which piles are driven, such as type and weight of driving hammer, height of fall of hammer, penetration of pile in inches per blow for the last few blows, and so forth. Hollowspun piles have been driven in different soils in various parts of the country and have been highly praised for their toughness and ability to stand up under very severe punishment.



Under the hammer, a concrete pile "goes home" without any breakage

One of the new piles is lifted from the supply at the site of a new building in Buffalo, N. Y.

Another test to determine the supporting power of a hollowspun pile was made on the site of the new Westinghouse Service Building at Newark, New Jersey. The pile tested was a representative one 28 feet long with a seven-inch diameter point and 14-inch diameter butt driven into the ground to a depth of 26 feet 6 inches. A platform was constructed and mounted on a steel plate embedded in mortar on top of the pile. Loads were applied on this platform at regular intervals until a load of 60 tons was reached. This 60-ton load, representing twice the working load, was left on over-night for a period of 16 hours 30 minutes, and then removed five tons at a time.



A 35-foot hollowspun concrete pile lifted ready for driving to begin

Settlement readings taken during loading and unloading indicated a net settlement of 3/64 of an inch at 30 tons and 3/16 of an inch at 60 tons. Examination of the pile after this test indicated no cracks or signs of distress.

HOLLOWSPUN piles, like other concrete piles, are driven with standard pile hammers, either single or double acting. As a protection to the top of the piles, cushioning material is frequently placed between the anvil block of the hammer and top of pile. This prevents damage to pile in cases of uneven tops and also where the pile is not kept dead true with the hammer. Various materials such as oak blocks, old manila rope, belting, or hose are used for this cushion.

After driving, preparations are made for capping the piles with concrete. These foundations are then ready to support columns, girders, walls, or whatever is required for the structure to be erected.

Proper engineering in the design and use of piles to meet local conditions will insure firm foundations with corresponding safety and durability. Hollowspun piles are admirably suited to meet the variable conditions encountered in different parts of the country and their adoption by various construction companies is evidence of their reliability.

MASS PRODUCTION OF PRESERVED FOOD

THAT sentiment and business sometimes mix is shown by a little two-story red brick house which nestles in a courtyard in Alleghany, Pennsylvania, surrounded by more than 15 city blocks of imposing factories all devoted to the vast industry that was the direct outcome of the work which was done in a portion of this small house. The little structure was moved on a barge to its present location from Sharpsburgh. It is now an inspiration to thousands of employees and a delight to many thousands of visitors.

All photographs courtesy H. J. Heinz Co., Pittsburg

A "hulling bee" in a food plant. The luscious strawberries will be made into preserves. Home canning cannot compete with mass production

AT the age of eight, Henry J. Heinz began to raise vegetables in his mother's kitchen garden at Sharpsburgh and peddled them among his neighbors from a market basket. The young man was so intrigued by seeing the fruits and vegetables grow, as it were, under his very eyes that he decided to make this his life work. As the boy grew, so did his business and the basket was first exchanged for a wheelbarrow. When he was sixteen he drove his own horse and wagon and had four on his payroll. He sold his produce largely in the neighboring city of Pittsburgh. Still he was not satisfied and in 1869 he began his vast enterprise by grating, preparing, and bottling horseradish in the little red brick house at Sharpsburgh. From this humble beginning there are today 25 factories, 253 salting houses, and raw products receiving stations having an aggregate floor space of 130 acres. The plants use the product of over 200,000 acres harvested by 200,000 people.

Entering one of the factories, the visitor is struck by the order and rigid cleanliness which prevails, and by the interest which the employees seem to take in their work. This staunch solidarity was induced originally by the personal influence of the founder who had an extraordinary gift of inspiring his associates. Even when success had crowned his efforts and the plant waxed large he thought nothing of taking off his coat and showing a laborer a better way of loading bricks on a wheelbarrow.

The experimental kitchen with its staff of chefs is constantly devising new subtleties of flavor and a committee of trained experts passes on their work and also sees that standards are maintained. It must not be supposed that all the work is done in one location. Plants are scattered all over the country and even to Seville, Spain, where olives are bottled and olive oil is produced. It is impossible to describe all the varieties of food products; the mystic number "57" never grows less, but no products are added unless the public taste ap-

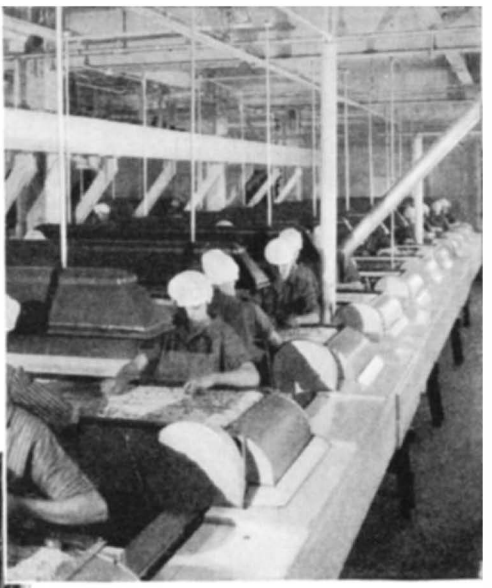
Hand packed pickles always display the same pattern. Great skill is necessary in placing the pieces

Preserving room has a battery of silver-lined copper kettles heated by steam. The kettles are double jacketed so that there is no danger of scorching the contents

proves. It is indeed a wonderful advertising slogan.

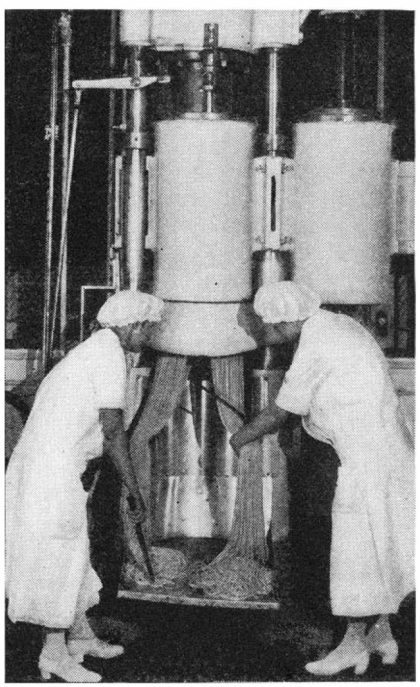
The preserving kettles are silver-lined and are heated by steam. All the operations are carried on with a strict temperature control. An interesting process which always attracts visitors is the canning of the lowly bean. Moving belts charged with beans glide between rows of keen-eyed girls who pass only those beans which are perfect. Then they are baked with dry heat, put in cans and the sauce and the pork added to those cans which are not "vegetarian."

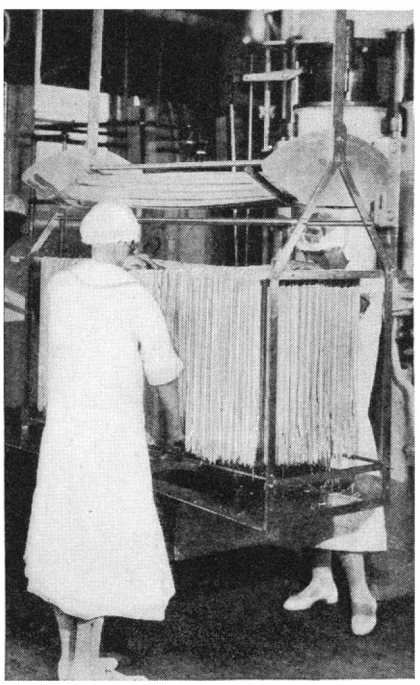
Equal care is devoted to the preparation of spaghetti, a food which is peculiarly sensitive to atmospheric conditions. All the air which enters the spaghetti department is filtered. Fine Durum wheat flour is mixed with water and the dough is mechanically kneaded, after which it is extruded into strands by a powerful hydraulic press. These strands are "bobbed" or cut to equal length and are then placed in a drying compartment. Finally the dry spaghetti goes to the kitchen where it is cooked and canned and a blended sauce of cheese and tomato is added. In the manufacture of tomato catsup, kitchens have been established in the region where the tomatoes are grown, so that they may be converted into catsup while still in prime freshness.

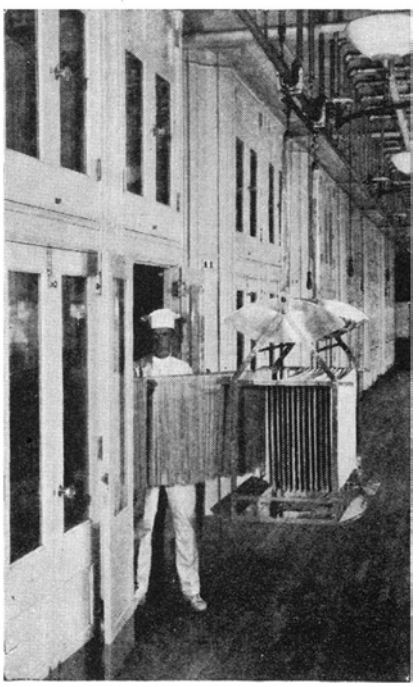


Top: **The beans are all sorted by hand, passing the keen eyes of several girls before they reach the oven for baking.** *Above:* **The bean filling rigs put the beans in the can.** *Left:* **Placing the pork on the baked beans**

Salting houses are located in the centers of cucumber raising districts. The cucumbers, immediately after being picked, are salted and then transported to one of the larger establishments in specially built cars. Vinegar is aged for months in huge wooden tanks to develop a flavor, for vinegar has other qualities besides sourness. Having the pickles and the vinegar, packing proceeds. Few people realize that bottles of plain and mixed pickles are all packed according to a definite plan. It is fascinating to watch the skill with which the expert pickle packers develop the pattern in the bottle. Rigid inspection assures that every pickle has its established position in the bottle. Every bottle of mixed pickles is arranged in the same pattern.







Spaghetti production. *Left:* **The Durum wheat flour is mixed with water, kneaded, and forced into strands by extrusion.** *Center:* **The strands are "bobbed" by girls to give them the right length.** *Right:* **Spaghetti on racks is placed in a drier**

The Commissioner of Salt Revenue, Northern India, making inspection

Fresh water for drinking reaches the salt making area on camels

Transporting pan salt by means of pack animals, human and bovine

An overseer measuring the mounds with a stick, as told in the article

SALT MAKING

By C. F. STRICKLAND
Indian Civil Service

ONE of the most important industries in India is the production of salt. Every human being, every animal, and a number of industrial enterprises must consume salt in one form or another, and the total annual demand of that vast country, with 330,000,000 inhabitants and 300,000,000 farm or transport animals, is no less than 2,000,000 tons, at the rate of about 13 pounds per human head. One quarter of this amount is imported, chiefly from Egypt and Aden. Of the remaining 1,500,000 tons, two parts are produced in sea-salines on the shores of Bombay and Madras (a little also in Burma), while 500,000 tons are excavated from rock-salt mines in the low hills of the Punjab, or made by evaporation from lakes and pits in the deserts of Rajputana.

The largest Rajputana source, yielding an average of 250,000 tons annually, is the Sambhar Lake on the boundary of the Jaipur and Jodhpur States. Though fed by four seasonal torrents in the hot months of the year, and covering at its maximum an area of 90 square miles, the lake dries up rapidly on the cessation of the monsoon rains in September, and is frequently dry by March or April. The salt is of high quality, containing 98 percent of sodium chloride; the remaining elements are sulfates and carbonates of soda without magnesium. It is extracted from the brine which collects in the lake during the monsoon rains.

The primitive methods of manufacture were either the scooping of salt from the bed of sections, roughly enclosed in the lake itself with barriers of grass and stakes, or its collection from small pans in the mud at the edges. The former process is now obsolete, and the latter is dwindling from year to year. However, petty contractors still employ each a handful of laborers to bank up the pans, measuring 100 by 50 feet, and to extract the product. The salt is white and good, but of small crystals and inferior to that of the government evaporating plants. It is collected in small mounds and carried to an accessible and level spot on higher ground. Each laborer there again makes a mound of what he has collected. Its density and dampness are tested by weighing a sample from each mound, and the total weight is then estimated by means of an official rod laid on the sloping side of the pyramid. A tally is kept of each man's output and he receives daily payment. All the salt is then carried in headloads to a main heap, and becomes the property of the government.

The salt is usually allowed to settle and dry for a period of 12 months, after which this "pan-salt," lying at points somewhat remote from the railway sidings, is sold to *banjaras* (hawkers and peddlers), who arrive from all directions with carts, oxen, camels, and asses and carry it off to the outlying villages of the Indian States in Rajputana.

THE main output in these days is derived from the large *kyars* constructed by the British Government. A *kyar* is an embanked enclosure measuring sometimes as much as 4000 by 1500 feet, and including from 20 to 60 flat pans. The surrounding bank is high and pitched with stone, and the pans within it are divided by low ridges of mud, on which narrow pathways are laid for laborers. The floor is of lake-mud, but can be improved by a layer of sand on which cleaner salt crystals are formed. Brine is admitted from the lake at a density varying from 3 degrees by the Beaumé

Making big heaps out of little ones by a primitive "telpherage" system

The man seated in the foreground is keeping tally of the salt weights

IN INDIA

hydrometer after a light monsoon to 10 degrees after heavy rains. Its density is gradually raised within the pans by evaporation during the cold and rainless season from October onward, brine of lighter density being introduced from reservoirs to check the process if evaporation is too rapid to allow the steady and even deposit of salt crystals on the bottom of the pan.

The "accretion" system, which has been employed since 1923, results in a more orderly deposit than the older system of successive "crops," and has been rendered possible by the increased reserves of low-density brine in the recently added reservoirs. Each *kyar*, and if necessary each pan, can be matured at a chosen date throughout the cold season, and a more permanent force of laborers retained than was practicable on a method of "crops" which matured all the pans in a short period from March to May. Temporary labor is more expensive and less efficient; the scalding heat of the brine in the pans after midday during April and May also precludes a full day's work; it is therefore better to carry on the extraction regularly during the cold months, as can be done by accretion.

Salt crystallizes at 25 degrees to 29 degrees Beaumé; at the latter figure the laborers with their baskets enter the pan, scrape up the salt with shovels, and carry it away on their heads. The system formerly used required them to pile it in great heaps containing each about 2000 tons.

Payment at the rate of one pice (half a cent) for each load was made by an agent seated at the foot of the inclined path. A few such heaps are still built up beside the railway sidings which run into the *kyars*, though most of the salt is carried directly to a central storage place.

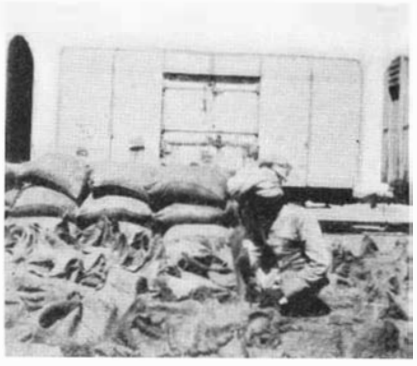
After settling and drying for a year, a heap is approved for issue, the salt is filled into bags, each of which is weighed, sewn up, and loaded in freight cars. Indents are handed in by merchants at Government Treasuries, and forwarded to Sambhar, where the salt officers select, bag, load, and despatch the salt. The cost of manufacture at 4 annas per maund (8 cents for 82 pounds) is recovered from the buyer, together with an excise duty at Rs.1/4/0 (44 cents), from which the Government of India receives an annual income of 25,000,000 dollars for all the salt of the country.

THE Sambhar works were re-organized and modernized in the years 1920-3 at a cost of 1,250,000 dollars. A dam two miles in length has been thrown across the end of the lake nearest to the salt works, converting the enclosed area into a reservoir of five square miles. The brine is pumped over the dam into this reservoir in the rainy season from the main part of the lake, and serves to supply the *kyars*. Permanent (meter-gage) or temporary (two-foot gage) sidings now run into the pans themselves, where the salt is directly loaded into trucks and hauled up a ramp to the top of a great open salt pile, the contents of which may at the fullest period amount to 200,000 tons.

To scientific manufacturers of salt the methods described may appear to be comparatively simple. It must, however, be remembered that India is a land with a low standard of living, which can bear only light taxation, and can not face the cost of an expensive installation. At all events the new method of recovering salt, as applied at Sambhar, represents a great advance on the primitive system of manual labor and scattered heaping, described earlier in the article, which has hitherto been in force.

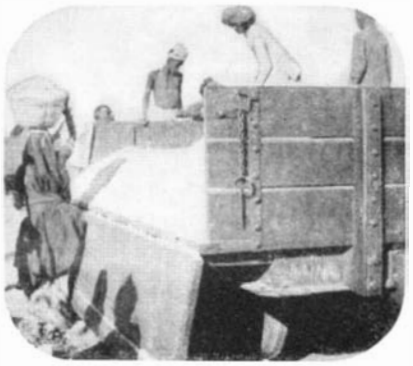
Transport on donkeys. In India this form of "gasoline" is cheap

Spindle-legged laborers, men and women, extracting salt from a pan

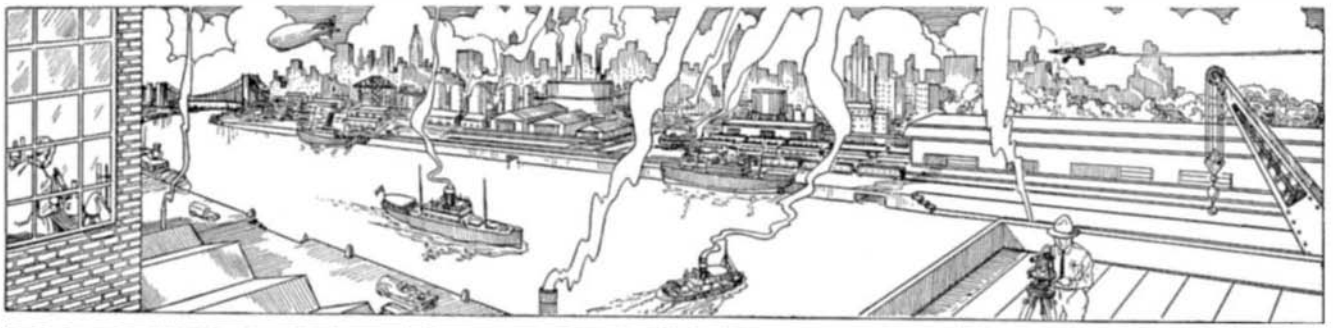


A workman sewing up the bags for shipment on the Indian railroads

A train of "trucks" discharging salt on top of a great central storage pile



Loading salt at the pans. It is dumped into "trucks" (gondolas)



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Large-Scale Insect Trapping

IN the summer of 1929 approximately 17,500 Japanese beetle traps baited with geraniol were used by the United States Department of Agriculture in lightly infested areas, and in 1930 the number was increased to 25,583. The department recommends trapping only where there is a light infestation. The baited traps attract beetles from a great distance and if used in heavily infested areas would draw abnormal numbers from neighboring properties to the property where the traps were used. The cost for bait and for operating the traps was $1.66 per trap in 1929 and $1.63 in 1930.

A new slot machine for dispensing cigarettes has been introduced in England. Five seconds after a penny is inserted, a lighted cigarette is delivered ready for the consumer

Synthetic Ham—What Next?

THE economic advantage of the cotton seed was stressed by David Wesson, technical director of the Southern Cotton Oil Company and vice-president of the Wesson Oil Company in a recent talk before the Rochester Section of the American Chemical Society. The title of his talk was, "Why the Cotton Seed?"

A new food product resembling ham in aroma and flavor was shown by the speaker and after his talk sandwiches prepared from it were served to the members of the audience. The new product is made by de-oiling cotton-seed meats, mixing the resultant material with vegetable shortening and water and then cooking it. The cost of the food, figured on its protein content, will be approximately five cents a pound, according to Dr. Wesson, as compared to a cost of between two dollars and $3.50 per pound of protein for meat products and 13 dollars per pound of protein when this material is consumed as lobsters. The product is in an experimental state at present but arrangements are under way to produce it in ton lots.—*A. E. B.*

Winter and Summer Sunshine

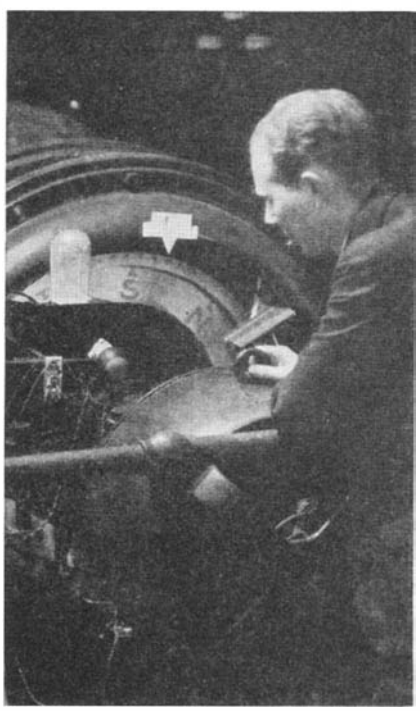
IN Toronto investigators found that a sharp increase in the ability of sunshine to prevent rickets occurred about the first of March. Colorado, the land of sunshine, has recently been subjected to a similar study by Drs. R. C. Lewis, G. M. Frumess, and H. B. Stein. They found that winter sunshine in Colorado contains a high concentration of biologically effective ultra-violet light and that there is no marked difference in the ability of winter and of summer sunshine in Colorado to prevent rickets. They feel that the reason why Colorado sunshine has such little seasonal variation is the fact that the relatively short-wave radiations reach that section throughout the year as a result of the high percentage of winter sunshine, the low humidity, and the small amount of smoke in the air.—*M. F.*

A New "Whirling Watcher"

A NEW type of stroboscope, a scientific device for "stopping" motion to study the behavior of machines operating at high speed, has been developed in the department of electrical engineering at the Massachusetts Institute of Technology.

The name stroboscope means "whirling watcher," and these instruments have long been used to study motion. The new type of stroboscope, which was developed at M. I. T. by Harold E. Edgerton, a member of the instructing and research staff, opens up a new field of research in that it permits "stop-motion" photography of moving machinery. Photographic exposures with the new instrument are made in a hundred-thousandth part of a second.

The unique feature of the new stroboscope is the electrical circuit which causes a condenser to discharge periodically through a thyratron mercury-arc tube. An intense blue actinic light of extremely short duration, precisely timed to correspond with the speed of the machine under observation, is produced by a large current through the tube, and makes it possible to adapt the stroboscope for photographic as well as visual observation. In the study of a synchronous motor, for example, the flashes occur as the north and south poles reach a given point in their whirling course. The thyratron is a tube that has been developed during recent years by the General Electric Company.



This photograph was taken with the aid of a new thyratron mercury-arc tube. The "N" and "S" on the poles of the 160-horsepower motor are moving past the camera at a ground speed of 95 miles per hour

NEW YORK LIFE INSURANCE CO.

51 MADISON AVENUE, NEW YORK CITY
(INCORPORATED UNDER THE LAWS OF THE STATE OF NEW YORK)
A MUTUAL ORGANIZATION, FOUNDED IN 1845

EIGHTY-SIXTH ANNUAL STATEMENT

TO THE POLICY-HOLDERS:

Most of us have labored together for a considerable period.

My service in Nylic has covered forty-two years. I have been President of New York Life Insurance Company for nearly twenty-four years.

In twenty-four years you have numerically been multiplied by three; and your collective property in this Company has been multiplied by three and a half.

You have made a great demonstration within a generation of the power that lies in co-operation between "humans." You have become increasingly convinced of two great truths.

First,— that "no man liveth to himself," and the less he tries to do that the more truly and fully he lives.

Second,—that men are naturally honest and that those in positions of responsibility and trust in business are more honest and much more capable than men are as a whole.

Emerging from the frightful financial disasters of 1930, people are wondering if it was all or in large part necessary. They are asking why such heart-breaking experiences should not naturally cease in countries organized to preserve the strength and the inspiration that lie in individual efforts and in the ownership of private property.

American life insurance reaches its present greatness just in time to answer that question. It is true that we have had in this the freest and most individualistic section of the world (United States and Canada) a disturbing experience. Could it have been avoided substantially? I answer it could and some day such happenings will be largely avoided.

As we emerge from this setback in our economic system we discover that one thing remains unchanged and substantially unaffected.

It is almost literally true that every man who owns property is poorer today than he was a year ago; but to the extent that his possessions are represented by Life Insurance he is as rich today as he was a year ago.

They (his Life and Endowment policies) have not shrunk in value—except as he may have used them as collateral to relieve his needs in other directions.

Suppose the total outstanding insurance a year ago had been 220 billions instead of half that—suppose the assets of the Companies had been 38 billions instead of half that. How much less would the speculation and loss have been in 1930?

Life Insurance Companies will ultimately achieve those totals and greater ones and they will yearly represent an increasing and conservative factor in the whole property problem.

Life Insurance assets are not used speculatively. With relation to our total national wealth those assets represent a steadily increasing factor. They increase the factor of stability and decrease the factor of chance. That gain has been steady for almost a quarter century. Outstanding insurance will double and assets will double long before the wealth of these countries doubles. The lesson of it all is that economic changes of profound significance and of fundamental importance are taking place as the result of the amazing growth of Life Insurance. Life Insurance does all that its devotees have claimed and now it emerges from this world catastrophe substantially untouched and rendering a public service that few people ever realize.

It was organized to mitigate the terrors of death. It has become a valiant and an increasing defense against the economic disasters that periodically devastate the business world.

In other words, we are, through Life Insurance, in these great, free countries, preserving individual enterprise and the rights of individual wealth and at the same time we are utilizing the almost immeasurable power of united and common action.

We are gaining on economic disaster and we shall go on gaining because Life Insurance will go on gaining.

In free countries there is no way to stop speculation; to do that arbitrarily would not be consistent with the principles of freedom. *But!* Yes, a great big *But!* When Life Insurance has become the great reservoir into which the people put their savings increasingly, speculation will become relatively less and we shall finally have adopted almost imperceptibly, a new economic program.

This will be founded on co-operation, brains and fidelity. That's a pretty good description of the elements that have made our Life Companies great—co-operation, brains, fidelity and, I add, hard work.

The balance-sheet above will show what a splendid part your Company is playing in the total.

DARWIN P. KINGSLEY, *President.*

New York Life Insurance Company
BALANCE SHEET—DEC. 31, 1930

ASSETS		LIABILITIES	
Real Estate Owned	$34,307,572.19	Reserves—ample to meet all contractual obligations	$1,588,057,722.02
First Mortgage Loans on Farms, Homes and Business Property	578,255,940.83	Dividends payable to Policy-holders in 1931	72,541,788.00
Bonds of the United States, Other Governments, States, Cities, Counties, Public Utilities, Railroads, etc.	706,752,997.95	All other liabilities	7,455,677.00
Preferred and Guaranteed Stocks	73,662,042.00	Total liabilities	$1,668,055,187.02
Policy Loans, Cash and Other Assets	396,089,181.03	General Contingency Fund.	121,012,546.98
Total Funds for Policy-holders' Protection.	$1,789,067,734.00	Total	$1,789,067,734.00

DIVIDENDS Payable in 1931	NEW BUSINESS 1930	TOTAL RESOURCES Dec. 31, 1930	Insurance in Force Dec. 31, 1930
$72,542,000	$900,897,000	$1,789,000,000	$7,626,000,000

Branch Offices in most of the Larger Cities of the United States and Canada.

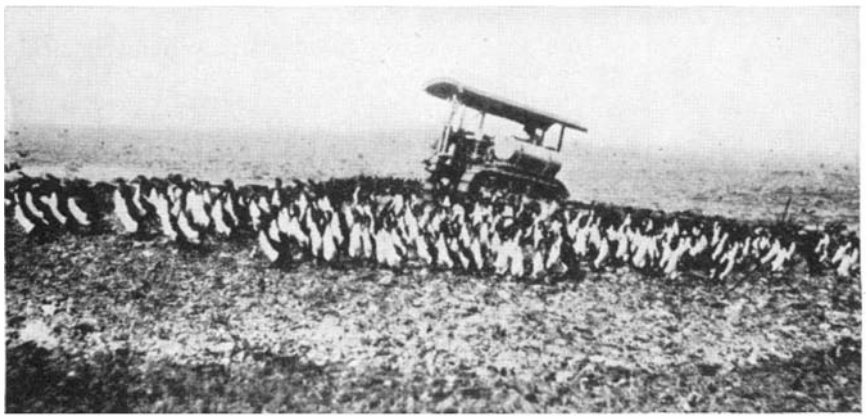
So powerful is the new stroboscope that still and motion pictures of a 160-horsepower motor have been made while the machine was running at full speed. Although the rotor was turning over at a rate corresponding to a ground speed of 95 miles an hour, every detail of the moving parts was shown as clearly as if the machine were standing still. Thus it was possible to study the characteristics of the machine from the moment the power was applied until it reached full speed.

The new stroboscope is being used chiefly to study rotating electrical machinery, but it can be employed to "stop motion" in almost any type of machinery, and will be useful for studying the behavior of cams, springs, valves, and other moving parts.

The instrument will be particularly valuable for the study of electrical machinery. It will make possible highly accurate studies of the angular displacement of motors, generators, condensers, and lines during switching or short-circuit disturbances. In the steel industry and in many other manufacturing processes, motors are often subjected to violent sudden load changes. The new stroboscope will make it possible to see and record photographically just what happens in the motor under such operating conditions.

Muscle Cramps

ONE of the most common complaints in recent years is muscle cramp, a form of pain which is closely related to the condition called "heat cramp." For example, athletes who perspire greatly and fail to get enough water into the body are likely to complain of cramps in the muscles of the thigh and the calf. Workers in extremely hot employment are likely to develop cramps which are related to somewhat the same cause. During hard muscular work, with or without high temperatures, when there is a great deal of perspiration, the kidneys are ordinarily out of action. In such cases there is an enormous output of nitrogen in the urine and retention of chlorides. After the salts are lost by free perspiring and a large amount of water is taken into the body, there is a rise in the diffusion pressure with a prompt onset of cramps. Prolonged sweating increases the concentration of chlorides in the perspiration, and decreases the percentage of chlorides in the blood. The intake of water during a sweat increases the excretions of both water and minerals. It is suggested that the prevention and treatment of such conditions involve taking water to which a small amount of salt is added as, for example, a salt solution from 0.3 to 0.5 percent.—*M. F.*



Guanayes marching and countermarching with the, to them, curious tractor

Machine-Minded Sea Birds

THE guanaye, or Peruvian cormorant, inhabits the islands in the Humboldt current off the coast of Peru. These islands have for a century provided the world with the valuable fertilizer known as guano.

The guanaye is protected by law from any molestation and until a few months ago no motor vehicle or airplane was permitted on or near its habitation. Recently, however, Caterpillar tractors were introduced on San Martin and Santa Rosa islands to take the place of the old-fashioned system of mining the guano by hand, and the birds were carefully watched for signs of anxiety.

On the appearance of the tractors the guanayes immediately manifested the keenest interest and fell into solid military formations in front of and behind the machines, inspecting every detail of the work in progress with profound enthusiasm. Indeed they marched and countermarched in such numbers that the tractors were operated only with the greatest difficulty.—*The Grace Log.*

Radio Pillow Sings to Sleepy Ear

A SPONGE rubber pillow that sings and talks to an ear placed upon it is the latest product of a radio company of Camden, New Jersey. It is intended for use in hospitals. A radio unit within the pillow is connected to a central radio receiver. So quiet is this type of installation that only the patient with his head on the pillow can hear the radio program.—*Science Service.*

Radiator Fluid Doubles Machine Gun Firing Capacity

ARMY officers at Aberdeen Proving Ground have doubled the firing capacity of machine guns by using ethylene glycol, a chemical employed to keep automobile radiators from freezing.

In experimenting, the officers substituted the fluid for water in the cooling mechanism of the guns and found that they could shoot twice as long as formerly. The fluid, it was discovered, ceased boiling almost as soon as the order to stop firing was given.

Water, it was said, continued to boil in the gun's jacket for some time after cessation of fire. They added that the loss by evaporation was almost twice as great with water as with the chemical.—*The New York Times.*

Sonic Altimeter for Fog Flying

AN instrument which would give a pilot indispensable aid in fog flying would be a height indicator or an altimeter independent of weather conditions—which the ordinary altimeter based on barometric principles is not. The General Electric

Photographs courtesy *The Grace Log*

The old method for harvesting guano for fertilizer. It is broken up by hand and packed in bags ready for shipment

With modern methods, the guano is broken up by means of tractors, thus replacing the method shown at the left

Industry daily finds new uses for this all-purpose board

GLANCE over the articles listed on this page. Masonite Presdwood helps to build them. Their makers will testify that, with Presdwood, they are better and more durably built, at a decided economy in manufacturing cost.

Presdwood is a versatile product. Each day brings new uses, and each new use suggests another. Its users quickly endorse the idea of "making it out of Presdwood." Somewhere in your own business, very likely, Presdwood can be of service to you . . . and it will serve you well.

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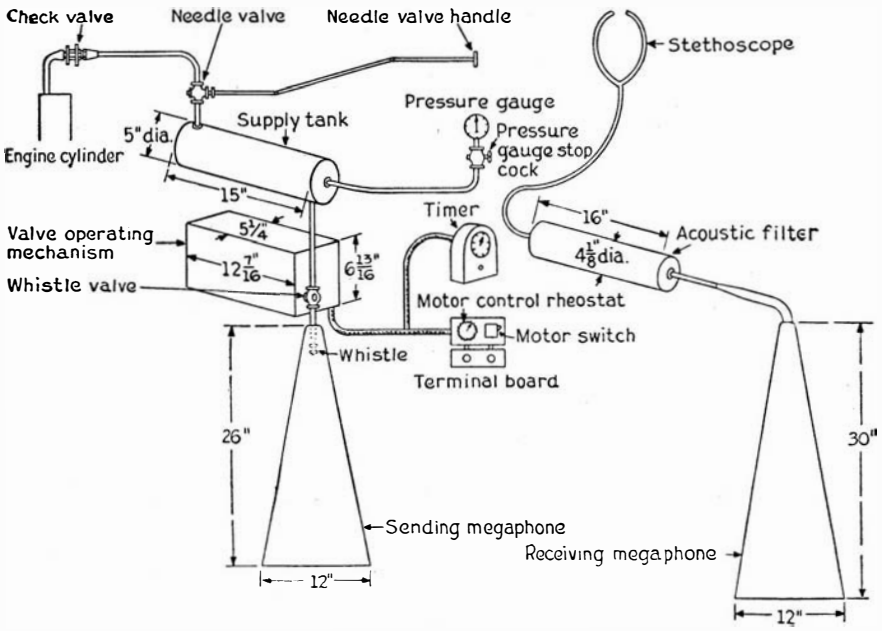


Diagram of the important parts of the new sonic altimeter

Company has now developed a sonic altimeter, which has been successfully tested by the Army Air Corps and which appears to meet this long felt want.

The sonic altimeter will give to the pilot the uncanny faculty the bat is said to possess—that of measuring distance from an object by the time which a sound takes to travel to and be reflected from the object. At least that is the time-honored explanation of the bat's ability to fly in pitch darkness and yet avoid all obstacles. The bat apparently emits a very high pitched note imperceptible to human ears.

The source of sound in the sonic altimeter is a specially designed high-frequency whistle, mounted in a megaphone which points down toward the earth. The air supply for the whistle is obtained by "bleeding" one of the engine cylinders through a check valve into a small storage tank. The supply of air required is so small that the functioning of the engine is not affected.

The receiving apparatus consists of a megaphone, also pointed downward, mounted in the tail of the airplane to receive the echo. This receiving megaphone is connected to the pilot's ears by a tube which terminates in an ordinary pair of stethoscope ear-pieces. An acoustic filter in the listening line reduces the engine noises.

The operation of the device is as follows: The pilot opens a needle valve which allows the check valve to pass air to the tank up to about 100 pounds pressure. At the same time he closes the switch which starts the motor-operated whistle valve. He also places the stethoscope ear-pieces in his ears. Each time the whistle valve sends out a blast a pointer on a timing point starts moving uniformly around its scale. The time taken to hear the echo is a direct measure of the height, and the scale on the timer is so arranged that the height is read directly.

We can imagine the pilot guided to a field by a radio beacon, informed of the boundaries of the airport by an electromagnetic signaling system, and making a safe landing by measurement of the height above the ground by use of the sonic altimeter, all in the densest fog. Altitudes of as low as 50 feet and as high as 1000 feet can be accurately determined by this instrument, which should certainly increase safety to a marked extent.—*A. K.*

International Aviation

IN the first chapter of his book, "International Control of Aviation," Professor Kenneth W. Colegrove summarizes in splendid fashion the problems of international aviation. One phase concerns the regulation of aircraft in the course of interstate journeys. The second includes the development of airlines and manufacture of aircraft by governments as a means of promoting their trade, colonial expansion, and national defense. A third phase concerns the regulation and limitation of aircraft as a weapon of war.

The first problem is a matter on which jurists and statesmen have long worked. Is the air free, or has a government absolute sovereignty of the air above its borders? What is the nationality of aircraft? Should it be registered under a flag? Should the nationality of the proprietor determine the nationality of the aircraft? What if the pilot is of different nationality than the proprietor? The movement toward international control is confronted with the problem of determining what questions properly belong to international regulation and what should be left to individual states.

Nationalistic rivalries, with the airplane as a new medium, is a subject to be pondered by statesmen and peoples. Should nations take on the burden of airlines, in themselves unremunerative, as a matter of national defense?

Finally what of limitation of military aircraft? Battleships may be scrapped, but will peace be furthered thereby, if powerful aircraft are built without limitation?

Professor Colegrove's splendid book gives much food for thought. Apparently not only the engineer and operator have thought seriously of aviation.—*A. K.*

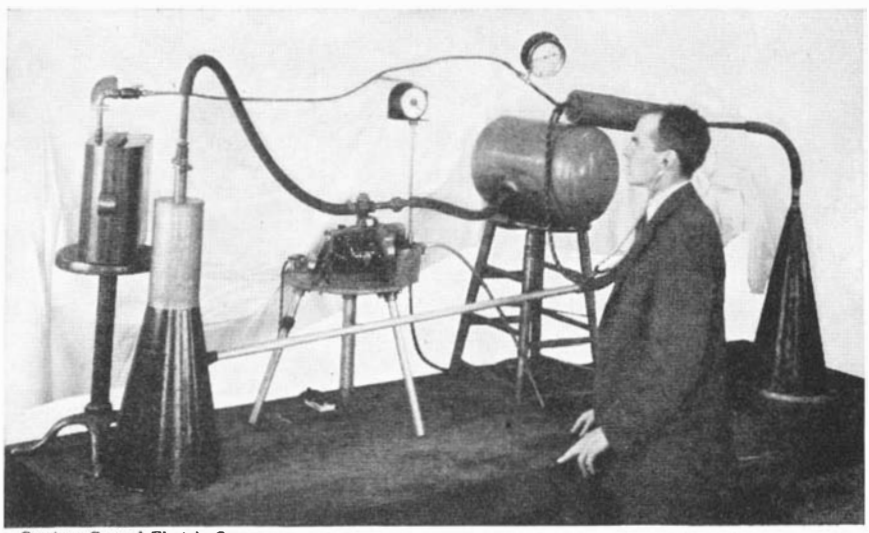
The Focke-Wulf "Ente"

THE type of plane known as "Canard" in French, "Ente" in German ("duck" in the vernacular), is not new. Santos-Dumont tried a Canard way back in 1907, calling his craft thus because of its resemblance to a duck in flight, and in 1908 Voisin made experiments with a similar type. In the United States, our readers may recall the efforts of Lieutenant Fernic, who perished in an unfortunate flight with a machine of similar design. Focke, in Germany, however, seems to be carrying on experiments with this type of "tail-first" airplane with fresh determination and success.

There are several advantages which may perhaps be considered inherent in this type of plane.

First of all, the Canard type cannot readily nose over even in the worst landing, because the center of gravity is so far behind the nose of the machine and the small front wheel.

Secondly, it is very difficult for the Canard type to stall; that is, have its wing meet the wind at too large an angle. The auxiliary wing at the front is placed at a larger angle of incidence than the rear or main wing. If the airplane noses up too much, it is therefore the front wing which "stalls." When this happens, the nose of the machine loses lift, and therefore the craft as a whole noses down. Stalling is avoided and this means the prevention of



Courtesy General Electric Company

The actual mechanism that constitutes the sonic altimeter

the dreaded, and very often fatal, spin.

Third, the occupants of the craft have a certain protection in the fact that the nose of the machine is so far from their compartment. Even if the machine crashes head on into the ground, most of the length of the fuselage acts as a shock absorber.

The mounting of two engines out on the wings is another measure of safety. Even if the engines let go, on a crash landing, they are not likely to injure the occupants.

The latest Ente is illustrated in our three photographs. It is powered with two Siemens Sh-14 engines of 110 horsepower each and its specifications are: Length over-all, 34 feet 6 inches; wing span, main wing, 32 feet 10 inches; wing span, forward wing, 16 feet 5 inches; area of main wing, 317 square feet; area of forward wing, 64.6 square feet; weight empty, 2585 pounds; disposable load, 1045 pounds; gross weight, 3630 pounds; maximum speed, 88 miles per hour; cruising speed, 80 miles per hour; landing speed, 52 miles per hour; climb to 3280 feet in 8.3 minutes.

These performances are not high, but then the Ente is quite heavily loaded in proportion to its power. Also there is a source of inefficiency in the fact that there is an auxiliary wing ahead to disturb the air flow over the main wing.

In its structure the Ente follows more or less conventional lines. Immediately in front of the leading edge of the main wing begins the three-place passenger cabin entered by a door on the right side. In front of the passenger cabin the top of the fuselage sweeps down to the pilot's cockpit. The fuselage ends in a blunt point above which it supports the front wing on a series of struts.

The forward wing is trapezoidal in shape. Its trailing edges are recessed for the elevators. These are balanced and supported by a number of brackets, so that a slot is formed between the fixed auxiliary wing and the elevators. The slot becomes narrower when the elevators are depressed for climbing, and larger when they are raised for nosing down.

Because the center of gravity of the machine lies so far back, the vertical fin has to be made of enormous proportions, so as to equal the effectiveness of a moderate fin on the conventional airplane, placed far back of the center of gravity. To the large fin is attached a large narrow rudder. Even with these large vertical surfaces some difficulty appears to have been met in keeping the plane on a straight course. That is why two relatively large fin surfaces have been placed outboard under the wings, at a point between the engine nacelles and the wing tip. These wing fins are toed-in, perhaps to help counteract the offset torque, if one of the two wing-mounted engines fails.

This original design gives a certain amount of promise and results of experiments with it will be carefully followed in the United States.—*A. K.*

Overseas Travel Greater in 1930

MORE Americans traveled abroad in 1930 via the Port of New York than ever before. For 12 months up to the end of November 1930, a total of 673,445 United States citizens passed in or out of Sandy Hook, an increase of 27,553 over the same period ending November 1929. Also during the same period, 34,296 more non-emigrant aliens departed than in the previous year.

These increased movements more than offset the drop in the number of inbound aliens bound for these shores, and which has been brought about by a downward revision in national quotas and stricter supervision of admittances.

New Line of Scale Model Airplanes

THE new line of model airplanes shortly to be introduced by the Selley Manufacturing Company, Inc., of Brooklyn, New York, with the approval and co-operation of the Curtiss-Wright Flying Service, is expected to establish a new vogue among the model enthusiasts of the country. The models are scale-reduction, non-flying models of the more popular Curtiss-Wright ships. They will be sold in complete construction sets through the Curtiss-Wright distribution facilities and will also be available to toy dealers throughout the country.

The kits will be packed in a modern and attractive cardboard box, sealed by the manufacturer to prevent loss of any of the parts. They will be known as the "Official Curtiss-Wright Models" and will be marketed partly under the supervision of the Curtiss-Wright Flying Service, Model Division, 27 West 57th Street, New York City.

The first three models will be the Curtiss Hawk Pursuit plane, the Curtiss Condor transport plane, and the Travel Air Mystery S racing type plane.

While these models are non-flying, scale reproductions, the plans are accurate enough for an expert model builder to make them into flying models.

Above: **Focke and his pilot Edzard in front of the Ente. This view shows plainly the auxiliary surfaces placed at the extreme nose of the fuselage.** ***Right:*** **The forward auxiliary wing, showing mounting, elevator, and slot**

A New Compass

AIRCRAFT flights are constantly increasing in duration and distance and require a correspondingly greater amount of navigation over unfamiliar territory and through fog and darkness. The compass therefore becomes more than ever an instrument of great importance.

In a new compass, termed the Pioneer Straightway Compass, made by the Pioneer Instrument Company, everything has been done to reduce period and overswing.

The front view of the Ente shows the abnormally wide landing gear, with struts running directly to the engine nacelles. Note the vertical fins near wing tips

To do this, the weight of the magnetic element has been reduced to a minimum, the damping factor has been increased, and yet the magnetic control has been made particularly strong.

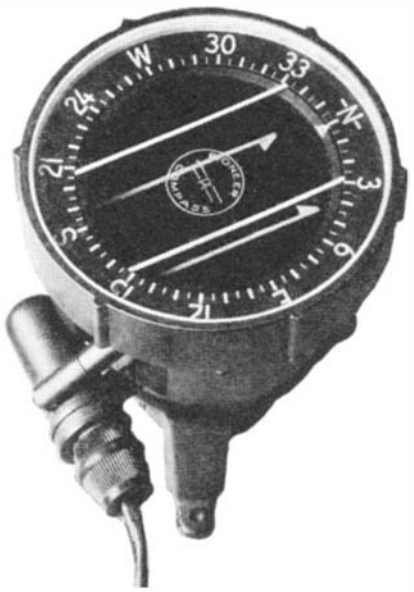
The indicating element differs from the conventional magnetic type in that the circular compass card has been eliminated to reduce weight and surface friction. It is now replaced by a spider which carries two broad parallel bars, treated with luminous material. The spider also supports magnets made of special cobalt steel of great magnetic retentivity. An accurately hardened and lapped steel pivot is placed above the center of gravity of the magnetic system. When the point of the pivot rests in the sapphire cup jewel, the spider is perfectly balanced, and the luminous lines and the magnets are horizontal. Great care is taken in the manufacture and assembly of the pivots and sapphire cups so that friction is practically eliminated.

The magnetic element is contained in a cylindrical bowl which is filled with a water-clear mineral spirit. This liquid serves to damp the motion of the magnetic element against oscillation while allowing it to remain sensitive to changes in direction. The bowl is fitted with a rotatable glass covered ring which can be locked into position by a thumb-lever on the side of the compass. A circular card with the cardinal points indicated by letters and the intermediate points by numerals is permanently fixed under the glass cover and rotates with it. Two parallel lines, which are coated with luminous paint, and are of the same width as the lines on the magnetic element, cross the center of the circular card in a north-south direction as shown in the illustration.

To steer a course, the top of the compass is turned until the desired heading coincides with the lubber-line, which coincides with the axis of the airplane. The top ring is then locked into place by a thumb-lever, and the plane is steered until the two lines across the glass face are parallel with the two lines on the magnetic element. The ship is then on the desired heading.

By using the parallel-line method of indication, the possibility of errors in reading is eliminated. The conventional magnetic compass must be observed from a position directly in front of the instrument, otherwise an error known as "parallax" is made. Therefore, the parallel lines greatly simplify steering. The permanent setting relieves the pilot of remembering his heading.

Such a compass must not leak when the altitude changes as much as 30,000 feet, and neither 122 degrees above nor 30 degrees below zero, Fahrenheit, must cause it to leak or freeze.—*A. K.*



New Straightway compass, showing parallel lines mentioned in text

Fastest on Land

ON Daytona Beach, Florida, Captain Malcolm Campbell on February 4 raced his specially-built *Bluebird* along the sands at the tremendous rate of 245.733 miles an hour. Before passing the measured mile of the course, he had taken a flying start of 5½ miles. His achievement puts him far ahead of the previous world record for land vehicles which was held by the late Sir Henry Segrave, also an Englishman, whose speed was 231.3 miles an hour.

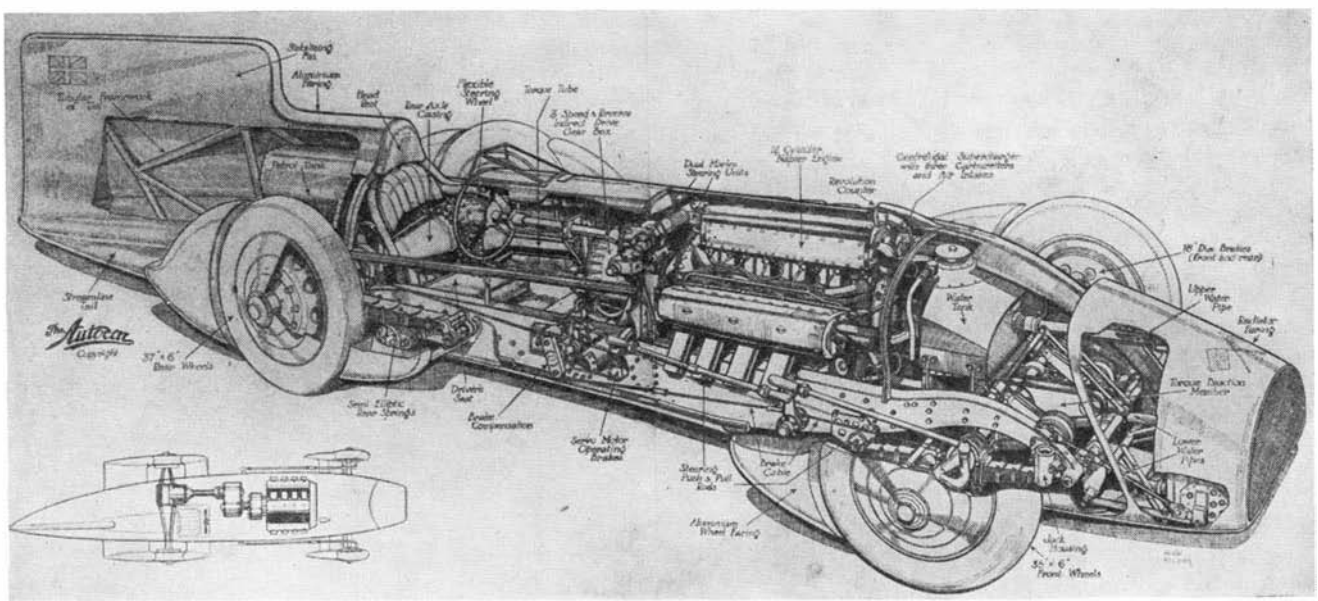
The accompanying illustration, reproduced through the courtesy of *The Autocar*, British motor magazine, shows details of construction of the new record holder, the *Bluebird*. It is driven by a 12-cylinder Napier-Lion aviation engine, the rating of which is said to be 1450 horsepower. The body and wheels are carefully streamlined and a large tail fin, similar to a rudder except that it is rigid, acts as a stabilizer to make straight-forward steering easier at high speeds.

It will be noted from the illustration that the radiator is not a part of the streamlined body but sits forward so that air passing through it is ejected along the outside of the hood. This design was adopted to prevent interference that would be caused by the increased wind resistance if the air were allowed to fill the inside of the body and emerge into the "cockpit" or other outlets toward the rear. Cooling water enters the radiator through one upper tube and returns through two others.

In order that the driver might sit as low as possible and thus give greater stability to the car, the drive is geared and offset to one side. This feature is shown in one of the drawings. Other details are more or less self-explanatory but the jack housing is unusual. This consists of a casting, bolted to the spring, through the tubular part of which a special screw jack is inserted when it is necessary to change wheels or tires. This was deemed necessary because of the great weight of the front end of the car.

The Biologic Detective

DETAILED studies of the reactions of the human body under various conditions have caused the development of a new science which may very well be called biologic detection. Already it has been shown that ultra-violet rays bring about fluorescent appearances which serve the purpose of detection. Thus a strand of hair found near the body of a dead individual might have belonged to any one of three people who had hair similar in appearance to that which constituted the evi-



Sectional view of Campbell's *Bluebird* and, lower left, top view showing off-set fin and drive shaft

dence. The application of ultra-violet light to the hair under suspicion revealed a purplish luminosity which was visible in the hair of only one of the three people under suspicion. It was found that the luminosity of the hair was due to the large quantities of aspirin which had been taken by and excreted in the hair of the individual concerned.

The biologic detective uses the X ray and ultra-violet rays for finding concealed things. He uses chemistry to determine the amount of alcohol in the circulating blood. He has investigative methods which show not only the age of blood stains but also the species from which the blood happens to have come. He has tests indicating possible paternity of a child, and by use of finger prints he obtains evidence of the greatest value in determining human relationship and in identifying suspected characters. The application of the microscope, the biologic precipitation tests, ultra-violet and spectroscope studies, and similar methods, are now a part of the regular practice of the biologic detective.

—*M. F.*

Big Gain for "Lucky Strike"

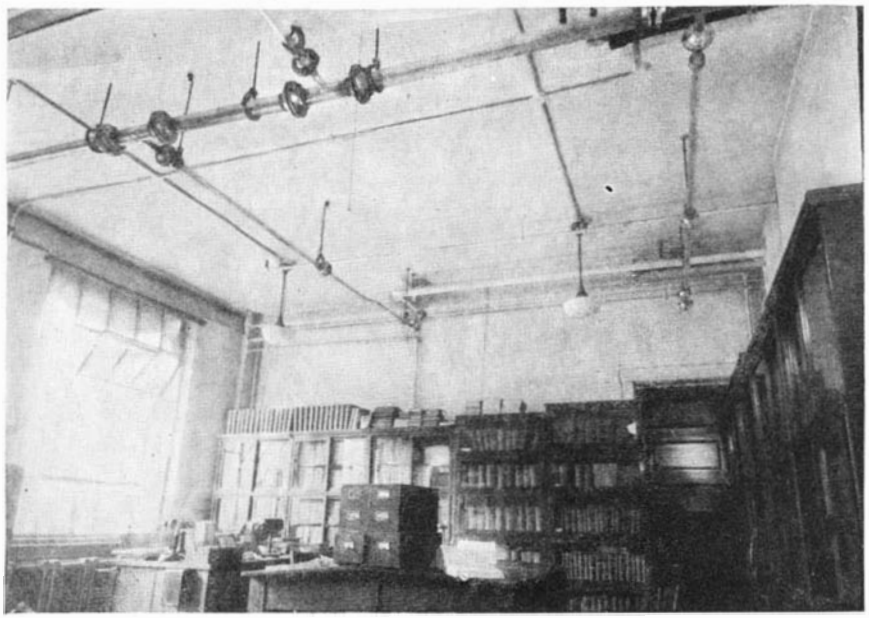
THE excellent showing of the American Tobacco Company is due in large measure to the success of its advertising campaign on "Lucky Strike" cigarettes. Sales of this brand in 1930 showed an increase of about 6,000,000,000 over 1929, while the cigarette industry of the country as a whole lost slightly. Other products, however, are also profitable, with half a dozen or more of American's lesser brands contributing as much as 250,000 dollars annually to earnings; though "Lucky Strike" cigarettes and "Cremo" cigars, the two brands to which practically all of the advertising is devoted, are the only ones showing large sales gains.

There has been no recent change in the trend of American Tobacco's operations, so that a further increase for 1931 seems reasonable. In this case, payment of an extra dividend before the end of the year might well be looked for, American Tobacco having followed for some time a policy of declaring extra dividends generously. Of course, American Tobacco's growing business necessitates the retaining of a substantial part of earnings to add to manufacturing facilities and to inventory, which is bought three years ahead. Both of these items will show increases in the December, 1930 balance sheet over the figures of the year before.—*Barron's.*

Addison's Disease

ADDISON'S disease is not a common condition. It is usually the result of some pathologic change involving the adrenal glands. In the past, patients with this disease have gone progressively downward, although having occasional remissions, but death ensued almost invariably after a fairly brief period. Heretofore, the treatment has merely included rest, warmth, relaxation, and good hygiene, with an attempt to supply in some manner the deficient substance, although until recently no active extract of the cortex of the adrenal was available.

During the last five years, investigators in various clinics have been attempting to isolate the active substance exactly as ac-



Pyrex pipes running through the office of a chemical plant enable an executive to keep a constant check on the color and so on of liquid flowing through them

tive substances have been isolated from the pancreas, the thyroid, the pituitary, and the liver. Apparently the long-sought substance has now been made available, since Drs. Swingle and Pfiffner of Princeton University and Dr. Hartman of the University of Buffalo have secured a substance which will prolong indefinitely the lives of animals from which the adrenal glands have been removed. Moreover, in one large clinic in the United States, seven patients have been treated with the remedy with apparently excellent results. They recovered their appetites, gained in weight, and felt much better.

Here is another example of what can be accomplished in scientific medicine by logical scientific experimentation. It must be pointed out that in this case, as well as in the discovery of insulin, dogs have been used. The result has been the possibility of longer and useful lives for human beings who previously would invariably have died.—*M. F.*

Chemical Glassware Invades the Plant

THANKS to recent advances in the technology of glass manufacture, the familiar laboratory glassware of the chemist is now available for the large scale operations of the factory. Glass pipe lines of Pyrex are being used for handling many liquids because such pipe does not corrode, is heat resistant, and permits constant visual inspection of rate of flow, color, and consistency. Pyrex fittings permit the same flexibility of layout as metal pipe and fittings. Installation requires no specialized skill—no tool other than a wrench. Cast aluminum split flanges fit over the pipe ends and are bolted together. A gasket of asbestos or other suitable material is used between the flange faces.

The photograph shows a section of glass pipe in a modern chemical plant where it runs through the office of an executive who is thus able to see the condition and rate of flow of the liquid by merely glancing up from his desk.—*A. E. B.*

Laboratory on Wheels Tests Milk

TAKING the milk testing laboratory to the milk sample, instead of the milk sample to the laboratory is a new procedure recently started by the New York State Department of Health, of which Dr. Thomas Parran, Jr., is commissioner. Two laboratories on wheels have just been put into operation by the New York State Department of Health to provide facilities for accurate examination of milk samples anywhere in the state. The laboratories will be used in the milk-supply study authorized by the last legislative session to bring about more effective sanitary control.

Passenger buses were adapted for the purpose by removing the usual seats to provide a space of 7 by 18 feet for equipment, according to a description in *Health News*. Laboratory benches are installed along the sides and across the back of each bus, and a sink with hot and cold running water is provided, a small water storage tank under air pressure, which may be filled from outside the bus, serving as a source.

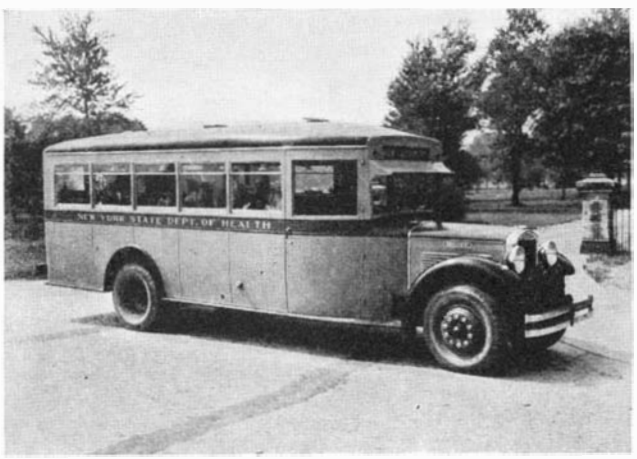
Most of the equipment is electrical; there are an electric water heater, incubator, refrigerator, autoclave, sterilizing oven, unit heater, fans, lights, and the like. Although the incubator is operated by storage batteries, most of this equipment makes use of an electric meter fitted with long lead-in wires to connect the bus to a 110-volt power circuit when the bus is standing at a milk station or plant. A Babcock tester for butter fat determinations, as well as microscopes and other equipment for bacteriological examination of samples, is included in the equipment.

In addition to determination of the sanitary qualities of the larger milk supplies throughout the state, the two traveling laboratories will make possible more or less pioneer work in some of the strictly rural communities, the report states.—*A. E. B.*

New Evil-Scented Denaturant not Deadly

DENATURING of industrial alcohol—not by poisonous wood alcohol, but by a new substance which smells like everything evil, which cannot be removed by bootleggers and which will not kill even if taken internally was begun on January 1. Alcotate, as the new denaturant is called, will be substituted for methanol in all completely denatured alcohol formulas, according to an announcement by Dr. J. M. Doran, Commissioner of Industrial Alcohol. Elimination of methanol in specially denatured formulas also is contemplated, but such action will require further consideration before it is made effective.

The Commissioner's decision to abandon the use of the poisonous denaturant had been anticipated for some time, as chemists of the Bureau of Industrial Alcohol had



Traveling milk laboratory used in New York State

Interior of the traveling laboratory

been working on the development of a non-poisonous but bootleg-proof denaturant for the past three years. Action by Commissioner Doran probably was hastened by renewed agitation in Congress this session against continued use of toxic denaturants.

Alcotate is a derivative obtained from California petroleum in the cracking process and is extremely obnoxious both in odor and taste. Commissioner Doran is convinced that the new denaturant cannot be removed from industrial alcohol by any chemical process, thus preventing the use of alcohol so denatured as a beverage. It has been subjected by the Bureau's laboratory to all known "bootleg" treatments, such as filtering through carbon and fractional distillation in column stills.

Courtesy General Electric Company

This new 50,000-watt lamp with a 1,500,000 lumen output delivers light equivalent in amount to that used in 50 average homes. Its 3-pound filament contains sufficient wire to make 125,695 twenty-five-watt Mazda bulbs. This lamp is for use in taking talking pictures

The present completely denatured formulas to which, said Dr. Doran, an increasing number of fatalities has been attributed, contain 4 percent of natural wood alcohol and 0.75 percent of aldehol. The new formulas will substitute for the wood alcohol 1 precent of alcotate and increase the aldehol content to 1 percent.—*A. E. B.*

Unsuspected Heart Disease

IN Cincinnati, the Heart Council recently investigated 1000 white men working in machine and hand tool shops as to the presence of physical defects that had not previously been found. Many men employees over 40 years of age refused to be examined for fear the examination might result in loss of employment. Previous to examining the mechanics, 1000 clerks had been carefully studied.

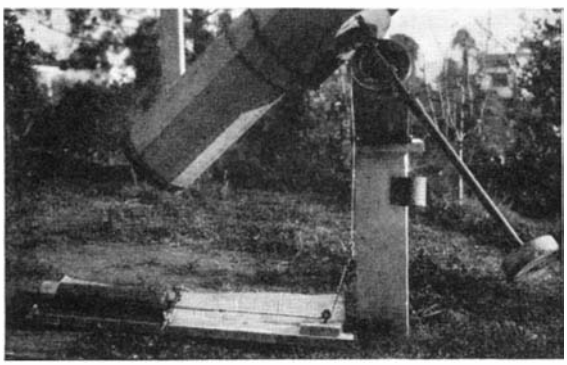
As an indication of the importance of early infections on the heart in later years, 21.9 percent of those who had lesions of the heart had had some of the common infectious diseases and 31 percent of all of the men examined had signs pointing to various irregularities in the heart. Almost one half of all of those who were

(*Please turn to page* 277)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

IT is now five years since the hobby of amateur telescope making was placed before our readers and nearly every issue of the magazine since then has contained in one place or another the description of some activity or other of the amateur worker. We receive numerous inquiries from readers who apparently have noticed this department for the first time and who either regard it as an isolated account or suspect it of being a department which may have appeared possibly as many as two or three times before. But matter on amateur's telescopes has appeared in about 60 back numbers of the SCIENTIFIC AMERICAN.



Harold A. Lower's clepsydra telescope drive

THIS month, instead of the usual description of telescopes made by the amateur from the instructions in the SCIENTIFIC AMERICAN book "Amateur Telescope Making," we present a few "accessories" and some odds and ends of the art. One amateur who seems to be everlastingly at it is Harold A. Lower of San Diego, California (1032 Pennsylvania Avenue). We have published photographs sent by Lower on one or two previous occasions and now we show one of his water-clock drive; also one of a flat he has made. Lower writes: "The picture shows about all there is of the clepsydra or water-clock. Everything is made of brass except the piston, which is aluminum. The inside of the brass cylinder was highly polished and the piston very closely fitted. There is so little friction that the piston will move of its own weight. The cylinder is mounted horizontally so that the changing weight of water will not affect the rate. The apparatus works much better than we expected. No tremors due to the drive can be detected, even with a high-power eyepiece. The motion is smooth and steady."

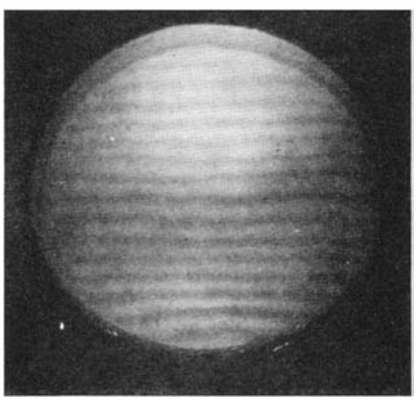
The principle of the clepsydra is simply water escaping through a minute opening. This allows a piston gradually to move and the piston rod actuates the telescope tube through some mechanical connection; in the present case by a length of picture wire. It is said that one must be fussy with details in order to make one of these things work accurately and smoothly. In fact, that is just what we had advised Lower before he made it, but it didn't stop him and he "proved the pudding." Later he sent us a word of warning based on the experience he gained: "First," he says, "there should be a screen to prevent dirt in the water from getting into the needle valve which lets the water out. Secondly, the needle valve requires a fine control; an old radio vernier dial works fine." The cylinder is usually placed on the north but Mr. Lower moved it to the east side, as shown, in order to photograph it.

Lower sends in a detailed criticism of his own flat; it is only a maiden effort, he says. The edge is turned (they usually are) but he expected that and purposely began with a larger disk (12 inches) than the flat he needed. Just inside the edge there is a raised zone of half a fringe (less than 1/200,000 of an inch). The irregularities near the center will be in the shadow of the secondary used in testing a Cassegrainian. The photograph was taken by blue light, hence the inaccuracies show up more than yellow sodium light, with its greater wavelength, would reveal. The photograph does not do the flat full justice.

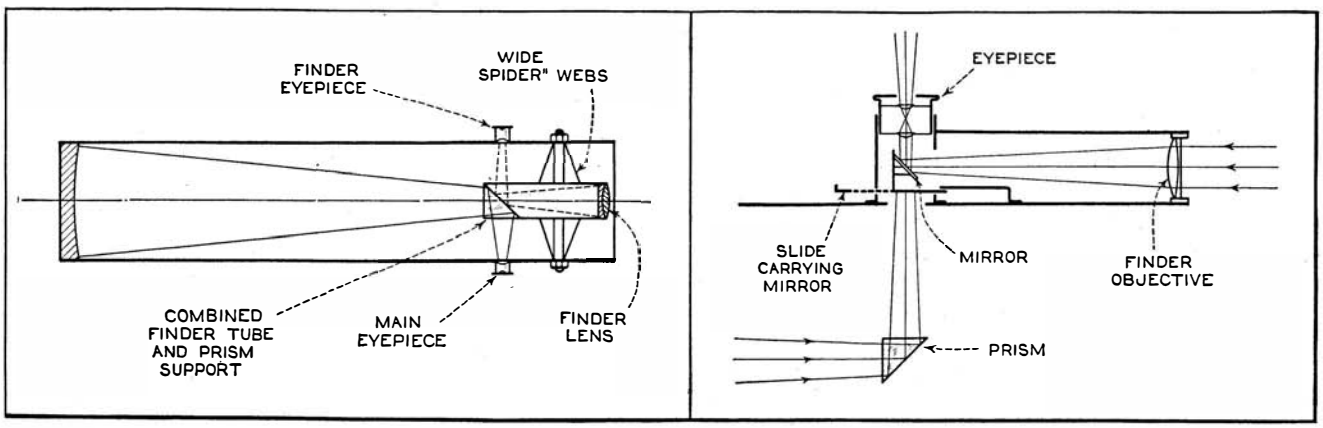
OPPOSITE is an observatory by G. F. Hofferberth (Rural Route 13, Dayton, Ohio). Hofferberth was one of the earliest telescope makers. He says: "Boy, that curved dome was some job [told you so]. Every time I wanted to add a piece of roofing it had to be cut curved, but the dome sure is a daisy. The dome framing is of wood and the shingles of Compo pitched down with steep roof pitch. The dome is 86 inches in diameter." Hofferberth, in an unguarded moment, has confessed that he built the dome in a barn and then had to tear off the side of the barn in order to get the dome out.

FROM Pittsburgh comes the following, signed by Leo J. Scanlon, Sec.-Treas. of the Astronomical Section of the Academy of Science and Art of Pittsburgh (1405 East Street, N. S. Pittsburgh, Pa.). "Here is a brainstorm I had recently for getting the most out of a prism or flat, when it is desired to use a finder on a telescope. When a prism is used you simply silver the back of it and use the silver surface for a flat mirror in the optical train of the finder; when a flat is used you silver both surfaces of the flat." See Scanlon's sketch.

BELOW is another which is no more of a "brainstorm" than the first—on the contrary, pretty good, we think. The writer



Fringes on Mr. Lower's flat



Leo J. Scanlon plays both ends against the middle

E. Lloyd McCarthy's invention, described in the text

is E. Lloyd McCarthy of Canton, New York (10 Powers Street). "In brief," he says, "the idea is to use one eyepiece for the finder and speculum also. When the slide carrying the small 45° mirror is pulled out the mirror delivers light from the finder to the eyepiece. When the object is in the center of the field the slide is pushed in, allowing the light from the speculum to pass through a hole in the slide and thence to the same eyepiece." Can you beat it?

IT appears that each and every amateur worker must have obtained a copy of the Bureau of Standards' Letter-circular 32, on

Hofferberth's observatory

Silvering, as the Bureau has repeatedly been forced to prepare new editions. This rough, mimeographed publication has now been replaced by Circular 389 of the Bureau, entitled "The Making of Mirrors by the Deposition of Metal on Glass." This is a printed pamphlet and a valuable source of practical information. It is no longer to be obtained from the Bureau but from the Superintendent of Documents, Government Printing Office, Washington, D. C., the price being five cents and, by the way, the Government will not accept payment in postage stamps.

In this new circular on silvering the Bureau, at which quite a lot of silvering is regularly done, lays new stress on the risk involved in silvering by the Brashear process. One is taking an entirely unnecessary risk, they state, "probably greater than is commonly realized," in silvering without goggles. We never have received word of a single explosion due to silvering, though several thousand have silvered. Can anyone tell us of a concrete instance? On general principles it is, of course, better to be careful than sorry and we have no motive for minimizing the risk or pooh-poohing it.

The same circular states that the reducing solution does not deteriorate with age. This statement has appeared many times and probably is correct. On the other hand we recall seeing in one or perhaps several rather recent periodicals or books the statement that reducing solution improves with age, up to a certain period, and then a deterioration sets in. Can anyone advise us where such statements have appeared? We have lost the reference.

Apparently the Bureau has upset the claim that the Brashear process of silvering gives a coat that reflects more light than the others. However, as our space is used up, let the worker obtain the circular and read about it.

CURRENT BULLETIN BRIEFS

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

ALGEBRAIC CHARTS, By Edgar Dehn. Six graphic charts for quick approximate solutions of quadratic cubic and biquadratic equations, for engineers and others. *Columbia Press, 509 Fifth Ave., New York City. —$1.00.*

EMBRITTLEMENT OF BOILERS (Bulletin No. 216, Engineering Experiment Station, University of Illinois) by Frederick G. Straub is a report of an investigation conducted by the Engineering Experiment Station in co-operation with the Utilities Research Commission. *Engineering Experiment Station, University of Illinois, Urbana, Ill.—65 cents.*

TIMBER GROWING AND LOGGING AND TURPENTINING PRACTICES IN THE SOUTHERN PINE REGION. (Technical Bulletin No. 204, United States Department of Agriculture) by R. D. Forbes, gives the measures necessary to keep forest land productive and to produce full timber crops. *Superintendent of Documents, Washington, D. C.—30 cents (money order).*

BURNING PULVERIZED IOWA COAL (Bulletin 97, Engineering Experiment Station, Iowa State College, Ames, Iowa) by Earl B. Smith, is a critical study of Iowa coal. *Engineering Experiment Station, Iowa State College, Ames, Iowa.—Gratis.*

THE CO-ORDINATION OF LIGHT AND MUSIC by A. L. Powell, describes the latest development in this comparatively new field of electrical endeavor. *General Electric Company, Nela Park, Cleveland, Ohio.—Gratis.*

WAR AND INVENTIONS (Reprinted from American Journal of Sociology, Vol. XXXVI. No. 4, January 1931) by Joseph Rossman, Ph.D., is a careful study which shows that war is a powerful stimulus to invention of war implements. The author, who is a patent examiner in the United States Patent Office, says that basic war inventions have been made chiefly by civilians. A military environment is not conducive to invention. *Address Dr. Joseph Rossman, U. S. Patent Office, Washington, D. C.—Gratis.*

THE EFFECT OF FURNACE GASES ON THE QUALITY OF ENAMELS FOR SHEET STEEL (Bulletin No. 214, Engineering Experiment Station, University of Illinois) by Andrew I. Andrews and Emanuel A. Hertzell reports an investigation conducted by the Engineering Experiment Station in co-operation with the Utilities Research Commission. *Engineering Experiment Station, University of Illinois, Urbana, Ill.—20 cents.*

TO make this page of greater value to our readers, the editor shall be glad to consider for review papers and bulletins on any phase of science, engineering, or industry. However, we do not wish ordinary catalogs, and we will not mention what is obviously propaganda.

Material submitted should give full information as to where obtainable and the price, if any, so that the reader may obtain copies directly without unnecessary correspondence. — *The Editor.*

THE NEW WAY OF DESIGNING AND BUILDING GAS LINES WITH SMITHWELDED PIPE (Bulletin No. 510) will be particularly illuminating and helpful to those who wish to arrive quickly at pipe line costs for various combinations of pressure, volume, and dimensions. *A. O. Smith Corporation, Milwaukee, Wis.—Gratis.*

ELECTRIC ARC WELDING presents such facts about the electric arc welding process as are essential to its successful application to practical work. 80 pages, Fabrikoid binding. *The Hobart Brothers Co., Troy, Ohio.—$1.00 postpaid.*

THE ECONOMIC PRODUCTION OF WORKINGMEN'S HOMES by Grosvenor Atterbury, gives an outline of a scientific solution of the housing problem and its relation to the development of the City of New York. The houses are factory built. The experiences of the Sage Foundation at Forest Hills are given. *Grosvenor Atterbury, 139 East 53rd Street, New York City.—Gratis.*

THE RADIO DECADE describes the progress that has been made in the art of radio communication from 1920 to 1930. It deals in main with commercial services, but touches lightly on broadcasting and the entertainment angle of radio. A double-page map giving a comparison of international communication services in 1920 and 1930 is especially interesting. *Radio Corporation of America, N. Y. C.—Gratis.*

ONE THOUSAND USEFUL BOOKS, compiled by the Detroit Public Library for the American Library Association, was published originally in 1924 and has filled a very useful niche. The classification is excellent, the titles are well chosen and prices are given. The needs of small libraries as well as those of individuals have been carefully considered. *American Library Association, Chicago, Ill.—75 cents.*

PIONEER MARINE COMPASSES gives full information as to both their straightway and skyway compasses. *Pioneer Instrument Company, 754 Lexington Ave., Brooklyn, N. Y.—Gratis.*

COW TESTING ASSOCIATIONS IN IOWA (Extension Service Bulletin No. 99, Iowa State College of Agriculture and Mechanic Arts) by C. L. Blackman, A. C. McCandlish, and H. R. Searles. The cow testing association is an organization of farmers for co-operation in the improvement of their dairy herds. Pamphlet gives detailed figures and pictures of cows of various grades. *Iowa State College of Agriculture, Ames, Iowa.—Gratis.*

PLANT PATENTS (Reprinted from January 1931 Journal of the Patent Office Society) by Joseph Rossman, Ph.D., deals with the recent amendment to our patent statutes covering the inventions of anyone "who has invented or discovered and asexually reproduced any distinct and new variety of plant other than a tuber-propagated plant." The plant breeder as an inventor is a novelty. *Address Dr. Joseph Rossman, U. S. Patent Office, Washington, D. C.—Gratis.*

THE PHOTOFLASH LAMP, ITS CHARACTERISTICS AND APPLICATIONS. These new lamps do away with the smoke of flash powders. The entire flash takes place inside a glass tube and thus all smoke, odor, and noise are eliminated. They enable excellent pictures to be taken in the home. *General Electric Company, Nela Park Engineering Department, Cleveland, Ohio.—Gratis.*

LIGHTING FOR SEEING by Dr. M. Luckiesh and Frank K. Moss. In this bulletin are given systematized glimpses of the results of scientific investigations, which aim to show that this new science of seeing is the result of a partnership of lighting and vision. It is well illustrated and contains much scientific data. *General Electric Company, Nela Park Engineering Department, Cleveland, Ohio.—Gratis.*

LIGHT FRAME HOUSE CONSTRUCTION (Bulletin No. 145, Trade and Industrial No. 41, issued by the Federal Board for Vocation Education in co-operation with the National Committee on Wood Utilization) affords a splendid compilation of technical information for the use of apprentice and journeymen carpenters. It is a large pamphlet of 216 pages and there are 163 illustrations and many diagrams. A most valuable book on carpentry as applied to house construction. *Superintendent of Documents, Washington, D. C.—40 cents (money order).*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 273)

20 pounds or more above normal weight had enlargement of the heart, whereas only 5.3 percent of those who were 20 pounds or more underweight had any disturbance of the heart whatever.

As an evidence of the importance of careful periodic physical examination, it is pointed out that the 1000 mechanics showed significant defects in 83.6 percent of cases, and that actually 88.5 percent of the men had defects of some kind of which they had not the slightest knowledge and of which they had not complained.—*M. F.*

Vacuum Clutch Control

TO many automobile drivers to whom the strain of depressing the clutch pedal for every change of gears is onerous, a new vacuum clutch control produced by the Hill Engineering Corporation of Richmond, Virginia, will afford a welcome relief. This device draws power from the intake manifold to depress the clutch pedal and release the clutch when a button on the gearshift lever is pressed.

When the button on the gearshift lever is pressed, it raises a piston valve, thereby connecting a vacuum chamber to intake suction, raising a diaphragm and its rod which pulls the clutch out of engagement by a cable running over pulleys.

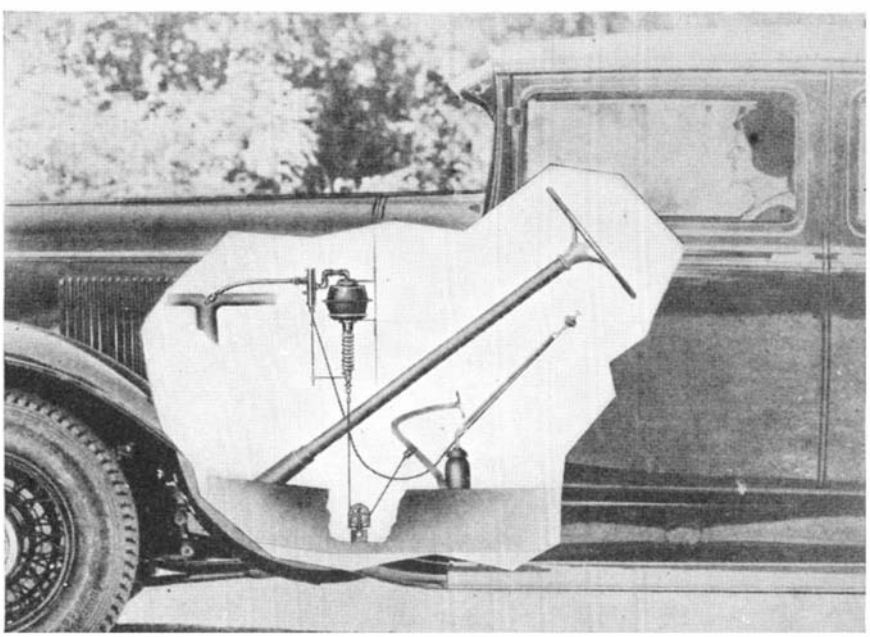
The upward movement of the diaphragm rod releases the tension on the lower coil spring, allowing the upper coil spring to open the atmospheric valve in readiness for subsequent clutch engagement.

When the button on the gearshift knob is released, the piston valve moves down, cutting off suction and allowing air to rush into the vacuum chamber, thus relieving the pull on the clutch cable and allowing the clutch to begin to engage. However, before the diaphragm rod has moved down very far, the resulting increasing tension on the lower coil spring closes the atmospheric valve, and thereafter air can enter the vacuum chamber only through the small bleeder hole. This slows up the downward motion of the diaphragm and permits the clutch to engage smoothly. The bleeder opening is adjustable by a set screw so that the rate of engagement may be varied as desired.

After the shift is completed, the hand, as usual, is removed from the lever, the button is released and the clutch takes hold smoothly and automatically. Releasing the button permits a swift return of the clutch pedal until it is automatically checked just before engagement.

In traffic, if the driver wishes to remain in gear for a quick start, he shifts to the desired gear and holds his thumb down on the button until ready to go.

The car may be allowed to coast by holding the button down. A double clutch operation can be made as rapidly as desired in changing speeds.



With this new vacuum clutch control, the driver does not have to press the clutch pedal with his foot. A touch on the button on the shift lever does the trick

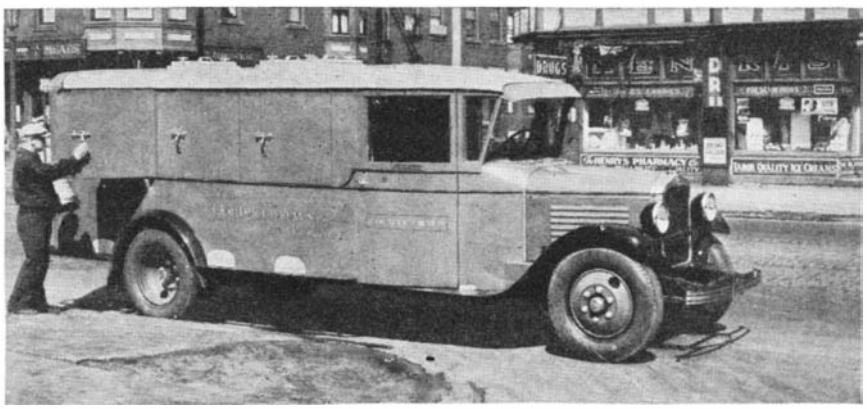
Duck Speed

A MALLARD duck banded on November 23, 1930, at Big Suamico, Green Bay, Wisconsin, was killed five days later near Georgetown, South Carolina, according to a report to the Bureau of Biological Survey of the United States Department of Agriculture. This is a record for individual speed of migration, the bureau says.

Moto-vita Addenda

WHEN the article on the Moto-vita, published on page 92 of our February issue, was prepared, the editors were given to understand that the device described was to be placed on the market very shortly for use on motor cars. Therefore, this fact, and the fact that it would sell at a low price, was stressed.

Since the February number was published, we have been informed that the Moto-vita is being developed, at the present time, exclusively for use on aircraft and large marine engines and that it will not be ready for general automobile use for a year or more. It can be furnished to those



An ice-cream truck refrigerated with Dry-Ice

interested at this time, but the price, for use on the average private car, is exhorbitant. When the present development work on the device for aircraft and marine engines is complete, it is planned to produce simplified units operating on the same principle and at a price within the reach of all motor-car drivers.

Cancer in Savages

THERE seems to be a common belief, largely promoted by faddists who are trying to secure a return from present diets to less complicated foods, that savages do not suffer from malignant tumors as do members of the white race. The argument is made that savages eat a diet consisting largely of fruit, nuts, and whole wheat, and that they do not have cancer in the same proportion as does the white man. The actual facts of the matter are that savages are not immune to cancer. Research carried on in the Belgian Congo recently revealed 34 cancers found by physicians among the natives of various regions.

The investigators conclude that, far from being refractory to cancer, the black race presents all of the forms of tumors that are encountered in the white race. One reason why the savage does not have cancer in the same proportion as does the white man is the fact that he does not live long enough to die of cancer. Cancer is essentially a disease of advanced age. Whereas the white race has a life expectancy of from 55 to 60 years, the savage race still has the life expectancy which formerly characterized civilized man; namely, from 30 to 35 years. Apparently there is not the slightest scientific evidence to indicate that the eating of any diet or any particular kind of food will in any way increase or lessen the incidence of cancer in any group.—*M. F.*

Sears, Roebuck and Company Stronger

REPORT of Sears, Roebuck and Company for 1930 will show a stronger financial position than was at first thought possible.

Notes payable at the end of the year were down to 17,000,000 dollars, a decrease of almost 14,000,000 dollars from the 30,798,000 dollars at the end of 1929. First estimate was that notes payable would be reduced only 7,000,000 dollars to 10,000,000 dollars, and a later estimate indicated a decrease of something over 10,000,000 dollars. The company also paid off during the year purchase money mortgage notes amounting to 1,018,172 dollars.

Despite the large reduction in notes payable during the year, Sears, Roebuck was able to end 1930 with an indicated increase of at least 2,000,000 dollars in cash over the figure of 7,089,500 dollars in cash at the end of 1929.

Sears, Roebuck and Company is not contemplating new financing through note or bond issue, or by any other means, according to company officials.

Following the announcement of its spring and summer general catalog, with about 1000 pages and 48,000 items, President Wood said: "Taking advantage of low basic commodity prices, our buying organization has made possible new lower costs to the public. In many lines they represent an all-time low. These reductions are in keeping with our policy to pass on to our customers any savings we have been able to effect."

Approximately 7,000,000 copies of the catalog will be distributed this spring. Prices therein will be in effect six months. Reductions are from the 1930 spring catalog, which was substantially lower than the 1929 book.

Minimum time payments have been reduced from five dollars a month to four dollars, and minimum purchase on time payment has been reduced from 25 dollars to 20 dollars. This 20 percent reduction is considered in line with the reduction in merchandise prices.

The center of the catalog illustrates a new plan under which a complete home modernization offer is made available under a single time-payment contract. Roofing, plumbing, electrical fixtures, lumber, and millwork purchases are all combined. The company provides the material to complete the contract, which carries an 18-month payment period.—*Barron's.*

Dry-Ice Refrigerated Truck

A NEWLY developed Dry-Ice refrigeration truck, with its light weight, elimination of corroding brine, and maintenance of lower temperature, is attracting the interest of ice cream manufacturers and dairymen.

Mounted on a six-cylinder White truck with balloon tires, is a three-compartment body. Two compartments are used for carrying bulk ice cream in cans, the third carrying special trays for package ice creams.

Refrigeration is accomplished by using solid carbon dioxide as the refrigerating medium, which has a temperature of 100

degrees below zero. This refrigerant looks like a block of tightly packed snow and is usually a cube about 10 inches on a side, weighing approximately 40 pounds. This Dry-Ice evaporates without moisture, giving off a gas that is circulated through the body.

Each compartment which is refrigerated with its own Dry-Ice, consists of an inner compartment containing the ice cream, with a galvanized iron tank for carrying the refrigerant. Entrance to the refrigerant tanks is through the roof of the truck body, which permits the filling of the ice cream compartments after the truck has been "iced."

The gas travels in a definite direction around the compartment between the inner metal compartment and outer walls. It returns to the top and is discharged through a metal port fitted with a control valve. With this valve the driver can control the speeding up or retarding of the evaporation of the refrigerant. The blanket of cold gas also acts as additional insulation and carries off heat that might pass through the outer walls of the body.

This type of refrigerator body, with the required amount of refrigerant, is much lighter than ice and salt refrigerated bodies, making it possible to deliver the same amount of ice cream with trucks of lighter capacity. Another advantage is that the Dry-Ice evaporates without moisture, reducing depreciation and maintenance cost of the trucks.

Chemical Stimulation of Red Blood Cell Formation

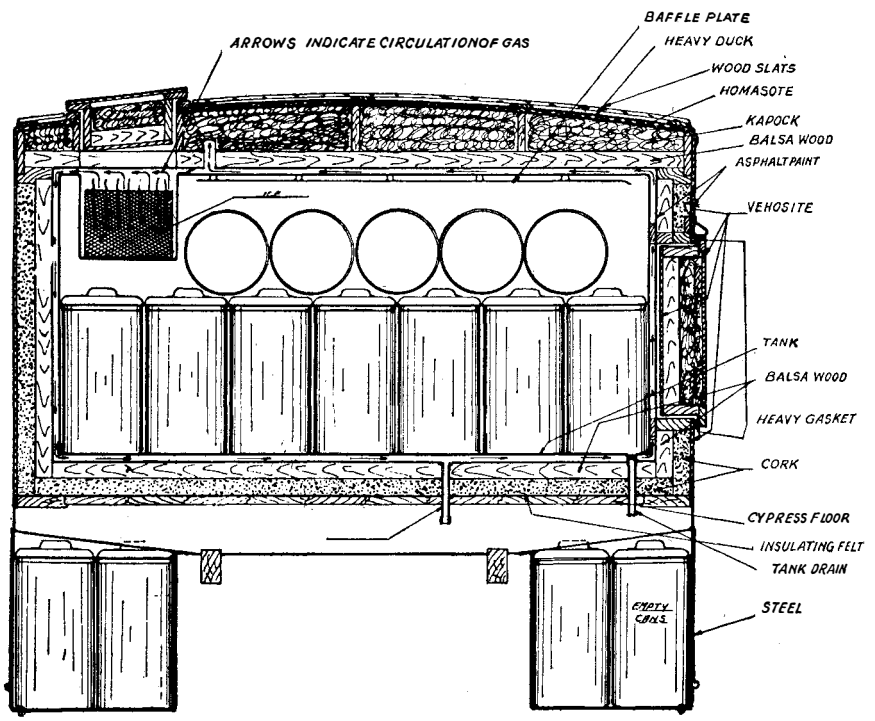
IN 1926, Doctors G. R. Minot and W. P. Murphy of the Harvard University Medical School demonstrated that the feeding of liver to a person with pernicious anemia produced an increased number of young and old red blood cells. Thereby was developed the control of what was formerly considered an invariably fatal disorder. It soon became apparent that the eating of large amounts of liver, either cooked or raw, could be exceedingly tiresome and distasteful. At first, methods were devised for making the liver more palatable by modifying the nature of the cooking. Eventually, biologic chemists were able to obtain from the liver a crude extract which seemed to have all of the virtues of the whole liver in stimulation of the red blood cell formation in pernicious anemia. These extracts could be taken as powder and thus the patient could avoid eating a half pound of whole liver every day.

Not long after, investigators in the University of Michigan showed that extract of the wall of the stomach served the same purpose, and could be purchased at a cheaper price than the original liver extract. However, either one of these extracts represents a cost to the patient of from three to five dollars per week and thus is a considerable drain on the purse.

The biologic chemists have not ceased their researches, however, and it now seems likely that they have isolated chemically a pure substance which serves the purpose of the liver or of the liver extract. It is a protein derivative, representing a compound of beta-hydroxyglutamic acid and hydroxyproline. Obviously the development of a pure chemical will lead eventually to a cheaper price for treatment and the possibility of a more accurate control of the disorder.—*M. F.*

Using and Preserving Excess Honey

HONEY production in Canada is growing rapidly, says S. J. Cook in *Industrial and Engineering Chemistry*. From 23,196,493 pounds in 1927, the yearly output rose to 25,574,798 pounds in 1928 and 39,978,735 pounds in 1929. There is a relatively small export trade, chiefly to Great Britain, but the total shipments to all countries do not exceed 2,000,000 pounds annually. Consumption in Canada is not keeping pace with the increased supply,



A cross-section of the truck shown on the opposite page, showing position of units and flow of cold gas. Dry-Ice is in the shaded compartment at upper left

and the industry has turned to scientific research with the problem of finding wider markets, either through the development of new uses in Canada or by the enlargement of export trade outlets. In the meantime there is a demand for an effective means of preventing losses by fermentation during storage.

It is now generally recognized that fermentation spoilage of honey is caused by sugar-tolerant yeasts, capable of restraining the growth of the ordinary yeasts. Tests of hive nectar, made throughout the season, indicate that infection with the sugar-tolerant yeasts is constantly present; hence, while strict sanitary precautions during production help to prevent loss by spoilage, they are not alone sufficient. Sodium benzoate, sodium sulfite, and sodium bisulfite are all effective within the permissible concentrations, and these three are the only ones out of the chosen list which seem, from the preliminary results, to be worth further testing on a practical scale.—*A. E. B.*

Potassium Phosphate Lubricates Where Oil Is not Suitable

THE use of non-oxidizing lubricants is required in certain chemical operations where oxidizing materials, such as potassium chlorate or peroxides, are handled. For this purpose, German chemists have developed a lubricant which is merely a solution in the form of highly concentrated potassium phosphate (K_2HPO_4). With a specific gravity of 1.8, the solution has the properties of a medium machine oil at 20 degrees, Centigrade, viscosity of 20 Engler degrees, and at 50 degrees a viscosity of 4 Engler degrees. It is produced by the neutralization of technical phosphoric acid with solid caustic potash. By the addition of water or the removal of undissolved particles the solution is then brought to the proper consistency. It can also be mixed for special purposes with graphite, talc, and other such useful fillers.—*A. E. B.*

New Rust Preventive Agents

TESTS have recently been carried out on two new rust preventive agents, called "Herolith" and "Tornesit," by the German Mannesmann Tube Works.

Herolith is a synthetic resin and is applied by brushing, prior to which scale is removed by pickling. Tubes coated with it have successfully withstood thorough mechanical and chemical tests, the former comprising tests for resistance to shock, scratching, and conveyance by train or motor-lorry. Thirty-five corrosive agents were used in the chemical tests, only three of which (hydrofluoric acid, caustic potash solution, and caustic soda solution) had any effect on the tubes. Dry heat up to 220 degrees Centigrade, and intermittent temperatures up to 300 degrees Centigrade, do not injure the coating. Steam tests, not yet concluded, have so far given good results.

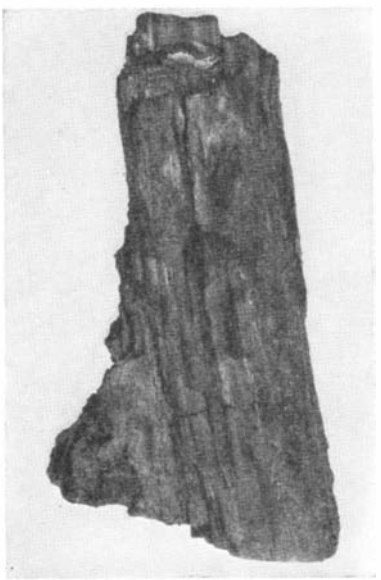
The other agent, Tornesit, is a rubber product similar in appearance to cellulose. It can be brushed on the part to be protected without preheating being necessary, and dries in three minutes. It hardens to such an extent after a few hours that even heavy hammer blows do not damage the coating. In contrast to Herolith, Tornesit is resistant to alkalis, and is attacked only by hydrogen sulfide, water, benzol, acetone, and aniline. It can be employed as a protective coating for iron and steel, wood, brickwork, and concrete.—*A. E. B.*

Oldest Wood Found

WOOD about 20 million years old—and still wood! Not petrified or replaced by other materials but definitely recognizable and largely in its original condition. The accompanying illustrations are of such a piece of wood recently taken from the tunnel of the inverted siphon or under-pass on the line of the main canal of the Kittitas Division, Yakima Project, United States Reclamation Service, near Ellensburg, Washington, and preserved by Mr. Gerald L. Perry, of Seattle.

This specimen was part of a tree completely embedded in an upright position in the Yakima basalt. On the canyon wall above the river is exposed the Ellensburg sandstone which definitely places this wood as belonging to the middle Miocene Epoch. Calculations based on the radio-activity of certain minerals has placed the Miocene Epoch somewhere between 19 and 23 million years in the past.

The accompanying illustrations clearly show the texture of the wood and also show the deposits of an iron sulfur compound in the grain of the wood. A close inspection shows this mineral deposit to be partially iron pyrites, but mostly a combination of sulfur and iron deposited at a much lower



One side of the piece of aged wood showing the grain and the iron deposits which were forced into top

temperature than ordinarily accompanies the formation of iron pyrites. The wood itself is somewhat blackened, either by age or heat, still shows the grain, will burn if ignited with a match, and has all the appearance of an old weathered piece of redwood, with the exception that its color is generally darker throughout and it lacks the characteristic odor of redwood. At the point where the mineral salts touched the wood, careful study shows an apparent forcing of the metal into the grain of the wood and a darkening effect in the wood which might be caused by an acid reaction or high temperature. From this evidence we could assume that the deposits of iron were

either made by precipitation from hot gases shortly after an eruption or from hot water (carrying an acid reaction) at a later period. Apparently these trees carried considerable bark and what appears to be a portion of this bark, carbonized by the heat, is to be seen on the specimen. Undoubtedly the moist bark of the tree protected the wood itself during the period of high temperatures.

Ammonia-Steam Cycle for Power

MENTION has been made in these columns of the mercury boiler in which the heat supplied the boiler is made to work twice, by first vaporizing the mercury and then, at a lower temperature, vaporizing water to steam. Now, a new combination is proposed, involving a chemical principle and the use of ammonia. The plan is described in a recent issue of *Power*, in an article based on an interview with a German engineer, Dr. Ing. F. Koenemann, who has proposed a binary power generation cycle employing ammonia and an ammonia carrier in the primary stage, and steam in the secondary stage.

Dr. Koenemann's process depends on the fact that the compound $ZnCl_2 2NH_3$ loses one molecule of ammonia at high temperatures, while the resulting $ZnCl_2 NH_3$ vigorously takes up a molecule at a lower temperature. The first effect absorbs heat and the second liberates heat. When the di-ammonia salt is heated in a boiler, it melts, and in a typical case, gives off ammonia at 100 pounds absolute pressure and 896 degrees Fahrenheit. After the ammonia has produced power in a turbine, it is exhausted at 239 degrees Fahrenheit and one pound absolute to a jet condenser "mixer" where it combines exothermically with some of the ammonia-depleted compound which has been cooled in a heat exchanger. The recombined compound at 444 degrees Fahrenheit is used to generate steam for a conventional steam cycle before it is returned to the boiler. Dr. Koenemann's calculations show the result to be a fuel saving of over 29 percent, and a reduction in cooling water of 40 percent.—*A. E. B.*

When a Chemist Waxes Poetic

FROM time immemorial, poets have sung of the deep blue sea, its beauty and its mystery. It is doubtful, however, if the ocean was ever before addressed in the language of a chemist as Norman L. Knight phrases his ode in a recent issue of *Industrial and Engineering Chemistry*.

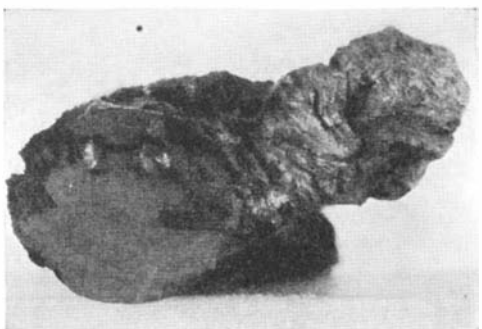
"O Sea! Thou saline and undulant aqueous solution of halides, carbonates, phosphates, sulfates, and other soluble inorganic compounds! What mysterious colloids are dispersed within thy slightly alkaline bosom? What silent and unseen reactions vibrate in dynamic equilibrium, constantly destroyed and instantly restored, among thy unnumbered oscillating molecules? What uncounted myriads of restless ions migrate perpetually throughout thy tentatively estimated volume? What unguessed phenomena of catalysis, metathesis, and osmosis transpire in thy secret fluid profundities under excessively increased pressure? What cosmic precipitates descend in countless kilograms upon thy argillaceous, gelatinous, siliceous, diatomaceous, and totally unillumined bottom? In short, most magnificent reservoir, what is thy flow-chart and complete analysis?"—*A. E. B.*

Chemical Treatment of Foods

IF ONE looks over the list of radically new developments made during the past year or two he finds a surprisingly large number of cases in which the introduction of a new chemical for foodstuff treatment has been the occasion or an opportunity for progress, says *Food Industries*, editorially.

Ethylene for maturing of citrus fruits, for blanching of celery, and for numerous other "ripening" tasks, is now a recognized reagent of our industries. Fungus or mold control is now recognized as a legitimate and necessary task of the producer. Within this field the borax treatment of oranges is only one outstanding case where a marked improvement in merchandising practice has at once followed the development of satisfactory mold-control.

Disinfection for control of insects and rodents about food plants is increasingly important and, fortunately, increasingly easy. There are numerous systems of fumigation more or less widely applicable that deserve consideration as a result of recent scientific and technical advance.—*A. E. B.*



Bottom of the specimen of old wood with a space polished to show the curve and grain of the ancient trunk. Iron deposits are on the upper part in this picture

Amber Laboratory Ware Resists Corrosion

TRANSPARENT, hydrofluoric acid-proof vessels have not hitherto been known. Glass is rapidly attacked by this acid. Two German chemists, C. Plonadt and A. Eisenack recommend for this purpose vessels of clear molded amber, which are produced and sold by the Staatliche Bernsteinwerke Konigsberg. These relatively cheap amber reagent glasses, beakers, dishes, and so forth, are completely resistant to concentrated hydrofluoric acid, as well as to 50 percent potassium hydroxide at water-bath temperatures. Even after four weeks no loss of weight was determinable. On the contrary, a small increase of weight occurred with hydrofluoric acid as a result of the absorption of the acid by the resin. This,

however, apparently caused no injury. If a thin layer of paraffin oil or, better still, molten paraffin is poured upon the reacting fluid previous to heating, the operations in the amber vessels can be carried out at water-bath temperatures with an entire absence of odor. The layer of oil prevents the evaporation of the hydrofluoric acid.—*A. E. B.*

Attributes Blue Color of Sea to Chemicals

WHAT makes the ocean blue? The usual answer has been that the color is simply the natural physical property of water in large quantities. Now, however, a prominent German chemist asserts that the blue is due to certain chemicals which impart the hue to the sea. The question arose when Richard Wilstätter and F. Haber, on a trip to the Canary Islands, began discussing the color of the briny deep. Whereas Haber preferred the well-known physical explanations, Willstätter believes that the blue, which is visible even in such a thin layer as in a bath tub, is due to dissolved, complex copper compounds of the nature of the cupri-amino salts. The conditions for their formation are present because of the known content of copper in sea water and the formation of ammonia and especially of organic amino compounds as a result of the decomposition of proteins. Dr. Haber is generally regarded as one of the greatest of German chemists. It was he who developed the synthetic ammonia process which played such a prominent part in Germany's war preparations.—*A. E. B.*

Road Funds Available

FEDERAL road funds available for new road projects on the federal aid system now total 235,383,877 dollars, says Secretary of Agriculture Hyde. Of this amount 80,000,000 dollars was provided by act of Congress of December 20 for emergency construction to increase employment. This fund may be used by states in place of state funds to match regular federal aid funds previously apportioned.—*Barron's.*

Vegetable Oils Solidified

FOR many purposes it is desirable to package and ship essential, mineral, and vegetable oils in a semi-solid form. Particularly is this the case with perfumes, lotions, ointments, concentrated deodorants, and many technical specialties for lubrication, tube paints, hydraulic fluids, and so on. For these purposes trihydroxyethylamine linoleate is now being used. It is marketed as a viscous amber oil, slightly alkaline in nature, possessing a faint odor, and soluble in water, alcohol, hydrocarbons, and oils.

If one part of this compound is mixed with one part of an essential oil and one of water, a stiff jelly results which does not lose its consistency with age. Larger amounts of water may be added slowly with stirring. The mixture gradually becomes less viscous, and after a certain excess of water has been added it becomes a typical milky emulsion. This latter phenomenon has been applied technically in producing so-called water-soluble oils, which consist of equal parts of trihydroxyethylamine linoleate and the oil. When this mixture is thrown into water a milky emulsion of the oil is formed. In disinfectant and deodorant sprays, where a slight turbidity is not objectionable, this method has eliminated the use of alcohol and other inflammable solvents and, in addition, has lowered manufacturing costs.—*A. E. B.*

New Products from Gypsum

SEVERAL new products consisting primarily of gypsum were introduced during 1929 and may lead to an increasing use of this material, according to the United States Bureau of Mines. An extremely hard dense plaster, suited primarily for architectural casting, was recently placed on the market. On the west coast, producers of gypsum products have developed a wall board that may be bent or folded to conform to structural needs. Gypsum lath that folds and is more or less flexible so as to simplify its application to intricately designed interior structures was also a new development. A new method for fastening wall board and lath to steel structural members was devised. Considerable research work was done to develop acoustical wall boards, and gypsum acoustical ducts that prevent the transmission of sound through ventilator shafts were placed on the market. Some companies are now producing artificial travertine, using gypsum as the principal material.

A process was patented for casting concrete objects in porous plaster molds. The plaster molds absorb a considerable portion of the water in the concrete mixture, resulting in concrete of great strength.

In the middle west and east the manufacture of gypsum lumber made considerable progress during the year, and it is reported that the future of this gypsum product is very promising.—*A. E. B.*

OUR POINT OF VIEW

(*Continued from page* 231)

have almost been stampeded by the specter they have conjured up of a super-economic system based grotesquely enough on (1) a form of peonage, approximating slavery, (2) the employment of the latest machinery, (3) the consolidation of the whole people into an industrial unit, and (4) the efficient co-ordination of their industrial efforts by the government. This economic colossus is supposed to develop the raw resources of Russia so efficiently that their exportable surplus of raw and semi-finished goods will flood world markets and undermine our present economic superiority.

The Russian government has been shrewd enough to encourage these fears. For example they assert that they will grow cotton in such quantity that they will break the cotton price just as some people claim they did the wheat price. They make extravagant claims of industrial progress.

Russia possesses enormous latent raw resources and she has a fecund, stolid peasantry capable of surviving almost any degree of human misery; it is quite possible that the breaking up of the great landed estates will eventually increase the efficiency of her agriculture; the enthusiasm of those who sincerely believe in Leninism and the

dictatorial energy of their governing group may force the adoption of modern machinery in her factories and on her farms.

Now we possess raw resources in abundance, our population is still essentially a mass of producers, and while our wage-scale and standard of living at first thought may seem a handicap in foreign markets, actually it has forced our employers to standards of efficiency that have enabled us to more than hold our own. Our own previous history supplies the negative to every single proposition advanced in favor of eventual Soviet economic domination of the world.

In our colonial days English theorists vainly tried on a small scale the "common stock" idea that is the essence of the Leninism or Marxism; the southern states proved before 1860 that slavery was economically unsound; under the pressure of the World War, with a more intelligent government than obtains in Russia to-day, we tried to consolidate industrial America, and from the operation of the railroads to the airplane program we failed miserably. Under this same imperious war demand we tried to distribute our skilled artisans to the best advantage; anyone acquainted with the actual development of our war industries can tell how inefficiently we handled our labor. In an almost hysterical fear some of us assume that Russia can succeed where we so signally failed, yet in a machinery age, Russia has to import not only machinery *but also the experts* to keep it in order, and in a civilization that has been created and dominated by nations believing in the fullest individual development, Russia pins her hopes on a system that sacrifices the individual to the state.

Russia will normally have an exportable surplus of wheat and flax; if she employs foreign managers she can supply the world with certain minerals such as manganese and with lumber. She did this under the Czars and we managed to survive. The only danger from Russia is that some of our parlor socialists and some of our unskilled alien labor will imbibe the fatuous ideas of Lenin and press them on our people, many of whom, bewildered by the rapid industrial developments since 1900 and the kaleidoscopic events of the World War, are too ready to listen to high-sounding phrases instead of doing a little quiet reflection for themselves.

Australia's Financial Plight

AUSTRALIA is now facing a crisis in her government fiscal policies. Briefly, Mr. Lang, Prime Minister of New South Wales, proposes that the Australian Commonwealth and state governments shall pay no more interest on their bonds, mainly held in England, until, first, Britain scales down Australia's debt as we did Britain's war debt to us; second, domestic holders of bonds agree to accept a reduction of interest to 3 percent; and third, the Commonwealth Government definitely abandons the gold standard.

The importance of Mr. Lang's proposal comes from the fact that the debt of New South Wales exceeds that of any of the other states and that he frankly advocates partial repudiation. London does not fear the adoption of this plan of open repudiation but it does fear an alternative plan recommended by Mr. Theodore, Federal Treasurer, which means inflation that would further increase the present crisis.

The sound but drastic plan to reduce the Australian government expenditures, to revise old age, invalid, and war pensions downward, excited too much opposition to be adopted. Before the war, Australia had embarked on ambitious but ill-considered socialistic plans that fastened extraordinarily heavy charges on the public treasury. The war placed additional strains on an already hard-pressed treasury. The government hesitates to inaugurate the only sound method of restoring Australian solvency.

Advices from London indicate that Britain will come to the financial aid of her dominion if necessary to prevent her bankruptcy. But this will only mean an additional burden on the treasury of the United Kingdom. Even school-boys should realize by now that governments as well as individuals must balance budgets, but enthusiastic advocates of state aid for various worthy enterprises always forget the teaching of experience and cheerfully look into the government's purse for some miraculous supply of gold only to find that the government has no money except that provided by the taxpayers. Our Congress and State Legislatures will do well to ponder Australia's condition when confronted with wholesale demands for government aid, all of which have to be financed by the citizens' money.

France, England, and the Iraq Oil

WHILE oil producers the world over are striving to control and reduce the current production of oil, which already exceeds the world's demands, a French company backed by the French government is preparing to rush to completion its section of pipe-line from the Iraq oil fields to Tripoli, Lebanon. The proposed British terminal of this same pipeline will be at Haifa and will serve both British and American oil companies interested in the Iraq fields.

The British and American interests do not wish to hasten construction of their end of the pipe-line and at present contemplate leisurely construction with completion about 1938. France, eager to obtain a supply of oil wholly under her own control, desires to finish her section in 1933. As both French and British titles to the oil fields come from the World War, there has already been much negotiation on the division of the oil. American interests depend upon concessions obtained from the Turkish government prior to the World War, and recognized by the Allied governments after the war.

It is easy to understand both the French desire to control its own supply of oil, and the opposition of the British and American companies already struggling with a world over-production to an additional supply thrown on the world market. We have watched the desperate and to-date futile efforts of domestic oil companies to control the output of oil in the United States. American companies are only hampered by anti-trust laws and the natural desire of owners of oil wells to realize on their underground resources. The Iraq situation is complicated by its international status and the fact that three governments are supporting the views of their respective companies. The future developments will be interesting to observe.

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

Stocking Repair Method Patent Held Valid

THE Court of Appeals of the District of Columbia recently affirmed the decision of the Supreme Court of the District of Columbia, holding claim 23 of reissue patent No. 16,360, issued to The Stelos Company, Inc., assignee of Frank C. Stevens, the inventor, valid and infringed.

The Stevens invention was found by the Court to have revolutionized the art of repairing runs in fabrics and particularly in hosiery. Prior to the Stevens invention runs in hosiery were repaired by stretching the stocking over the finger tips, which method made it difficult to insert a needle beneath the thread, and moreover was slow and was trying to the eyes. Stevens conceived the idea of stretching the fabric or stocking over a holder having a depressed surface with sufficient depth for the free use of the needle. The needle which he devised comprised a hook at one end, a latch or bridge pivoted adjacent to the hook and in position to open and close the latter with the operation of the needle, and a notch or recess at a point opposite the free end of the latch or bridge. By employing the recessed holder this needle could be used in a reciprocating manner to pick up the threads in the run faster than the eye could follow the operation and with but one forward and one backward motion to accomplish the purpose for which previous methods had to use twice the number of forward and backward strokes.

The Stevens reissue patent covers both the needle and the method by which the needle is used to repair the runs, although only claim 23 for the method was involved in the above mentioned suit. The use of the special holder in the method was regarded by the Court as revolutionizing the art, and caused the Court to remark: "Its simplicity now that Stevens has disclosed it, causes wonderment that it had not been discovered before."

"Kalas-Sill" Not Registrable as Trademark

IN an appeal from the decision of the examiner of trademark interferences dismissing the opposition, First Assistant Commissioner Kinnan recently held that the applicant, Olaf Hertzwig Trading Company, Inc., is not entitled to register the words "Kalas-Sill" as a trademark for canned herring.

It was shown by the opposer, B. Westergaard and Company, that the words are considered as descriptive in Sweden, meaning substantially "banquet herring" and that the Swedish government refused to register the notation on the grounds that it "seems to indicate the nature and purpose of the goods." A notation that is descriptive in Sweden and when used by Swedish people is not registrable in the United States as a trademark.

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.

It was further shown that the earliest use of the words by the applicant was about August 1, 1924, whereas the opposer sold goods bearing the words as early as February, 1924. It was held in consequence that the applicant had not established itself as the owner of the mark.

Therefore the decision of the examiner of trademark interferences was reversed, the opposition sustained, and it was adjudged that the applicant is not entitled to the registration for which it had applied.

Correspondence School Curbed

C. N. COX, who conducts a correspondence school in Denver under the name The Norton Institute, is ordered by the Federal Trade Commission to cease representing that a "C. H. Norton" is president of the so-called institute or has any connection with the business. The name "C. H. Norton" was found to be fictitious.

Other prohibitions pertain to prices charged for the course, advertising, and representation regarding preparation for civil service examinations.

Cox is ordered to stop representing that prices of the courses are other than the prices at which they are actually sold. He is to discontinue publishing letters of recommendation unless they are genuine and actually received by him and to stop representing in newspaper advertising or "Help Wanted" columns that he does or can furnish the position of forest ranger. Representation that the course in forestry is sufficient adequately to prepare persons to take United States Civil Service examinations for the position of forest ranger is also prohibited, unless and until the course of instruction be modified so as to afford information on every subject included in the examination.

The so-called institute is conducted by Cox and one clerk in a portion of two office rooms.

The course in forestry was found to be inadequate because for one thing it did not show the necessary ages for qualification under the civil service rules, which omission might cause numerous persons outside the age limit to spend money for the course when they could not benefit therefrom. In addition, the course was found to give misinformation regarding the number of questions in the examination, also to contain several erroneous answers and not fully to cover the subjects as prepared by the Civil Service Commission.

Furthermore, there is no mention as to necessary experience that applicants must have had in order to pass the examinations when, as a matter of fact, the only people who pass them and obtain appointments are those with actual field and forest experience. It was found that in examinations held by the civil service, out of 80 competitors who stated they had taken The Norton Institute course, only four passed the examination and the papers of the four showed them all to have had experience.

Speckled Coal Marks Refused

IT was recently held by First Assistant Commissioner Kinnan that the Blackwood Coal and Coke Company, of Philadelphia, Pennsylvania, is not entitled to register as a trademark for coal, a mark described as consisting "in a plurality of blue specks of irregular size on the surface of the lumps, no claim being made to the lump of coal *per se*."

The ground of the decision is that the Delaware, Lackawanna and Western Coal Company, of New York, had previously used and registered as a trademark for coal, a mark consisting in coloring the surface of some of the lumps of coal in the mass blue, and that applicant's mark is so similar thereto that the contemporaneous use of the two would be likely to cause confusion.

In his decision, after stating how the opposer had used its mark, the First Assistant Commissioner said:

"It is believed to be obvious enough that purchasers would be quite likely to also designate the applicant's goods as 'blue coal.' From the specimens filed and the testimony presented it is deemed the examiner of interferences was fully justified in his conclusion that the goods of the respective parties, when viewed at such a distance that the general color effect of the entire mass would be observed, would appear to the average purchaser as quite similarly marked and confusion would be practically certain if the marks appeared upon the respective goods in the same market."

Gas "Dope" Complaint Dismissed

THE Federal Trade Commission has dismissed a complaint charging E. K. Whitney and others, of Providence, R. I., trading as Motor Snap Company and as Whitney Sales Company, with circulating misleading statements regarding higher engine efficiency obtained by placing tablets in the gasoline tank of a motor vehicle.

Building Design Judged Patentable

AN appeal was recently made by Wilbur B. Foshay and Gottlieb R. Magney from the action of the primary examiner in finally rejecting the following claim:

"The ornamental design for a building, as shown."

The opinion of the Patent Office Board of Appeals follows:

Appellants' design is for a building which resembles in appearance the Washington Monument. The Examiner, in his statement, says the claim is not rejected on the ground that the design is a simulation of the Washington Monument, and the only references cited have been withdrawn as such. He further states that the claim was finally rejected on the sole ground and for the sole reason that it is not proper subject matter for a design patent as contemplated by the design statutes. Accordingly, this is the only question that is before us for consideration.

In the case of In re Hadden, 1927 C. D., 160, the Court of Appeals of the District of Columbia held a grand stand to be proper subject matter for a design patent. The examiner asserts that the Hadden decision is not controlling in the instant case for two reasons. The first of these reasons relates to the clearness of the disclosure in the Hadden application drawings. It is not seen how this reason has any bearing on the question of whether or not a large building structure may properly be regarded as an article of manufacture under section 4929, Revised Statutes.

The second reason advanced by the examiner is that the court was not fully advised of a prior Commissioner's decision rendered in 1890 and of the Patent Office practice following such decision, and that in view of these facts, as well as the decision of the Supreme Court in the cases of Jacobs *vs.* Baker, 7 Wall. 295, and Fond du Lac Co. *vs.* May, 137 U. S. 395, the decision in the Hadden case is erroneous. The early Commissioner's decision can be regarded as in no sense constituting a precedent which would be binding upon the appellate court. The Supreme Court decisions were considered in the Hadden opinion. We are satisfied the Hadden decision is controlling in the instant case as to the sole ground of rejection involved in the appeal.

In one of the early actions in the case the examiner required division between Figures 1 and 2 on the one hand and Figure 3 on the other hand. At that time he indicated that Figures 1 and 2 show a patentable design. The applicant attempted to comply with the requirement by asking that a print of Figure 3 be made for this application and sheet 2 of the drawing, which contains Figure 3, returned so that a divisional application might be filed.

The examiner's subsequent actions denied patentability of the claim, and it does not appear what his attitude is at the present time with respect to the question of division. Applicant in his brief asks us to rule in view of amended Rule 41 that all three figures may be retained in the application. Since this question is not involved in the appeal, it is believed the initial ruling thereon should be made by the examiner.

The decision of the examiner is reversed.

Ban Threats of Patent Suits in Bad Faith

THE Federal Trade Commission has ordered Flynn and Emrich Company, Baltimore, manufacturer and seller of stokers and coal feeding mechanisms, to discontinue the practice of threatening persons or firms with patent infringement or damage suits for the purpose of diverting the trade of competitors into its own channels, and without intention of actually bringing such suits.

Findings of the Commission show that a mechanically operated stoker made by the respondent was covered by letters patent, but that devices similar in design were being sold by competitors, and that attorneys informed the respondent they considered the company to have a good case and that its patents probably would be upheld by the courts.

The Commission found that representatives of the company were furnished copies of the patent papers as well as given permission to show them to prospective customers and to point out that certain features were embodied in the Flynn and Emrich stoker and were patented and that if any other manufacturer incorporated the same feature in its stoker, it was infringing this company's patents. The company also permitted its representatives to make known that a user of an infringed article could be made a party to a suit just the same as a manufacturer could.

In several instances Flynn and Emrich salesmen interviewed persons who had contracted to purchase the stoker of a competitor, the Perfection Grate and Stoker Company, of Springfield, Massachusetts, and warned such persons that they might get into trouble over patent rights, the Commission found.

During the period in which the respondents' salesmen were making these statements the company had not determined to bring any suit, the Commission found, and at the time the Commission's complaint was issued in March, 1929, the respondent had brought no suit.

These statements of the representatives were held by the Commission to be directly chargeable to the respondent company and to have been made in bad faith and without definite determination to bring suit for infringement or damages, and for the purpose of preventing a competitor from selling its products.

Claude's Neon Patents Upheld

FEDERAL Judge Frank J. Coleman recently handed down an opinion holding the American Neon Light Corporation and the Neon Tube Sign Corporation guilty of infringing the patents obtained by George Claude in 1913 and covering the neon light principle.

Claude's patents are now owned by Claude Neon Lights, Incorporated, which brought suit against the two concerns demanding a permanent injunction, an accounting of profits, and estimate of damage.

Judge Coleman, who sat without a jury, decided that only two officials of the American Neon Light Corporation took part in the infringement. They are Otto B. Schulhoff, president and chairman of the board of directors, and John W. White, secretary.

Judge Coleman exonerated William T. McGurk, Abraham E. Lefcourt, Louis Haas, Bertram A. Unga, and David Nicholsurg, directors of the American Neon Light Corporation. The complaint was permitted to remain against White, William J. Rose, J. A. Greene, and Eugene I. Doctor, who are said to have been the principals in the Neon Tube Sign Corporation and traded under that name. In addition Morris Jacobs, of Kane, Brooks & Co., brokers, was named.

By the decision of Judge Coleman an injunction obtained in 1928 is made permanent and Claude Neon Lights, Inc., may sue the individuals named.

Coal Saver Fraud

A COMPOUND that is alleged to make poor coal good and good coal better, is involved in an order of the Federal Trade Commission to F. L. Mennie of Omaha, Nebraska, trading as Mineral Coal Saver Company, Mennie Manufacturing Company, and M. and K. Manufacturing Company.

Besides ordering Mennie to cease advertising that his product, consisting principally of common salt, will make poor coal good and good coal better, the Commission prohibits such other presentations as the following: That such a compound prevents or removes soot; increases the heat from a given quantity of coal to any extent in British Thermal Units; gives 20 percent more heat with less coal; is carefully compounded under supervision of a chemist (unless and until such time as a qualified chemist is actually employed for this purpose); is a chemical mixture of proven worth or scientific merit (unless and until, after a comparative test of the use of the product with the non-use thereof, under otherwise identical conditions, its worth shall have been demonstrated scientifically); and that "modern science in such a compound has produced a sootless or smokeless treatment for coal."

Directions for use of "Mineral Coal Saver" say to dissolve one pound in six to twelve gallons of water, depending on the kind of coal, and apply by sprinkling.

Mennie's product, analyzed by government and civilian experts, shows for different samples slightly different compositions, as to about 10 percent; but common salt averaged about 90 percent in all tests.

Mennie testified that his formula called for 240 pounds of salt, half as much rock salt or fine salt, to which he added twelve pounds each of potassium chlorate and potassium permanganate and a small amount of coloring to "camouflage."

Coal, when treated with the "saver," was found to burn with a high yellowish crackling flame and to release one half to one and a half percent additional oxygen in the fire chamber so that there was additional combustion to that extent.

Expert chemists testified that this maximum increase in oxidation of one and one half percent would neither make poor coal good nor good coal better, nor do the other things as claimed by Mennie and prohibited in the order.

Inventors Called Saints

SPEAKING before the Executives Club of Chicago, Professor Harry A. Overstreet of the College of the City of New York recently made the following reference to inventors:

"We have the antiquated idea that the saint is a man so good you can't live with him. On the contrary, the inventor is the modern saint, the man whose inventive spirit enables him to give us machinery and ideas to make life as life ought to be."

BOOKS SELECTED BY THE EDITORS

AMERICAN DIESEL ENGINES—*By L. H. Morrison*

THIS is a comprehensive discussion of all present-day Diesel engines built in the United States, written in an interesting manner, and containing information of value to both the executive and the operating engineer. Among the topics covered are: relative costs of Diesel and steam plants; operation and adjustment of Diesel engines; and advantages of Diesel power for factory plants, excavators, central stations, etc. It also covers fuel and injection systems, lubrication, and engine output in a thorough manner. A much needed text.—$5.20 postpaid.

AVIGATION

By Harvey H. Holland, Capt. Air Corps, U. S. A.

BASED upon his experience as a transport pilot, airship pilot and free balloon pilot, as a member of the A.S.M.E. and the Society of American Military Engineers and by reason of his training as an airplane and balloon observer, the data given in this condensed little book of 272 pages is exceptional in its practical conclusions of the principles and methods of avigation practice. It is a textbook for student pilots and airmen preparatory to Department of Commerce examinations, as well as an authoritative reference for the seasoned pilot and airman.—$2.65 postpaid.

ZOOM—*By Capt. George R. White*

YOU will get more interesting sidelights from this book as to what to do and what not to do, than from any other source we know. Facts, incidents, impressions and knowledge of the simple mechanics, just the things one wants to know and ought to know, before starting to fly. The knowledge of meteorology shown here is practical experience translated into most understandable language. Young and old alike will read easily through the 182 pages and confess that they have learned a lot not contained in more formal treatises.—$1.65 postpaid.

ENGINEER'S VEST POCKET BOOK

By W. A. Thomas, Consulting Engineer

CLEAR and compact in arrangement, an almost incredible scope has been encompassed in this handy little book of 400 illustrations, 153 tables, 30 curves, with an index of 725 items. It is a most ready reference regardless of whatever branch of engineering one may specialize in. Durably bound in morocco grained leather, gilt edges, flexible.—$3.00 postpaid.

SHORT WAVES—*By Charles R. Leutz and Robert B. Gable*

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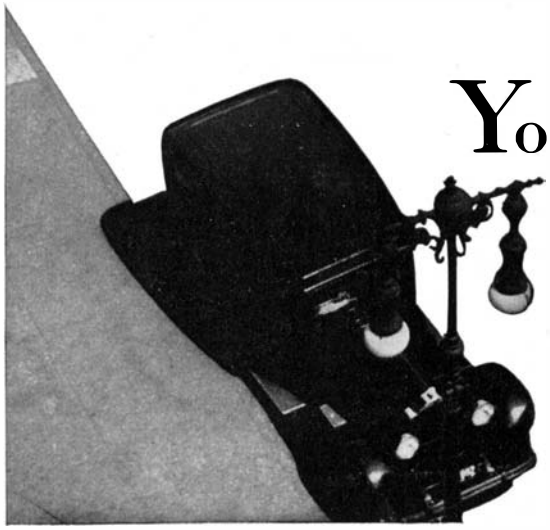

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But-

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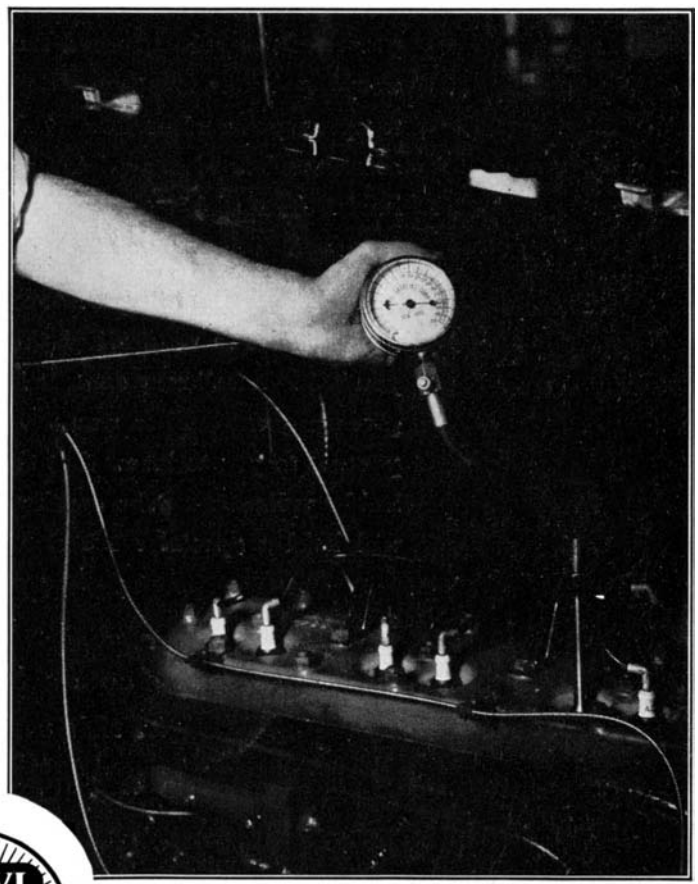

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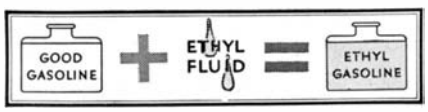

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