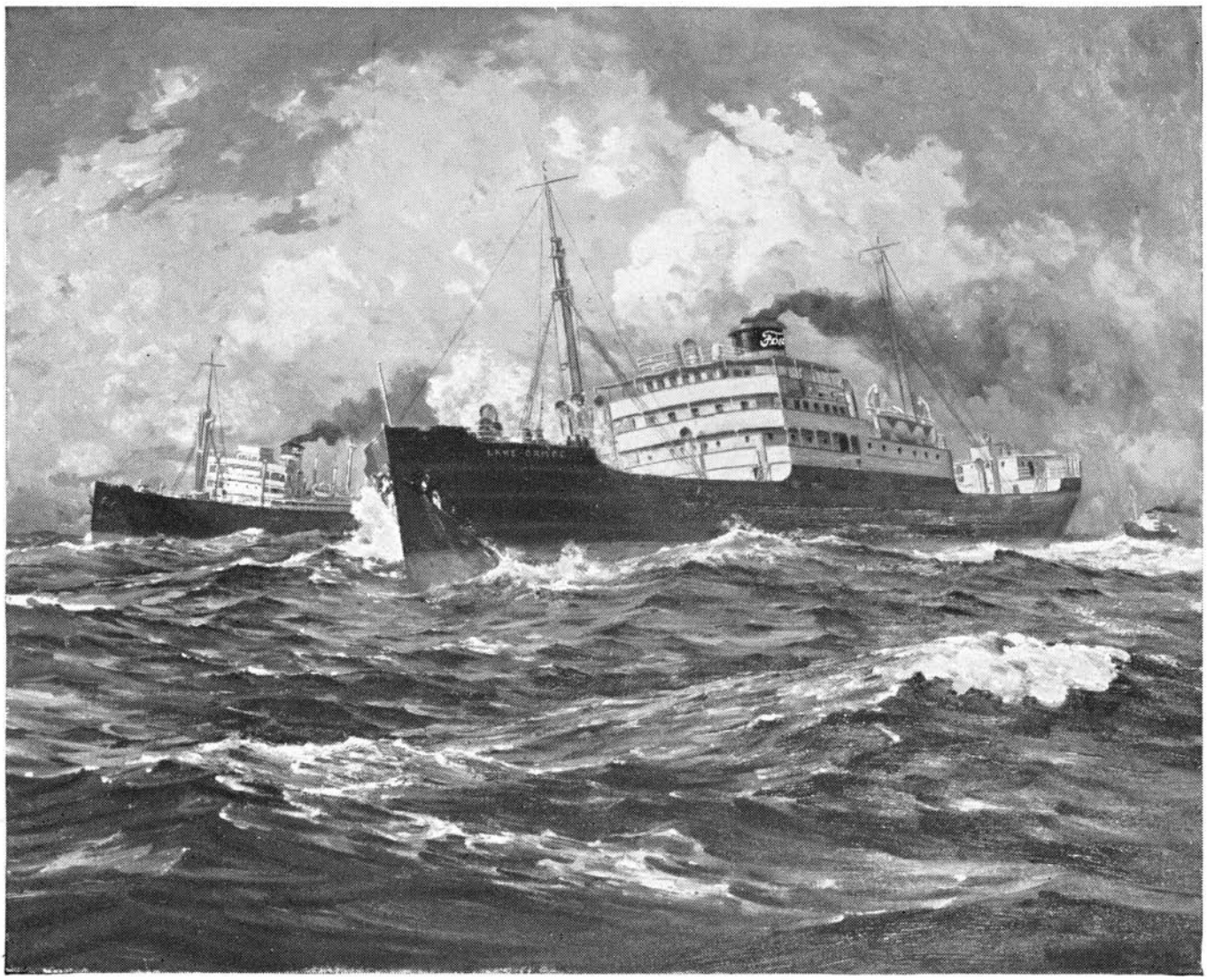
SCIENTIFIC AMERICAN

OCTOBER · 1931 35 CENTS



S.S. East Indian and Lake Ormoc, of the Ford Fleet

DESTINED FOR DETROIT

IN THE DAYS when the life and energy of New England were expressed in terms of sailing-ships and adventurous voyaging, the little port of Salem meant more to the people of Malaysia than all the American Colonies together!

Today, though few think of Detroit as an ocean port, cargoes from the farthest corners of the earth find their way by sea and river, canal and lake, railroad and highway, to the docks at River Rouge. At East African ports, ships are piled with red ore of friable chrome destined for Detroit. Rare varnish ingredient comes from Formosa. Diamonds, even, are in the cargo from South Africa. Rubber and nut-oil come from the Yangtze, the Amazon, and ports of the Malay States. Better known than Salem ever was, Detroit, today, typifies America.

All the world contributes to the making of a Ford! For all the world is searched to find the best of raw materials to manufacture this famous car. And all the world receives back again an automotive unit of transportation that brings a new idea, a new stimulus, to the service and well-being of mankind.

The Ford principle has always been to produce the best possible car for its purpose, regardless of cost; and then, by applying the highest degree of efficiency and the most painstaking economy, to bring the cost of its production down as far as possible.

Materials arrive at Detroit, by railroad, truck, steamship and airplane under exact co-ordinated control. Wherever it has been found necessary in the interests of better speed and consistent economy, Ford has realigned and created systems of transportation to further reduce the ultimate cost of manufacture.

As far places contribute to the production of the Ford automobile, civilization gains by its use.

FORD MOTOR COMPANY

SCIENTIFIC AMERICAN

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EIGHTY-SEVENTH YEAR • ORSON D. MUNN, Editor

CONTENTS · OCTOBER · 1931

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ACROSS THE EDITOR'S DESK

WHEN an organization devoted, not to profit, but to service to humanity, has been in active operation for 50 years, with constantly increasing efficiency and scope, it is obvious that its very foundations must have been laid with rare foresight. Such is the case with the Red Cross, this year celebrating its 50th anniversary. In times of peace and in times of war this world-wide group of earnest workers has carried on with a vigor that has made its insignia symbolical of aid to the suffering. There is not to be found a parallel case in the annals of history, and we take this occasion, with the publication of a short resumé of the work of the Red Cross, to extend to them a hearty vote of thanks for their past work, and a hope for a future even more brilliant.

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In our issue for August 1931 we presented an article on "Carl Akeley's Africa," telling something of the work of this eminent naturalist in the wilds of what was formerly known as "darkest" Africa. Thanks to his enterprise, the appellation has been changed to "lightest" and much knowledge of that vast continent has been made available. One of Akeley's fondest dreams has, since his death, been ably carried on by his wife, and from her pen we have obtained an article telling in detail of Africa's first national park. If the publication of such material does nothing more than dispel many erroneous impressions regarding Africa, it will have served its intended purpose.

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Probably the majority, if not all, of us have at some time read wildly imaginative stories of life on Mars or some one of the other planets. Such stories make interesting light reading if one does not try to see too far beyond the actual written words, but when subjected to the scrutiny of science they are found to be nothing but froth, with little or no background of fact. When the man of science approaches such a subject, he takes into consideration many phases that are ignored by the fiction writer and bases his analysis on known laws of science. An article backed by just such reasoning has been prepared for us by a Fellow of the American Association for the Advancement of Science, Prof. Edwin Lincoln Murray, and is scheduled for November. The subject of his discourse is "Are there men in other worlds?" and his treatment of it will furnish much food for thought.

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Extravagant claims in millions of words are so often made for half-baked schemes—which are then wholly forgotten—that the public generally has become somewhat chary of unique developments. Thus because little has been heard in recent years of the Emmett mercury vapor and water vapor power generation scheme, some people believe that the idea has been abandoned. One man recently asked us if it had not "proved unsuitable." "No," we told him. "It has proved eminently practicable." The efficiency of one plant that has been operating for some time shows this; the plans for construction of two new, but larger, plants indicate it; and an article covering this unique process to be published in a coming issue will point out the reasons.

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There is an old saying among prospectors for gold that "gold is where you find it," and in spite of the huge quantities of oil and gas that are being produced today the same saying may be applied to them. But—and this is a big BUT—geologists have learned that they are found in certain places. Just where these places are is the problem that must be solved and the path toward this solution is one which science is treading with a stride that becomes more assured as knowledge of the subject increases. An article soon to be published tells of the progress that has been made.

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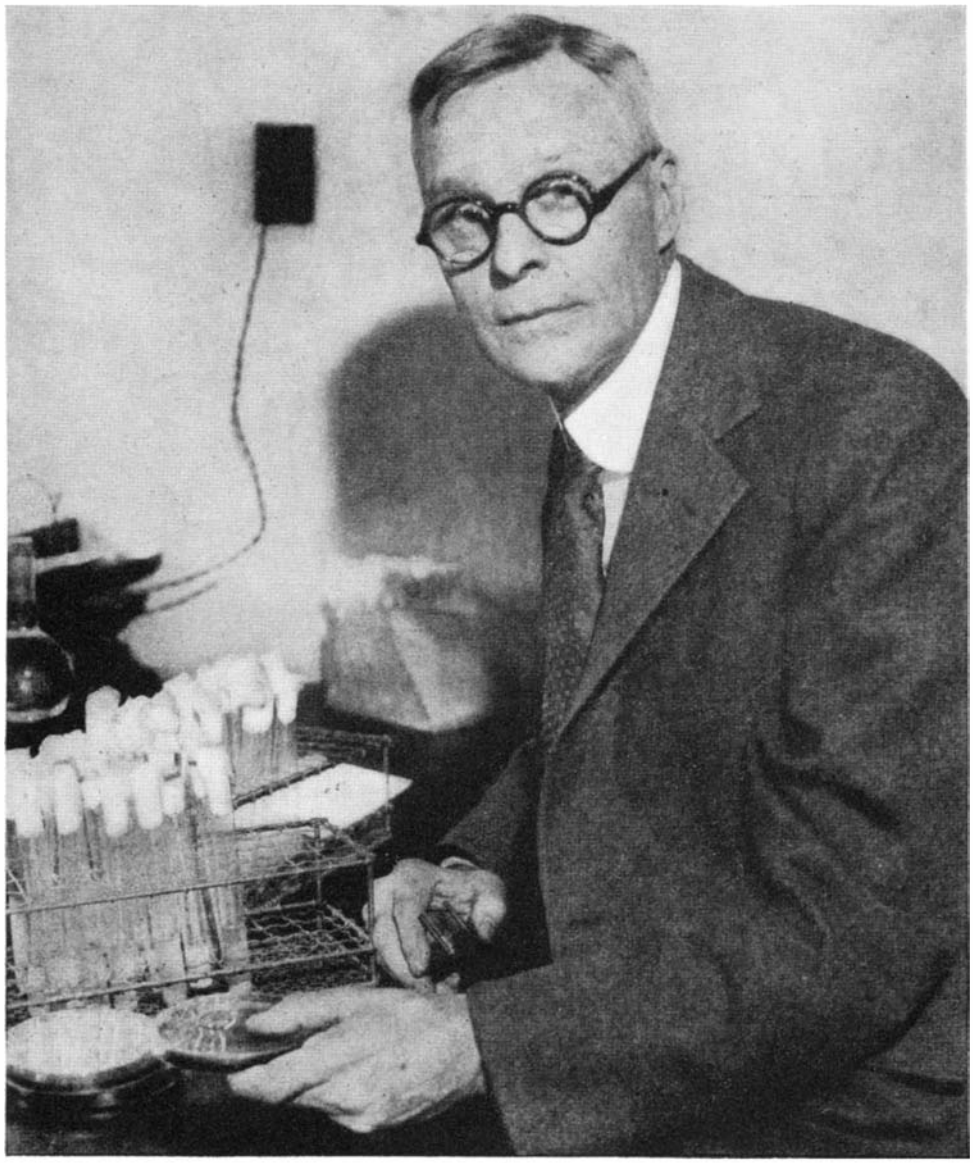
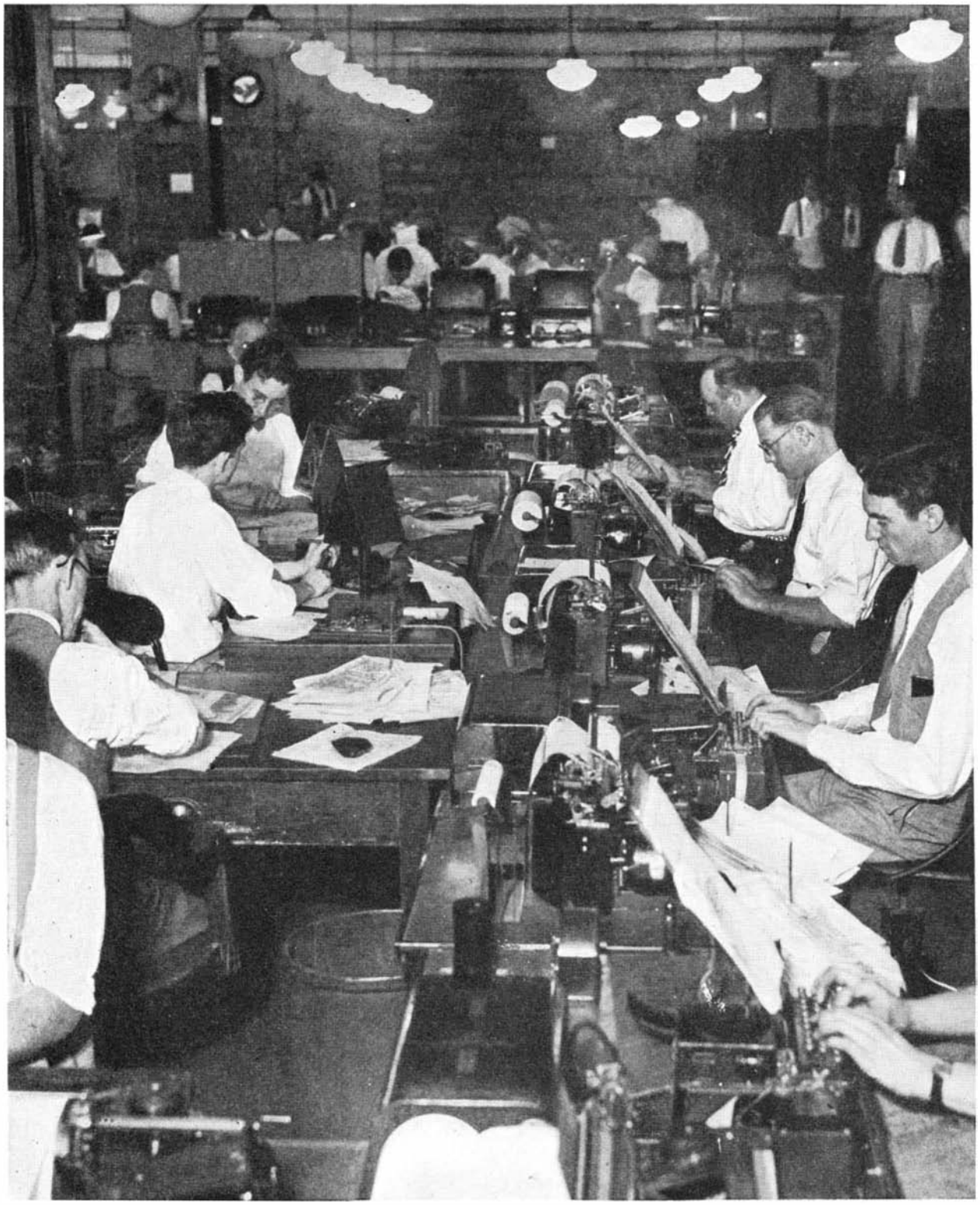
You buy a railroad ticket; board the train; the ticket is punched, possibly several times, and finally collected. As far as you are concerned, that is the end of that ticket. But behind the little rectangle of cardboard or the strip of folded paper is a history and a future that is complicated and interesting. From the printer's press to the macerating machine, the beginning and end of the ticket, its life and route are vital to the railroad industry. We have reduced this life history to an illustrated article that will give you a better realization of how the business of railroading is run. It is scheduled for next month.



ARTHUR I. KENDALL

A NEW discovery which seems destined to open up a vast realm of understanding of disease in a peculiar corner of medical science where almost everything heretofore has remained stubbornly hidden from the view of the vexed bacteriologist, has been made by Professor Arthur I. Kendall of the Northwestern University Medical School. The germs of most diseases are visible under the microscope but those of a few—measles, influenza, the common cold, smallpox, sleeping sickness, and others—apparently were too minute to be seen under the most powerful microscope. In studying germs with a microscope it long has been the standard method to culture them on gelatin, agar-agar, and broths—standard laboratory media. But the germs of the few diseases named always died when an attempt was made to culture them artificially, though they survived readily enough (quite too readily) within the body. To Dr. Kendall came the inspiration that perhaps the reason lay in the culture medium itself; in the body this would be pure protein, in the laboratory something else. He made a culture medium of pure protein and discovered that these peculiar germs thrived on it. Not only that, but they went through cycles when they became microscopically visible. Other common germs, hitherto thought always visible, underwent an invisible phase. It is not unlikely that this discovery will have a far-reaching effect on practical medicine. At least, more is sure to be heard of it.



THE NEWSROOM RUNS AT HIGH PRESSURE

THE newsroom of The Associated Press is as busy as the Stock Exchange but without its confusion. The men at the left are the editors who prepare the copy for the wires amid the terrific din. The men at the right are turning "copy" in the form of short "takes" into punched ribbon, shown on page 226. This ribbon in turn is fed into sending machines which transmit news at the rate of 60 words a minute to groups of member newspapers, geographically located for economical "hook ups." The same tape can be used for different wires, but news is usually "edited" for various sections, and a new tape made.

Newsroom where news is being edited and tape perforated for transmission by the printer telegraph.

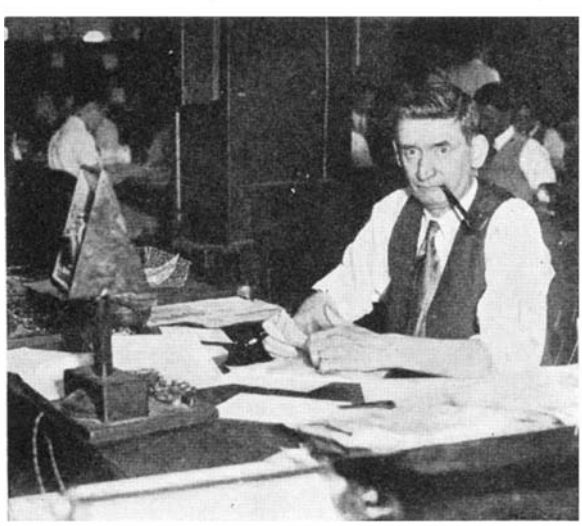
Morse operators are still on the job sending corrections and news that would hamper the main circuits

BEHIND THE SCENES OF NEWS GATHERING

By ALBERT A. HOPKINS

WHAT would breakfast be without the morning paper and coffee? We are apt to consider the newspaper as a matter of course; it costs little, it requires little effort to secure and the regularity of issue vies with the punctual rising and setting of the sun. The newspaper limns a picture of the world as it is, and we are apt to forget what work and talent are back of it all. The gathering of news and its dissemination is "big business," if ever there was any, representing an investment of 10,000,000,000 dollars and a yearly turnover of 5,000,000,000 dollars, and giving employment to over a million persons. The daily circulation of newspapers in the United States is 40,000,000, and 27,000,000 on Sundays.

The product is as ephemeral as hot-house fruit or orchids; the news of the morning fades into the afternoon specials with their market quotations, sold on the streets 15 minutes after the market closes. The raw materials consist largely of brains and ground spruce with a little lampblack and varnish thrown in. There is a vast amount of talent employed in getting out issues day after day on time with up-to-the-minute news. While the newspaper is an article of prime necessity, still it is about the only thing that did not go up in price during the World War. We may pay a cent more daily or a few cents more on Sunday, but we are paying the small increase for better news service and quality.



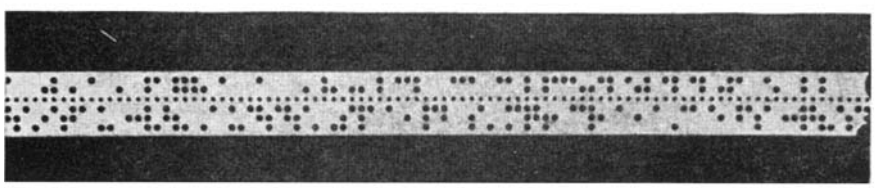
"Meet Mr. Harry French" in charge of the "west wire." He stopped long enough to look up from his task of reading 100,000 words in eight hours. He selects only 30,000 words for transmission to western papers, via high-speed printer-telegraph lines

Never in the history of our time have people been so avid for news and our insatiable eagerness to be informed requires ceaseless activity on the part of reporters and editors who rush feverishly to get the news to the public red-hot, while it is still news. The dean of American journalists, Charles A. Dana, used to say that the newspaper profession is a learned profession in one sense, for the utmost amount of learning can be put to use. Human nature is at the back of all good journalism and the gift for logical presentation of human traits, combined with scholarship, tends to produce a perfect newspaper.

The old-time reporter was just as able and resourceful in his time as the present day alert young man or woman, and there is ample evidence that he could write. He was daring, enterprising, and fully competent to cope with prevailing conditions. The old-timer usually was not harried by the necessity for speed. Even if he were, the reporting of news and the transmission of it to the newspapers was much more leisurely than it is today. Telegraph and telephone and cable systems were not as ex-

Tabulating market reports which come in over the tickers. Twenty men each handle from 40 to 50 stocks and keep them corrected all day

assessment to pay the cost of independently gathering and distributing the news of the world for the common benefit of members of the group and for them alone. There are a number of news gathering associations but the greatest of them all is The Associated Press which operates 225,930 miles of leased wires supplying 897 evening and 389 morning papers, or 1286 in all. Through the courtesy of the officers of this organization we are enabled to describe one of the most romantic and at the same time prosaic businesses in the world.



Perforated tape is punched as shown on page 224 and is used for feeding telegraphic transmission machines. About 60 words are on this section of tape

tensive as at present. The radio or wireless telegraph, which is probably the most outstanding development in facilitating the gathering of news from remote spots, was unknown. Today, however, if the editor of a paper in San Francisco cannot obtain a full record of what is going on in India within two hours he feels that The Associated Press has missed the grade.

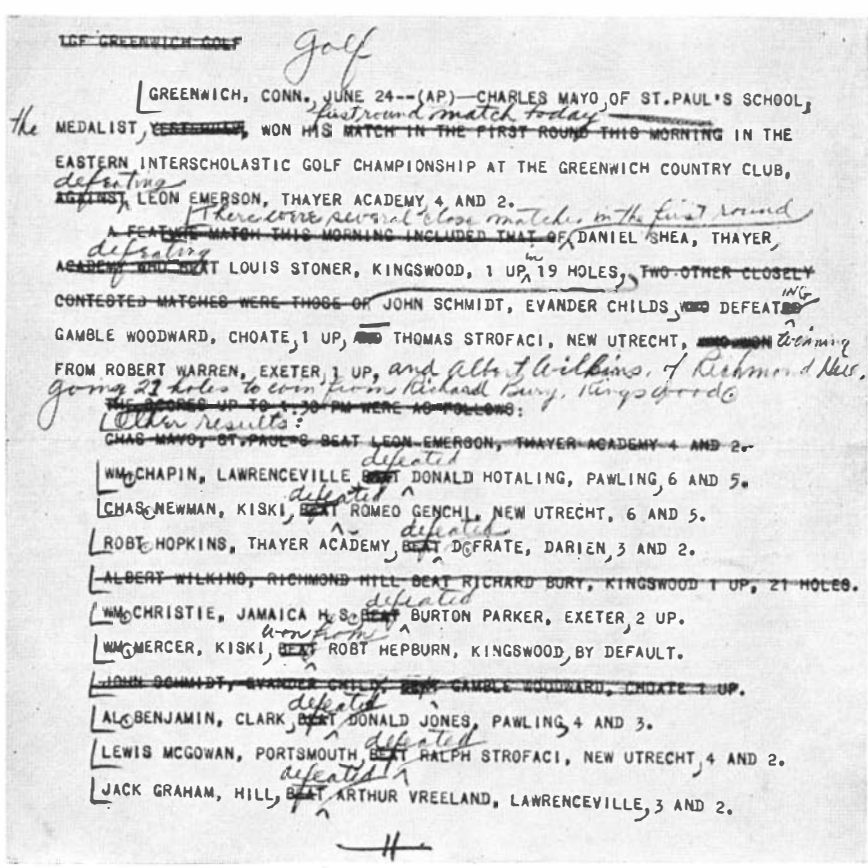
Capital enables a newspaper to run at a reasonable cost so that it is not swallowed up by expenses that might have been avoided. Out of the struggle to keep on the right side of the ledger has grown co-operative journalism which relieves editors and reporters from much of the drudgery and expense in individual seeking after news. Partial emancipation of the staff from petty and painful detail gives an opportunity for literary form, better English, more checking of facts, and an all around better perspective. The consequence is that perhaps not quite so many men are employed on the newspapers, but the remainder are apt to be better educated and more capable men who have a chance to expand.

THE primary and controlling motive and direct purpose of the newspaper is to make money and to do this expenses must be kept down. This is best accomplished by intelligent co-operation in which a group of newspapers combine to exchange news with each other, each member contributing to the common pool the news of his vicinity, and in addition a pro-rata

One thing should be strongly stressed and that is that The Associated Press is a purely mutual organization. There are no stockholders and under their charter it is forbidden to make profits. Each member has one vote and one vote only on all questions save that of the election of directors which, broadly stated, is according to the assessments paid. It is for these reasons that the enterprise is the world's greatest co-operative undertaking. After a member has been in the field for five years, he has a "right of protest" against the election of another member in the same field.

There is a long story back of the formation of this organization but in brief the facts are as follows: The leaders in the newspaper world thought that the prosperity of their properties and indeed the safety of the Republic itself are founded on an undefiled news-service and were unwilling to entrust such a terrifying power to any private group. After a conflict of years the victory of The Associated Press was complete. Now the members have a news-service of their own—their servant and not their master.

A membership in a great city is valuable. When the New York *World* gave up the ghost, the membership was perpetuated by a skeleton newspaper called the New York *Repository*. Should a newspaper want to buy this membership it would probably cost upwards of 500,000 dallors. A membership is often erroneously called a "franchise." New York has eight English language papers having membership—probably enough for the good of the industry.



GREENWICH, CONN., JUNE 24--(AP)—CHARLES MAYO OF ST. PAUL'S SCHOOL, the MEDALIST, won his match in the first round this morning in the EASTERN INTERSCHOLASTIC GOLF CHAMPIONSHIP AT THE GREENWICH COUNTRY CLUB, defeating LEON EMERSON, THAYER ACADEMY 4 AND 2.

Other results:

WM. CHAPIN, LAWRENCEVILLE defeated DONALD HOTALING, PAWLING, 6 AND 5.

CHAS. NEWMAN, KISKI, defeated ROMEO GENCHI, NEW UTRECHT, 6 AND 5.

ROBT. HOPKINS, THAYER ACADEMY, defeated DEFRATE, DARIEN, 3 AND 2.

WM. CHRISTIE, JAMAICA H. S. defeated BURTON PARKER, EXETER, 2 UP.

WM. MERCER, KISKI, won from ROBT. HEPBURN, KINGSWOOD, BY DEFAULT.

AL. BENJAMIN, CLARK, defeated DONALD JONES, PAWLING, 4 AND 3.

LEWIS MCGOWAN, PORTSMOUTH, defeated RALPH STROFACI, NEW UTRECHT, 4 AND 2.

JACK GRAHAM, HILL, defeated ARTHUR VREELAND, LAWRENCEVILLE, 3 AND 2.

A fine example of well-edited copy ready for tape punching. "Blue pencils" exist only in novels and in the movies; the editor's pencil is fat, black, and soft

The Board of Directors of The Associated Press are all active newspaper men selected from all sections of the country and election to the Board is esteemed a high honor. They take their duties very seriously and attendance at the meetings of the Board and the Executive Committee consumes from one to two months of their time each year. President Frank B. Noyes says: "I regard the work of the staff as one of the wonders of the world. News does not collect itself; human endeavor, human sacrifice, human brains are honestly expended in order that you and I may be promptly and accurately informed of the daily happenings of the world."

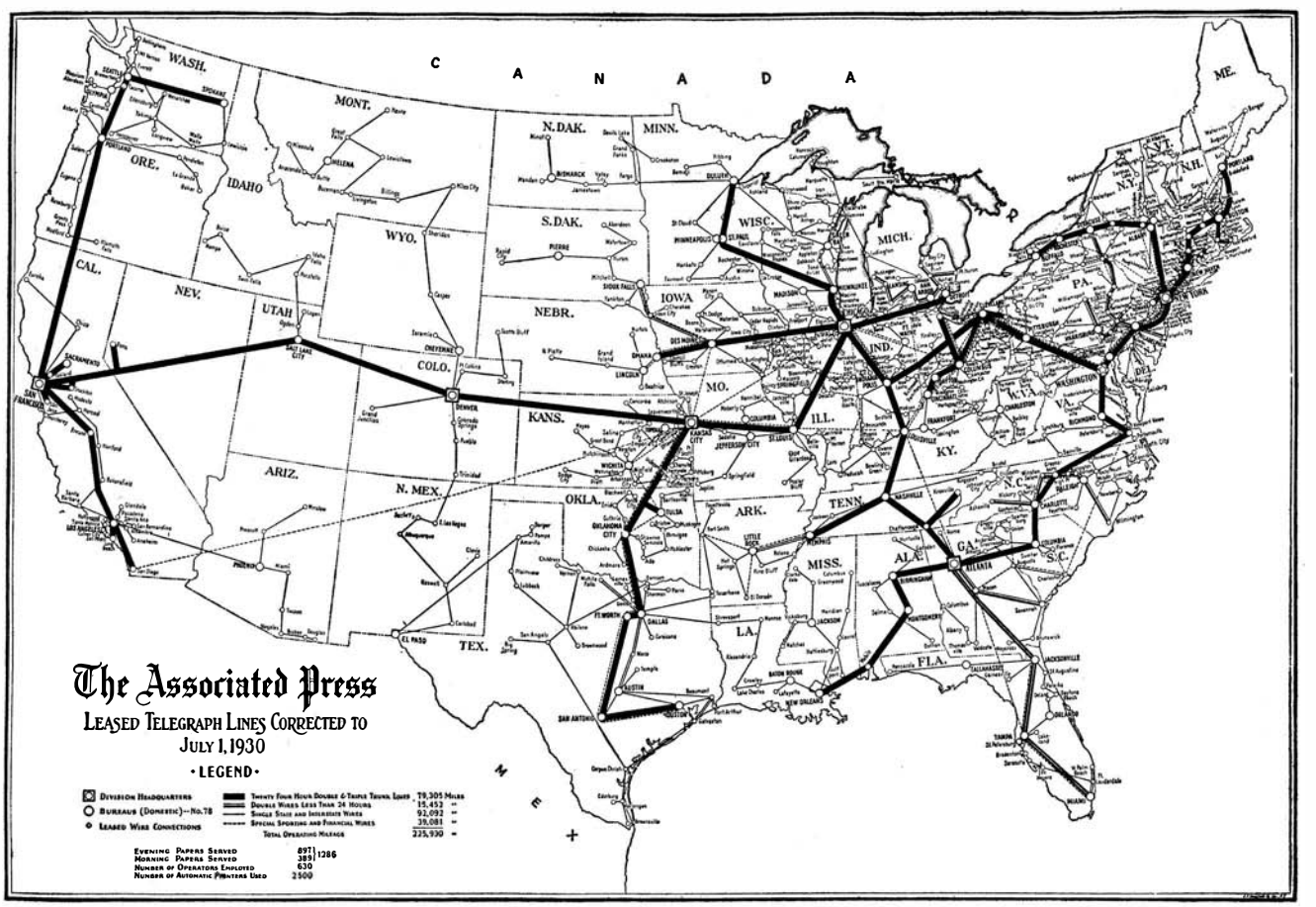
"Check and double check." Girl pasting up market quotations on sheets for checking. Gummed tape passes from printer over sponge

Every event reported by (AP) men must be accurate and unbiased and the news must not be gathered from back stairs gossip. The immediate operation of the service is in the hands of a general manager and since the organization in 1893 there have only been three of them—Melville E. Stone, Frederick Roy Martin, and Kent Cooper who now presides over this vast network of detail.

There are regular accredited correspondents in all the principal cities of the world who look after sending important news in condensed form by radio or cable. These men are trained American newspaper workers and are entirely independent of any one except officials of The Associated Press. Foreign news bureaus are also affiliated with the organization and the names Reuter, Havas, and others are to be found on doors in the New York offices. The cable and wire news is extremely condensed but is "unpacked" and expanded to normal by the cable editors.

The staff proper numbers about 3300 of which 1800 are full time employees and 1500 are what is known as "string" correspondents. To this must, of course, be added the personnel of the individual newspaper members and allied agency staffs. About 80,000 individuals are engaged in securing and transmitting the news. The cost is over 12,000,000 dollars a year which is borne by the individual member newspapers based on the actual service rendered, and may vary from 10 dollars a week to several hundred dollars a day. Naturally a paper requiring only a few hundred words daily should not pay as high as those requiring 75,000 words daily.

There are 85 bureaus scattered all over the country, each with its news and photograph file. If a San Francisco newspaper wants a photograph of the Eiffel Tower because a lady just toppled



The heavy lines show 24-hour trunk lines. Papers numbering 1286 are served by 225,930 miles of wire

Here is the copy from an eight-hour "trick." It is roughly fastened together in little books for filing

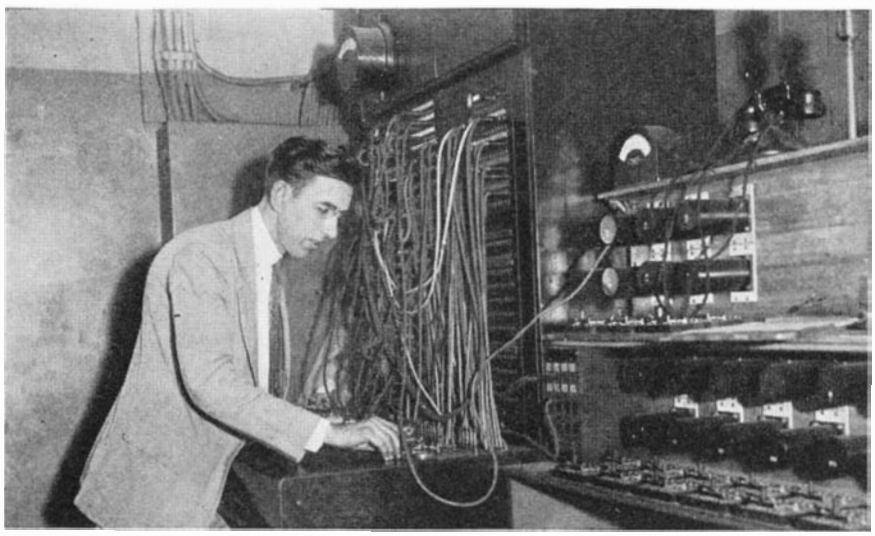
off, they do not have to send to New York for it. It usually is available locally.

The main office of The Associated Press is located in an office building on Madison Avenue, New York City, and as you leave the elevator you hear a type of noise which is indefinable. This is caused by the typewriters, the Morse instruments, printer telegraphs, tickers, and the hum of conversation incident to this enterprise. This noise and the more dramatic incidents were broadcast one night and it "went over big."

The telegraph and cable are the backbone of communication. There are 225,930 miles of leased wire involved. There are 79,305 miles of twenty-four hour double and triple trunk lines; 15,452 miles of double wires which are used less than twenty-four hours; 92,092 single state and interstate wires; and 39,081 miles of special sporting and financial wires, all leased for the exclusive use of this organization. The news comes in from member newspapers, is edited, and sent out again to the other member newspapers if the editors deem it of sufficient interest.

Nearly all transmission now is done mechanically. A tape is punched by the operator, is examined for errors, and put on transmitting machines which send the electrical impulses over the wires to operate typewriters in the newspaper offices. The great trunk lines—the western circuit, the southern circuit, and so on—carry the news to the great cities. In addition to the main trunk lines there is an elaborate system of state wires over which news of particular states is carried much more fully than is desired in other states. For example: New England is a tight little assemblage of states that is very much interested in New England news. There are 42 of these state or regional circuits. The smaller members without telegraph facilities often receive their news by telephone, a number of papers being on the same telephone circuit.

Mr. Kent Cooper has estimated that the wordage of the news report for one normal week totalled 2,562,715 words, exclusive of the figures of the bond and stock market which alone fill an average of 12 columns daily in the larger newspapers. In that week the news came from 1850 different cities and towns throughout the world, and consisted of 17,323 separate items. No single newspaper received all of this news.



Switchboard through which all telegraph circuits run from N. Y. newsroom of The Associated Press to all parts of the U. S., Canada, and South America

ONE of the most important functions of The Associated Press is to furnish the member papers with financial news. The quotations are received from the N. Y. Stock Exchange on the new high-speed tickers but other exchanges still use the old style ticker. Each tabulator has a group of stocks to look after and as he notes the changes he prepares for transmission prior to the close of the market. Later changes are made so that the metropolitan papers can be on the street a few minutes after the market closes. This is a great feat involving supreme accuracy. The changes are sent with code figures which make all clear to the compositor.

A "feature service" provides special articles and matrices of pictures so that stereotypes may be cast in the home newspaper office to make printing plates. Newspapers often have no photo-engraving plants to call on. This service has been established only four and a half years, but is now used by over 1000 member papers.

The Associated Press is a very wide distributor of photographs. Some of the larger papers receive 250 a week. All possible means of communication are used; airplanes, steamships, automobiles, fast trains, even telephone circuits which transmit pictures by wire.

Newsphoto distribution rack indicates when pictures are to be dispatched by train or air mail to members. New York papers get pictures eight times daily

OUR POINT OF VIEW

Cause or Effect?

IN a recent appeal to the scientists of the world, Professor Albert Einstein asked them to discontinue their research for the creation of new instruments of war. "Those who believe that the danger of war is past," he is quoted as saying, "are living in a fool's paradise. We face today a militarism far more powerful and destructive than that which brought on the World War disaster."

We shall, for the moment, pass over the apparent inconsistency between Professor Einstein's request and his explanation (quoted) of the reasons for it, and will agree, in part, with him. The signs do point to the danger of wars to come; there is evidence of the existence of more selfish, Nietzschean nationalisms than ever before felt a superiority over and sought to dominate other nations. Professor Einstein is, however, a world-famed physicist, not a sociologist; and he apparently does not accept the fact that this "militarism," this contempt or hatred for other nations is in men's minds, not in their accumulated trappings of war. Those who desire war, who see it as their destiny, who, like Alexander, weep when they can not tread the warpath of the conqueror, will continue to rattle their sharpened sabers. Others then, peacefully inclined but chary nevertheless, are forced to perfect their engines of destruction simply in self defense. The man who goes out in a boat does not *expect* to drown but he carries a life preserver just the same; and the mere fact that he has it does not bring on a storm!

We hope some day to see the abolition of war for all time, but we know that only a change in human nature will make this wish come true. Armament is the effect, not the cause of the warlike aspect of the world; and while disarmament is a laudable aim, it must have a reasonable minimal limit until national animosities have ceased to exist and the long-heralded and hoped-for brotherhood of man becomes a fact.

Fundamentals

IN our highly mechanized civilization, it is difficult for the average person to get more than a general idea of how most of the products of man's knowledge, ingenuity, and industry have been evolved or the processes involved in making them. He may know these products in his own field thoroughly and some of those in allied lines, but about others that have a vital place in our scheme of things he can only read tame, abbreviated accounts.

Aviation is one modern industry which appeals to millions but which, because of its characteristic rapidity of development, possesses many mystifying features. To those who are interested simply because of the fascination of the subject or who wish to study the secrets of the airplane's aerodynamic efficiency or of its construction, we recommend a visit to the Museum of Science and Industry when in New York City.

This museum's aviation room, which is to be formally opened to the public this fall, is the first of its kind in this country. There the visitor may push buttons and operate instruments that show the action of air currents around aerofoils and other shapes, and on the Flettner rotor; may operate devices that teach the principles of aviation instruments; may study structural details of various airplanes and aviation engines; may, in fact, seat himself in the cockpit of a pivoted instruction ship and actually turn and dive and zoom as he handles the controls.

The value of such a museum to the layman, the engineer, the industrialist, and particularly to the coming generation of aviation experts—those young students who want "to see the wheels go 'round"—is great indeed. In no commercial organization and in but few museums of the world can anything comparable to this exhibition be seen; and the officials of the museum who are responsible for it are to be highly complimented on the success of their labors.

Rolling Down to Rio

GONE are those romantic days when spread-sailed clipper ships, braving coastal storms and the hurricanes of the old Spanish Main, threaded their way through jewelled isles of the West Indies and went "rolling down to Rio." But the romance that very nearly disappeared with them and the advent of the steamer, has come back in the form of great spread-winged argosies that lift into cerulean skies and jump into and beyond the glittering tropics in much less time than either the clipper or the steamer could make the trip.

On page 234 are given a few of the highlights behind the reason why America holds an outstanding position in the field of international air transport. Representing a community of interests on the part of industry, commerce, finance, and the government of the United States, Pan American Airways is an American institution today—the "aerial merchant marine" of the United States—accomplishing in the skyways the same important mission that our merchantmen are furthering on the high seas.

In less than four years, this international air transport system—today larger by a wide margin than the great subsidized international air units of Europe: Imperial Airways, of Great Britain; Deutsche Lufthansa, of Germany; or Aeropostale, the continent-girdling system of France—has established an impressive record. More than 80,000 passengers, at a rate equivalent to more than 45 percent of the persons carried each month on the 26 domestic air lines in this country combined, have traveled over the air routes to the West Indies, and to Central and South America. And what is perhaps more important to the average person, insurance statistics show that the traveler is safer in a Pan American plane than he is in a railroad train or his own automobile.

Drug Control

IN July, 28 out of 57 delegations of nations signed at Geneva a convention for the limitation of narcotic drug manufacture. This is the first forward step in the difficult problem of drug control that has been made for many years.

The drug traffic has increased at a most alarming rate during recent years, especially in the United States. The legitimate needs of the world for narcotics amount approximately to the low figure of eight or ten tons annually. And yet production runs to several hundred tons! What is still more shameful is that America is by far the largest user of narcotics!

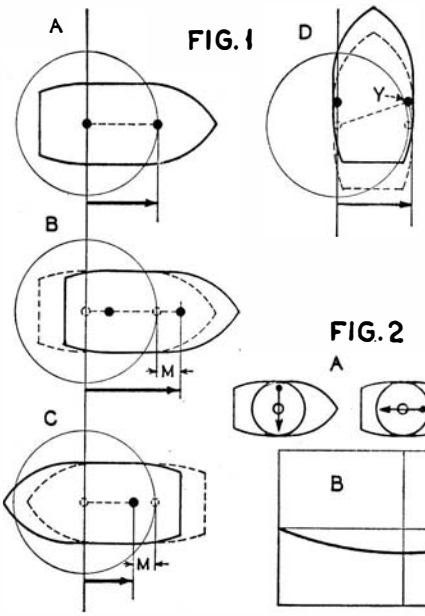
Drug addiction is not a vice; it is a disease, a habit acquired unwittingly in many cases but more often through the wiles and trickery of the dope-peddler than whom there is no lower animal on earth. If the agreement to limit narcotic drug manufacture is strictly adhered to, as is confidently expected, fewer lives will be ruined by the deadly powders. If they are not made in such large quantities as heretofore, the drug-peddler can not sell them, for unlike alcoholic beverages, narcotic drugs may not be synthesized; there can be no such thing as bootleg narcotics except in comparatively negligible quantities.

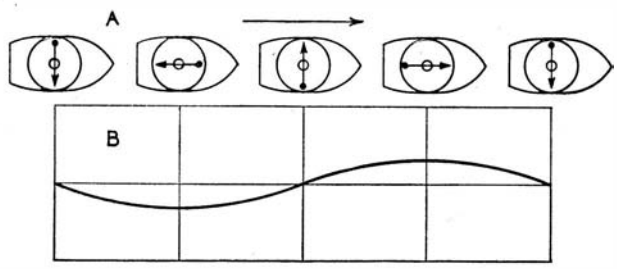
MORE HARD LUCK FOR THE ETHER

By HENRY SIMON
Jena, Germany

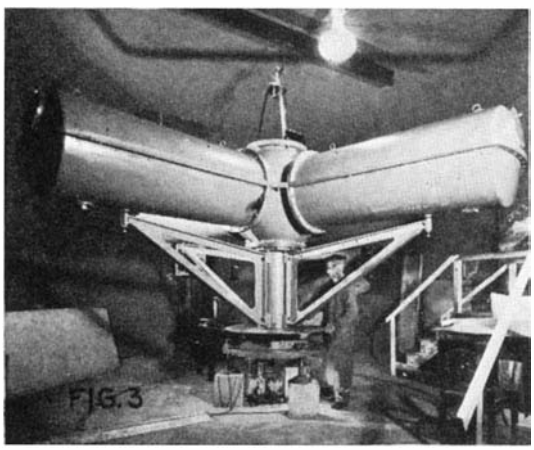
IS there an ether, or is there not? Scientific opinion on this great question is still divided. It is answered in the negative by the adherents of the Einstein theory. Another and a smaller group of leaders of scientific thought answer it in the affirmative; as indeed it had been answered by scientists generally until the end of the 19th Century. It was the famous "ether drift" experiment, carried out by Michelson in 1887, that first raised doubts as to the existence of the ether. The findings of that experiment were later to become the foundation for the theory of relativity.

Michelson reasoned that if the earth is moving through an ether, and if that ether is the carrier of light, then a light signal sent in the direction of motion through the ether must travel slower than a signal sent in the opposite direction. A rough picture of his idea may be had by imagining a ship at sea, on which a sound signal is sent from one point of the deck to another. On looking at A and B, Figure 1, it will be plain that the time of the signal will be lengthened or shortened by the distance M, according to whether the signal is sent with or opposite to the direction of motion.





Differences in the time of a sound signal on a ship at sea, an analogy with the ether drift experiment. The spreading sound wave is indicated by a circle



The Joos-Zeiss interferometer recently used

If the signal were sent crosswise of the ship over the same distance, as at D, then evidently there would be practically no difference, although the observer would have to be stationed at Y because of the lateral drift.

Let us go a step further and imagine the whole apparatus, sending station, observer, and all, placed on a platform which was set slowly revolving as the ship proceeded, as at A in Figure 2. Then evidently there would be a gradual periodic transition in the length of time taken by the signal from normal to below normal, back to normal, and to above normal. This transition might be graphically expressed for each revolution of the platform in the shape of a curve something like the one in B.

It was exactly an effect on this order, obtained with an apparatus designed on the broad principles of the ship analogy just suggested but using light instead of sound and carried on the earth as it rushes through space instead of on a ship plowing through the ocean, that Michelson strove for in his classic experiment. How he overcame the difficulty of measuring time differences, which at the speed of light of 186,000 miles per second would run into billionths of a second, by transferring the problem to the realm of interferometry, will be explained further on. Suffice it to say now that his final instrument was so sensitive that it would positively reveal a light velocity difference of only one mile a second as against a conceivable maximum difference of 18 miles a second due to the earth's motion around the sun, and of several hundred miles a second due to the supposed motion of the Milky Way system as a whole through space.

In spite of this extraordinary sensitiveness neither Michelson nor succeeding investigators working with instruments based on his idea were ever able to obtain any but a wholly negative result. Although the ether was known—thought—to be the carrying medium of light as air was that of sound, not the slightest indication of an "ether wind" or ether drift was ever discernible. Though this result had not been expected, it was fully as important from the standpoint of science as a positive result would have been, for it clearly indicated some vital fault in previously accepted reasoning. One obvious conclusion to which it might be conceived to point was that the reason for the absence of the ether drift was that no ether exists. It is this assumption, indeed, which has become one of the corner stones of relativity.[1]

AT any rate, after many repetitions of the experiment, both sides had accepted the null result as a fact, and each had drawn its conclusions accordingly. A tremendous stir was therefore created when in 1925, Miller suddenly reported that in again repeating the experiment with a new apparatus, he had noted what seemed to be an undeniable ether-drift effect. If true, then this dis-

[1]Strictly speaking, Einstein never did, as is often said, "throw out the ether." As an ether was not a part of his system he never brought one in.—*Editor.*

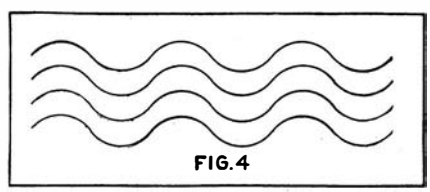


Diagram illustrating light waves

covery would have a momentous bearing on one of the great riddles of the universe. The cause of the ether proponents would be strengthened and, by the same token, that of the relativists would suffer correspondingly by the collapse of one of their principal tenets.

IT was because of Miller's experiment and the questions it raised, that an extraordinary effort to settle the problem was undertaken by the University of Jena with the aid of the Zeiss Works, renowned builders of optical and astronomical equipment. The purpose of the instigator of the idea, Professor G. Joos of the chair of theoretical physics of the University of Jena, was to raise the sensitiveness of the new apparatus beyond all previous means; also to cause it to record its findings automatically in permanent form, ready for any one to check them by the instrument's own handwriting, instead of relying upon subjective readings as in all previous instruments.

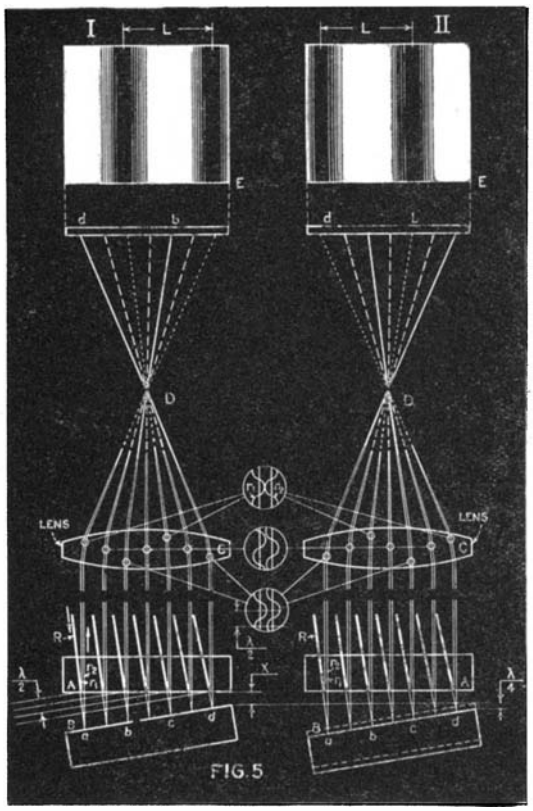
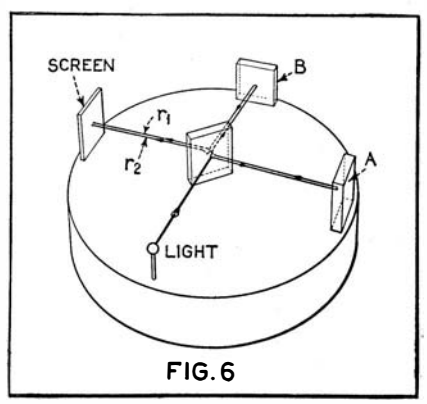


Diagram showing the formation of interference bands. This may be passed over hurriedly by the casual reader but ten minutes close study and tracing of lines will repay the reader who wishes a clear understanding of the subject

A general view of the interferometer is seen in Figure 3. All former ether drift apparatus has followed Michelson's design, having a body of marble or steel, which bore the optical parts and floated in a bath of mercury in which it was slowly rotated around its axis. The new interferometer differs in this as in almost every other detail from all previous forms of apparatus, though it is like them in its essential principle. It will be of interest briefly to review this principle and its application to the purpose under discussion.

A stream of light issuing from any source may be regarded as a bundle of extremely fine parallel rays, all vibrating in exact unison somewhat as indicated in Figure 4. No matter whether the distance traversed by these rays is an inch or a million miles, they will normally continue vibrating in exact time.

Under some conditions, however, it may happen that some of these component rays are thrown "out of step." This takes place, for example, when two plane surfaces, of which the upper one is transparent, are placed nearly parallel to each other, and illuminated by monochromatic light, as in Figure 5. Any incoming ray R is partially reflected by the upper mirror surface A by way of r_1. The remaining light passes through the thin semi-transparent coating of silver to surface B, whence it is reflected in a form of a second wave train r_2. It will be evident that r_2 has to travel over a path longer than that of r_1 by twice the distance X between the reflecting surfaces. If the difference contains a half wavelength, then on coming together at D the wave crests of the two trains will collide, motion will destroy motion, and darkness will be the result. With the two mirroring surfaces at a small angle as shown, a pattern like that at E will be produced, with dark bands marking the indicated locations. By studying Figure 5, it will be seen that as the distance between the reflecting surfaces is varied by any amount whatever, the dark bands will travel over the surface of screen E in one direction or the other, reassuming their original arrangement each time the distance X has been increased or decreased by half a wavelength.



A schematic representation of the Michelson ether drift interferometer. Compare with diagram below

The length of light waves differs for different colors of light, but remains an exact constant under like conditions. For green light, for example, it is about 0.00002 of an inch. To produce a movement of the bands equal to the distance between them, therefore, X must be varied by 0.00002 ÷ 2, or 0.00001 of an inch. The fixed distance L between bands is usually adjusted to something like an eighth of an inch by altering the angle between the two surfaces. With the aid of special instruments, a shift in position of the thousandth part of this distance can be detected, equivalent to a variation of distance X by 0.00001 ÷ 1000, or one one-hundred-millionth of an inch.

In the diagram of the ether drift interferometer of Figure 6, the only real difference from the case portrayed in Figure 5 is that the reflecting surfaces

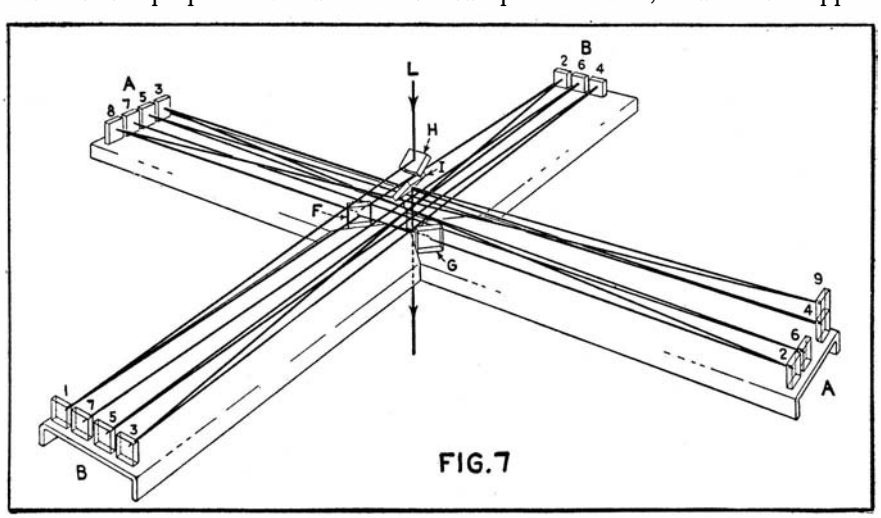
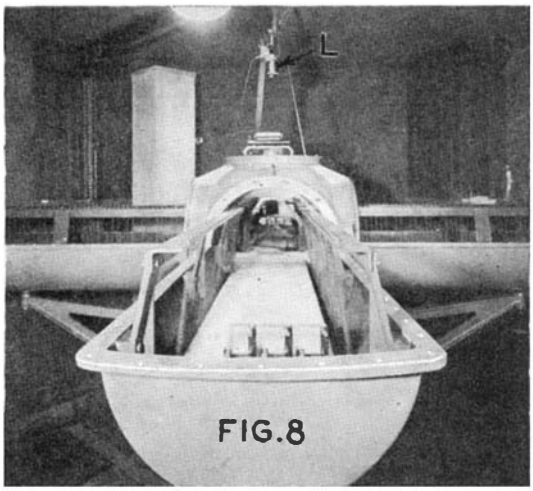


Diagram of light path in the Joos-Zeiss interferometer. The ray coming from inclined mirror H over I is split into halves by half-silvered mirror F. The path taken is shown by the numbers. From I the path leads to a moving plate



Interferometer casing opened, showing suspension of the fused quartz cross from springs

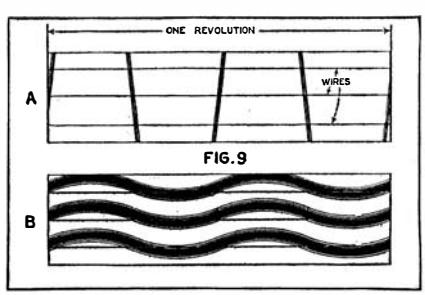
are two widely separated mirrors while the light-dividing function of glass plate A of Figure 5 is delegated to a separate thinly or "half" silvered glass plate at the center which transmits a portion of the light and reflects the other portion at right angles. Otherwise, the interference phenomena arise in exactly the same way between the respective rays, light areas and dark bands being produced as the two wave trains return to the screen shown at the left in the same or opposite conditions of phase.[2]

IF the arrangement of Figure 6 is now imagined as being rotated around a central perpendicular axis, then we have an apparatus analogous to that of the sound-signal experiment made on the boats. Assuming that there were an ether drift, then a point denoting successive positions of each band during each revolution would produce a sinusoidal curve similar to the suppositious one of Figure 2, though double because the light rays run in two directions of the platform instead of one.

In the ether drift interferometer, this light path is lengthened by reflecting the light back and forth several times in each direction from a succession of mirrors. The total length of this path is nearly 70 feet, a distance in which the discoverable shift of a fractional wavelength represents nearly the one hundred billionth part. Some conception of what this means will be had from the statement that if it were possible to measure the 240,000-mile distance to the moon with an equal degree of accuracy, then a variation in this distance of half an inch could be positively detected by measurement, while a difference of ten feet would appear as a coarse error readily noticeable even with the naked eye.

The optical carrier which bears this system and constitutes the most important part of the interferometer is best seen from the sketch of Figure 7. It comprises a flat quartz cross 15 feet in width in either direction and composed of four wings of shallow channel section. The production of these large quartz parts in itself was a feat that would have been impossible a few short years ago. The reason quartz was decided upon is its extremely low coefficient of expansion, combined with freedom from the effects of magnetic influences exercised by the earth, such as might cause disturbance if invar metal were used.

The cross thus produced is highly delicate and without adequate support would be mechanically a fairly limber object. Yet any deflection sufficient to disaline the mirrors by even a millionth of an inch—such as would arise by bending the cross over its length by the thousandth part of a human hair



The expected effect, supposing there really were an ether drift

—would render the whole instrument unfit for its purpose by causing a shift of bands exceeding the possible ether drift effect. These difficulties are avoided by suspending the cross from a total of some 700 piano wire springs, in the manner seen faintly in Figure 8.

The optical arrangement on the cross consists of 17 mirrors, one light-dividing plate F, Figure 7, and one compensating plate. To this system a ray of light is admitted from a mercury lamp L (shown also in Figure 8) placed above the instrument over inclined mirror H, and, after being split at F and running its course over mirror groups A-A, B-B, is reflected down and through an objective below the apparatus by a second inclined mirror I. Each mirror on the cross has a delicate screw adjustment for purposes of alinement. One mirror has a frame with three fine horizontal wires in front, which appear in the photographic record as fixed lines, and serve for checking the position of the interference bands on the mirror.

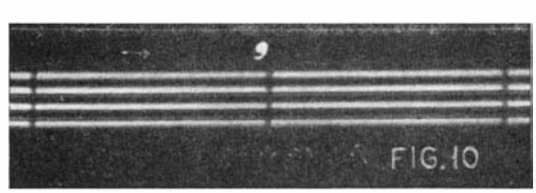
The light metal casing in which the cross is carried can be hermetically sealed. Each arm is braced underneath against the hollow column on which the casing with the cross is revolved around its tubular pivot. The instrument is revolved once in ten minutes by a simple round belt drive, the belt being kept slack to prevent the transmission of vibration.

A complex mechanism as well as a delicate one is the camera drive. This comprises a telescope driving clock at one end, and a photographic plate-holder at the other. As the clock revolves, the plate is slowly fed along under a fine cross slit in the diaphragm of the objective. Through this a hair-like section of the interference picture is photographed (Figure 10) on the moving plate.

AFTER two years of concentrated planning, construction, and adjustment, it took but a few days' and nights' running of the instrument to obtain its answer. Briefly that answer is again no trace of an ether drift effect.

To the layman, it will naturally be of interest to know how the photographic records would look, supposing there were an ether drift. Such a picture is shown in Figure 9. The maximum, 38 bands, could of course be obtained only if the plane of the cross in the instrument coincided with the motion which the earth, as a member of the Milky Way system, executes through space. Both sides of the argument agree that a full effect might not result in any case, because of the possibility that the ether might be "entrained" or dragged along to some extent by large bodies of matter as they rushed through it. Even after making every allowance for this entrainment, however, if there were an ether, some measurable effect similar to B, Figure 9, should remain.

As it was, the uncurved photographic records of Figure 10 clearly demonstrate that an ether-drift effect, if there were any, could not be over one mile per second—so low a fraction of the known 18-mile-per-second velocity of the earth around the sun that probably no explanation will ever reconcile it with the properties of all-pervasiveness and high density which were assigned to the ether.



The effect actually obtained was straight lines. Exit the ether, a figment of the imagination

[2]Because, if the ether drifted past the earth as the earth moved through space, the light waves would be carried along with it, and would be carried faster in the direction of the drift or "wind" than at right angles to it; as in Figure 6 when one or the other of the two beams is turned in the appropriate direction.—*Editor.*

TUNGSTEN BOWS TO THE PLATING BATH

TUNGSTEN is no longer the "rare material" it was thought to be at one time. Large deposits of tungsten-bearing ore occur in different parts of the world and the processes of reduction have been simplified and improved. The industrial application of this metal with its alloys and compounds is constantly being enlarged. Dr. Colin G. Fink, head of the division of electro-chemistry, Columbia University, says: "It is considered today one of the 'key metals' of civilization. On the basis of annual tonnages the world output of tungsten is less than one third that of nickel, and only about ten-fold that of gold. However, due to such fundamentally economic products as tungsten alloy steel and tungsten filament lamps, tungsten today occupies fifth place among the first ten essential metals of modern civilization. . . . The outstanding valuable chemical and physical properties of the metal and its alloys and compounds, such as, for example, the metal's resistance to severe corrosive agents, including hydrochloric acid, the extreme hardness, second only to the diamond, that can be brought about by the addition of small percentages of other elements to the tungsten, ensure for the metal, its alloys and compounds, a far-reaching further development. . . . To be deprived of tungsten would cripple a dozen industries, including the lighting industry, the steel industry, and radio."

Professor Fink is the originator of the ductile tungsten lamp filament which is used throughout the world. Emboldened by his success with chromium plating he now adds tungsten plating to his achievements in the realm of electro-chemistry.

International Newsreel

Dr. Colin G. Fink at Columbia University where he has made important discoveries

The first attempts to plate tungsten were made by a German chemist, Zettnow in 1867. He used a bath of molten sodium tungsten, and succeeded in obtaining a tungsten oxide by electrolysis, but failed to make pure tungsten.

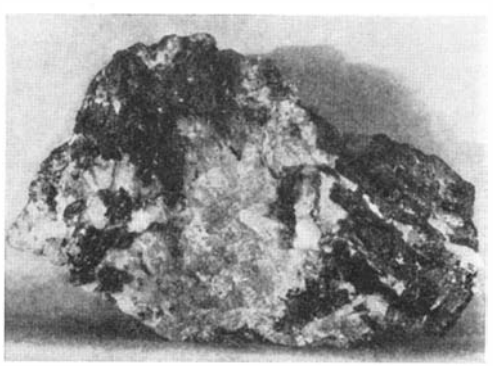
Dr. Fink has shown the writer some remarkable specimens of the results obtained by tungsten plating and certainly the dream of over 60 years has been realized. The product has a beautiful color, whiter than silver. When we have household utensils made of aluminum and plated with tungsten the work of the housewife will be curtailed, for the luster is imperishable. Dr. Fink considers that cutting tools which have been plated with tungsten will prove of the greatest possible use and value.

"A comparison of tungsten with other metals," said Professor Fink, "shows the desirability of a tungsten coating. Cadmium, silver, and nickel are all duller and have a much lower melting point. Chromium is almost equally bright, but it melts at a much lower temperature, and is soluble in hydrochloric acid."

Professor Fink's process involves the passing of an electric current through an aqueous solution of sodium tungstate. Deposits of metallic tungsten are successfully produced on a variety of metals, including brass, copper, and iron; also carbon. The tungsten deposit is smooth, hard, and coherent, having a high luster.

A piece of brass which Professor Fink had plated with a tungsten alloy was not noticeably attacked by hydrochloric acid in a week. A coating of any other common metal of equal thickness, Professor Fink pointed out, would have had a life of seconds, rather than of hours, under similar conditions.

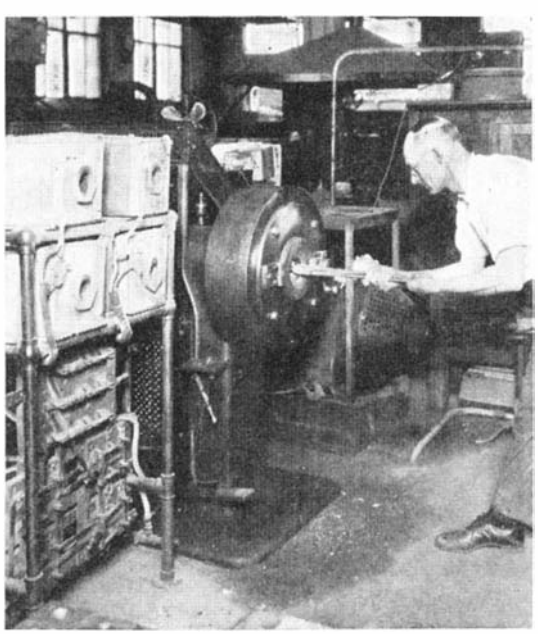
The problem which was set out to be solved was that of developing a process for the electro-deposition of metallic tungsten from aqueous solutions which would be adaptable for use on a commercial scale. Electroplated metallic coatings are usually desired because of the decorative value of the plated metal, or because of an increased resistance to corrosion.



Ferberite from Colorado is a source of tungsten. White areas are quartz

Dr. Fink says: "The sodium carbonate solution to which tungstic acid has been added is in most respects a good plating bath. It is easily made up; it is neither poisonous nor corrosive. The salts can be readily obtained on the market and in a pure condition; the tungsten deposit produced is clean and bright; no addition agent, such as glue is necessary." He has also been successful in depositing tungsten alloys.

Dr. Fink is to be congratulated on the successful outcome of a series of experiments extending over a quarter of a century. Such patient pioneers are one of the assets of our country.



Tungsten is a product of the electric furnace. Our illustration shows the swaging process

THE SUN AN ATOM BUILDER— A NEW THEORY

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 sun—and all the stars as well—are all tremendous heat engines, drawing energy from some internal source, transmitting it into heat and radiating this out into the depths of space where it is lost, not merely to our knowledge but almost to our powers of speculation. The rate at which this process is proceeding is so great that it is hard to realize, even for a mind trained in handling large numbers. To express it in ordinary engineering units is hopeless. We can do better if we recall that, according to the principles of relativity, heat, like other forms of energy, has mass and might imaginably be weighed.[1] It is perfectly reasonable to speak of a pound of heat, but a pound of heat is an enormous amount—enough to convert 30,000,000 tons of cold rock into molten incandescent lava if it could be fully utilized, or to supply 2,000,000 horsepower for almost a year.

Measured in these huge units we find that the sun is sending out 4,200,000 tons of heat every second, and it has been shining at substantially this rate not merely for the few thousand years of history but for the thousand million years or more of geologic time. What can be the store upon which it draws if after this incredible prodigality its resources show no sign of depletion?

IT has long been known that no ordinary chemical action could produce more than a few millionths of the amount of energy required, and even the gravitational energy liberated by the gradual shrinkage of the sun's mass accounts for only a few percent. Something must be happening to the very substance of the sun—the atoms of which it is composed—so that their aggregate mass is diminishing at the rate of 4,200,000 tons every second. Either some atoms are disappearing completely or a greater number are undergoing some change which diminishes the combined weight.

Both processes are imaginable within the scheme of modern physics. Perhaps under exceptional circumstances a pair of the positive and negative electrical charges of which atoms are built up—a proton and an electron—may meet and annihilate one another, leaving nothing but a spark of outgoing radiation carrying the energy represented by the combined masses which have vanished, and the stars may be kept shining by actual consumption of their substances. Or again, the process may be one of building and not of destruction of atoms. Hydrogen, the lightest and simplest of atoms, consists of one proton and one electron. The heavier atoms have two or more electrons circulating outside a nucleus, which doubtless contains both protons and electrons locked together in some way not yet fully understood. The total number of electrons inside and outside the nucleus equals that of the protons in the latter, so that we might imagine the complex atom to be built up out of a number of atoms of hydrogen. But the weight of the heavier atom is in all cases less than that of the corresponding number of hydrogen atoms. This indicates that in the process of formation a large amount of energy would be liberated by the "packing" of the constituents of the nucleus. This "packing defect" of mass varies a little from atom to atom, being greatest for iron and the neighboring elements, but it averages about one part in 130 of the original mass.

IF, then, we could turn one pound of hydrogen into heavier elements enough energy would be liberated to provide 100,000 horsepower for more than six weeks. If the sun were originally composed of hydrogen its gradual transmutation to other elements would provide heat enough to keep it shining at its present rate for over a hundred billion years. The complete annihilation of the sun's mass would supply the radiation for more than a hundred times as long.

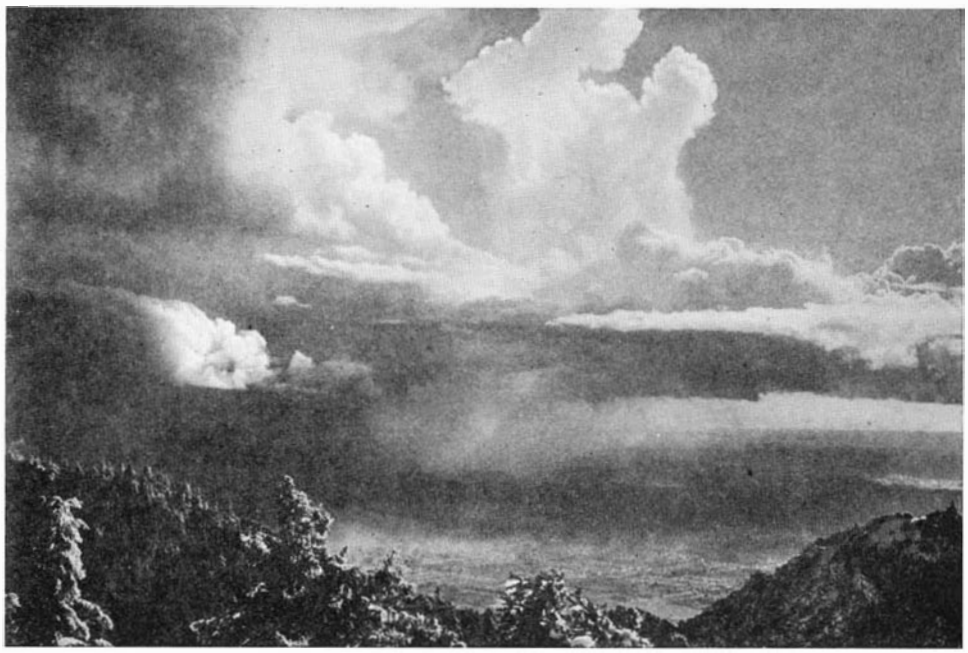
It is evident, then, that if either of these processes were at work within the sun its mass and presumably also its size and brightness would have changed very little in the whole range of geological time, and it is generally believed among astrophysicists that one or both of these strange things actually does happen.

But until very recently the details have been completely obscure. We know that under ordinary circumstances atoms are very stable structures indeed. Radioactive elements, to be sure, do break down automatically, emitting amounts of energy which, though great by any ordinary reckoning, are small in comparison with that which would result from building atoms of equal weight out of hydrogen. But these elements are present in very small proportions on earth and are not abundant enough in the sun to show at all in its spectrum. Very little heat (in comparison with the amounts here under consideration) can be produced from all sources inside our planet, otherwise so much would escape to the surface that it would be red hot all over.

Most investigators therefore agree in supposing that the heat-liberating process inside the sun and the other stars goes on faster at the very high temperatures which prevail in their interiors than it would in colder matter of the same composition. It looks at first sight, though, as if this would make a star's life extremely precarious. Heat generated deep inside a star must take a long time to work out to the surface. The actual amount produced per second inside the star must be so adjusted as to balance this leakage. But suppose that by any accident the star's interior grew a tenth hotter. Heat would then be produced more rapidly, faster than it could escape. Then the inside of the star would tend to grow hotter, still more heat would be produced, and we might expect the star to end with an explosion of prodigious magnitude.

THIS would doubtless happen if the star was compelled by some supernatural force to remain at the same size. But an actual star, if the temperature and pressure increase in its interior, will expand and an expanding mass of gas tends to cool. Calculation shows that with actual conditions the cooling due to expansion would more than balance the initial heating and leave the star as a whole cooler than at the first, the excess of energy liberated being used up in expanding the star against its own gravitational attraction. This cooling would diminish the rate of production of heat and so turn off the over-supply and remove the danger of explosion. The first temporary expan-

[1] See Heyl, "The Strangest Thing in Physics," *Scientific American*, June, 1929.—Editor.



Last month two striking photographs taken from the Mount Wilson Observatory by the astronomer Ferdinand Ellerman were shown. At the right is another, from the same viewpoint. A hail storm is passing over Pasadena, while at the right a patch of white marks the city of Glendale, hail covered and shining in the sunlight that penetrates an opening in the clouds. Farther still, to the right of the picture, is the ocean beach line 30 miles away

sion would, however, go too far and be succeeded by a contraction, so that the star would be set into "pulsations," swelling and shrinking. The Cepheid variables, an important though not a numerous class of stars, appear to behave in just this way.

But here another theoretical pitfall opens. It is possible that the pulsations may get out of control and become more and more violent until the star breaks up. To escape this we must assume that the increased heat production does not follow instantly upon a rise of temperature but lags long enough to allow the expansion to take place (a few hours in the case of the sun and a few weeks or months for the giant stars). Sir Arthur Eddington favors this hypothesis; Sir James Jeans disagrees and attributes the heat production inside the stars to atoms heavier than any found on earth, which decay like the radioactive elements but more slowly. No one, however, until very recently, has made even a suggestion from the side of atomic theory how any such atom-building process could actually occur. An important paper by Professor Atkinson of Rutgers, which has just appeared, makes the first attempt.

STARTING with the recent wave theory of the constitution of atoms and their nuclei, he finds that at temperatures of 10,000,000 degrees or more a flying proton may sometimes hit the nucleus of a light atom in such a way that it goes in and sticks there, producing a new atomic nucleus of greater charge and weight. By repetitions of this process and by the capture of electrons by nuclei in a corresponding manner, heavier atoms would gradually be built up. Under conditions such as might prevail in the interior of the sun an atom of helium would last on the average but a few seconds before a proton entered its nucleus and built it up into one of lithium (of atomic weight 5). Further captures of electrons and protons would build up ordinary lithium atoms of weights 6 and 7; then atoms of beryllium, boron, and the heavier elements. By the time the process got as far as oxygen the intervals between further upbuildings would increase to many millions of years and heavier atoms would be produced very slowly.

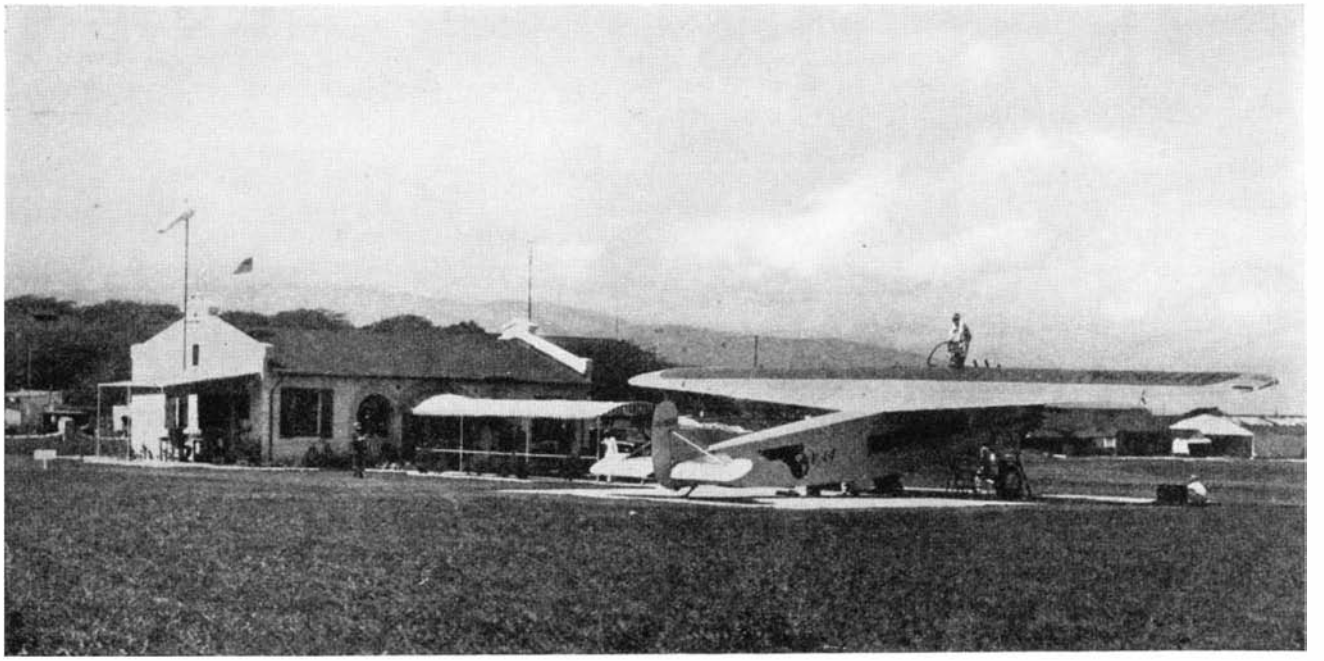
If this was the whole story all the atoms of helium and the other light elements would soon be built up into carbon, nitrogen, and oxygen and things would come to a stop. But there is good reason to believe that one of the kinds of beryllium atoms (an isotope of atomic weight 8) is unstable, each nucleus of this sort breaking down after a considerable average interval into two helium nuclei. This affords a fresh supply of helium and the process will go on anew with a steady formation of heavier atoms from the hydrogen, which it is assumed formed originally the main part of the mass if not almost the whole, and of course with a steady liberation of the "packing energy" in the form of heat. The whole process of atomic synthesis should be very greatly speeded up with rising temperature, so that the heat production shows both the dependence on temperature and the time lag which are demanded on astronomical grounds. A further and very striking success of the theory is found in the fact that the strength of the lines in the solar spectrum indicates that lithium and beryllium are present in but small proportions, while the succeeding elements up to oxygen are more and more abundant. This is just what is predicted, for the lighter elements have such short lives before their atoms get built up into heavier ones that there should not be much of them present at any one time, while the longer lived and heavier ones up to oxygen should be increasingly abundant.

The elements heavier than sodium, however, would not have had time to be formed in any considerable quantities in this manner, even during the whole life of the star, and it appears that some additional process of atom building not yet amenable to the theoretical discussion must be at work to produce them.

THE temperature deep in the interior of the sun which will be required to keep it going by atom building is estimated by Professor Atkinson as about 20,000,000 degrees, a value in agreement with the earlier calculations of Eddington if hydrogen is assumed to be the major constituent, as it certainly is on the sun's surface. For other stars of the "main sequence," ranging from those in Orion through Vega, Sirius, Procyon and the sun, to the faint red dwarfs, the calculated temperatures are of the same order of magnitude.

Years of further study will be needed before the full consequences of this most interesting theory have been worked out. Its present preliminary statement may be much modified, but it is a notable advance that a physical theory of the heat production within the stars has been propounded which not only explains many properties of the stars themselves but also accounts for peculiarities and the relative abundance of atoms of different kinds which have previously been entirely unexplained.

It is hardly necessary to add that in the present state of our knowledge other theories of the heat-producing process are also possible. Of one of these we hope soon to speak.—*Lowell Observatory, Flagstaff, Arizona.*



Refueling the "West Indies Air Express" at Port au Prince, Haiti, while the passengers lunch in the terminal

WINGS OVER THREE AMERICAS

By W. I. VAN DUSEN

FROM no point in the world can you travel so far or so fast, in one simple step, as you can from the busy terminals of America's international air transport system. So rapidly has the United States stretched its wings across a hemisphere, however, that few in this country realize that America has the largest air transport system in the world—the Pan American Airways System—the routes of which link every country but two in the three Americas—North, Central, and South.

From Miami, Florida, a great eastern trunk line reaches 7500 miles down through the West Indies to Port of Spain, over the Guianas, and along the south Atlantic to far-off Rio de Janeiro and Buenos Aires. South from Miami stretches the direct, continent-linking route, the longest over-seas airline in the world, striking directly across the Caribbean Sea 1350 miles to Colombia, stopping in Jamaica on the way. A third route brings Havana within two hours; a fourth reaches the Bahamas, and a fifth wings over the Yucatan Straits to Salvador.

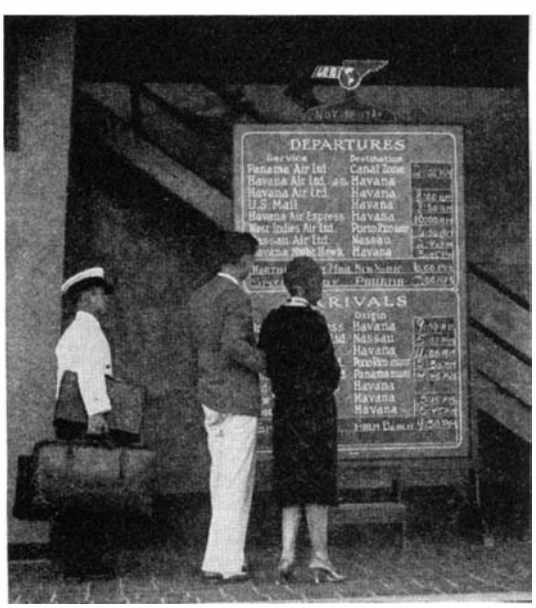
From Brownsville, Texas, the western trunk line reaches through Mexico and Central America to the Panama Canal. There it branches, one route going eastward on a transcontinental line to Trinidad, the other going south to Peru and Chile, then turning east to hurdle the four-mile-high, ice-capped peaks of the Andes to Buenos Aires.

Translated into travel terms, these routes mean that in one single day of lazy voyaging you can experience the lure of gay old Havana; look upon the mosaic fields of Cuba's sugar cane; stop off in mystic, fascinating Haiti for lunch; marvel at the oldest cathedral in the New World, at Santo Domingo; and dine in a roof garden over-looking grim old Morro Castle.

If you choose to go directly south from Florida, you land in quaint Jamaica the first night. Or, faring westward, between dawn and dusk you may explore western Cuba, pass over Yucatan Straits, gaze upon crumbling gray temples of the ancient Maya in the jungle vastness of Quintana Roo, and arrive in Salvador with time to spare for a stroll before dinner. Or, leaving from Brownsville, your first day will take you over the hills of Mexico, above ancient pyramids, through toy-like Vera Cruz, and along a range of jungle-covered mountains to Guatemala and Salvador.

THE second day on the eastern route lies along the old Spanish Main, to old Bluebeard's Castle in the Virgin Islands, to Antigua, Martinique, Guadeloupe, and then cosmopolitan Port of Spain at the cross-roads between the New World and the Old. Or, going southward from Jamaica, your airliner brings you to Colombia and over the land of the San Blas Indians to the Panama Canal.

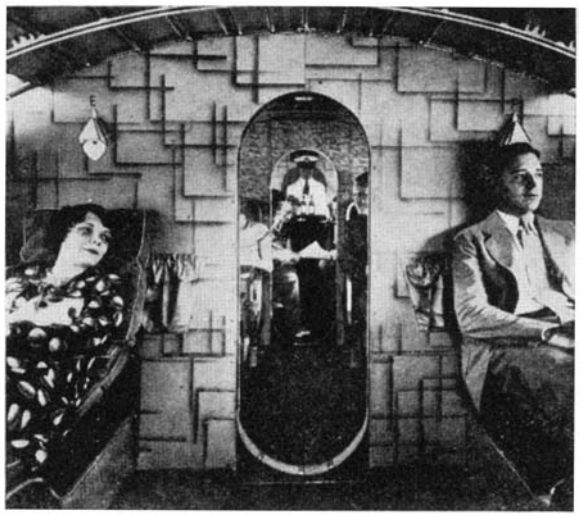
From the west you explore the smoking range of volcanoes through Nicaragua and Costa Rica, sail between the blue Pacific and the incomparable hills



International airliners boast a regularity of schedules that surpasses earth-bound travel

and valleys of Panama to end your day in old Panama City or in Cristobal. The third day of flying carries you through western Colombia to Ecuador, the little republic perched on the equator along the glistening coast of which the sea still washes up "pieces of eight"—some ancient pirate's treasure. Your fourth day brings you to Lima, "City of Kings" in the land of the ancient Incas, and then, on the sixth day, to Santiago, capital of Chile, nestling at the foot of the majestic Andes.

The eastward route takes you through the Guianas, tiny bits of England, Holland, and France; on down the south Atlantic, over the 200-mile mouth of the Amazon River, Brazil, and the magnificent harbor of Rio de Janeiro. Another day and you pass Santos, the world's coffee port, over southern Brazil, the purple land of Uruguay, and arrive at Montevideo, resort center of a continent. Then after a cruise up the Plata River you reach Buenos Aires, third largest city in the western hemisphere and the Paris of the Americas.



Roomy cabins, larger than Pullman compartments, provide comfort for the international air traveler

TO one who has journeyed to South America aboard slow-moving steamers, or overland over rough trails in jolting motor cars, erratic trains, or on creeping burros, the change wrought by these airliners is impressive. Swift and comfortable, they sail serenely over tropic jungles, endless miles of ocean, and rugged, sky-piercing mountains, dip into fascinating ports of lands yesterday's traveler never reached, and peek into out of the way nooks and corners of this world of ours. Yet they speed you to your far-off destination in a few brief hours.

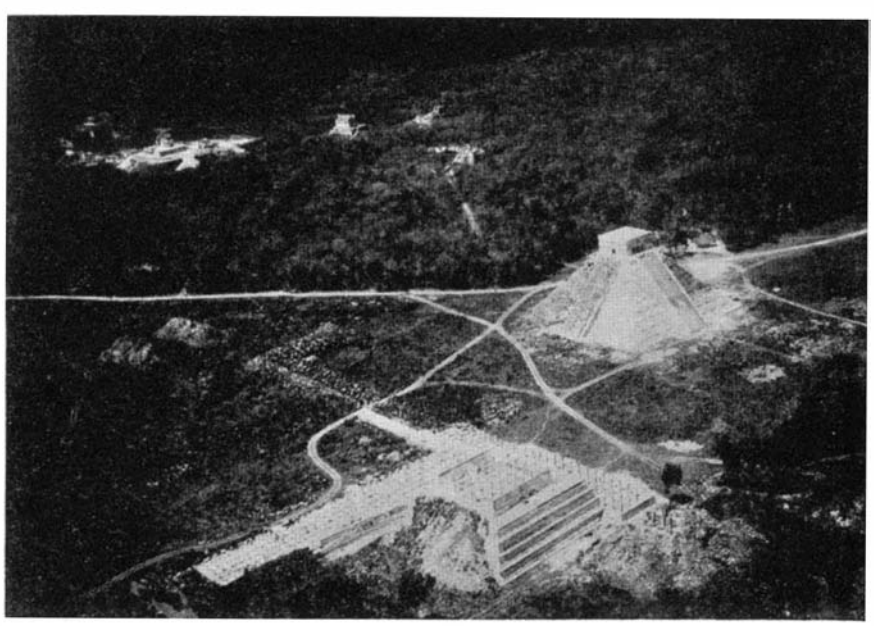
When one considers the enormous barriers its planes hurdle every day, the reason why this great international system so early achieved world leadership of air transport is obvious. Their pilots encounter conditions not encountered on all of the airlines in the United States combined. On one route their planes pass through four seasons of the year—spring in New York, summer in the West Indies, autumn in Brazil, and winter in Buenos Aires—all within seven days. On another route the airliners cross the Caribbean Sea, flying for seven hours without sight of land. On still another route, their planes fly from sea level and 90 degrees in the shade to 20,000 feet above sea level and 38 degrees below zero, and back to sea level and summer heat, all in a single hour.

While these conditions have been met, and mastered, by the planes and their pilots, obstacles just as spectacular have been conquered by the engineers on the ground. Over trackless wastes they have surveyed continent-linking air routes. Impenetrable jungle has been beaten back for the building of airports and, in one instance, a mountain was leveled to provide a landing field for these international liners of the sky. As assistants they have had small armies of natives who had never seen an ocean liner nor a locomotive. Indians have trudged with gasoline on their backs through miles of dense jungle wilderness bringing supplies to refueling points so that the passengers and mail might go through on unfailing schedules.

Nearly a third of America's aviation industry has been concentrated on this one job that demands rigid qualifications both for men and material. As these international airlines pioneered the first tri-motored airplanes to be used on airlines in the United States, so also have they encouraged development of even bigger and faster transports. Such efforts will culminate in the giant Pan American Flying Boat *S-40*—a mammoth sea-going airliner and the largest commercial airplane in the world—which will carry 40 passengers and a crew of five. This ship—for the trans-Caribbean air line and to provide Pan America with marine flying equipment to match Europe's advances—is now nearing completion at the plant of the Sikorsky Aviation Corporation, in Connecticut. Greater speeds, more comfort for passengers, shorter trips between distant terminals through fewer stops for fuel, are some of the objectives toward which new airliners are being developed.

The operation of this great network of international air lines, reared on the trails blazed by Colonel Charles A. Lindbergh, is an example of the highly organized medium of transportation the airplane represents today. From the big terminals, a fleet of more than 100 modern airliners, operating on split-second schedules and laden with passengers, mail, and express, ply between North and South America with impressive regularity. The fleet includes tri-motored airplanes for 12 and 14 passengers, twin-motored amphibions for eight persons, and giant twin-motored flying boats with luxurious accommodations for 24 and 32 passengers. In more than 20,000,000 passenger miles of flying they have completed their scheduled trips 99.67 times out of each possible 100.

IN the huge storage hangars, the "round house" of the airlines, the giant airliners receive minute inspections after each flight. A corps of in-



Air passengers over Yucatan fly over crumbling temples of the ancient Maya Indians reared in the jungles many centuries ago and but recently discovered

spectors checks every inch of the planes; master mechanics go over the motors; and an expert tests each of the instruments in the pilot's cockpit. The machine is scrubbed with soap and water, and placed in perfect condition before it is accepted by the chief inspector. At periodic intervals, the motors are completely overhauled, and after a definite number of flying hours, the ship is disassembled and rebuilt.

Little of this meticulous care is ever realized by the passenger as he watches the airliners being drawn from the hangars, one every 30 minutes on some schedules. To set the wheels in motion he has simply stepped into any one of the ticket offices of the principal railway systems or a dependable travel bureau and asked for a "ticket to Buenos Aires," or to any other of the 90 ports served by the Pan American Airways System. Air fares over these international routes are approximately 10 cents per mile—25 dollars to Havana, 200 dollars to Panama, 603 dollars to Rio de Janeiro. In some instances the fares are actually less than steamer fares.

FROM any principal city in the United States, then, the passenger is routed over the associated rail systems, or on the domestic airways, by the fastest connecting schedules to Miami or Brownsville. At these, the international terminals, he is met by an aerocar and transferred directly to the airport. While he breakfasts in one of the dining rooms in the terminal station, his baggage is carefully weighed and stowed in a special compartment aboard the plane. Five minutes before scheduled departure time, a warning bell notifies the passenger his airliner is ready. A courteous, uniformed steward directs him to his seat, sees that he is comfortable, and hands him a morning paper as the plane taxies out to the end of the runway for the take-off. With his plane poised at one corner of the turf field, the pilot tests each of his motors. The Field Manager at the terminal station is also checking this last-minute inspection. When everything is satisfactory, a white light appears, the motors roar, the great ship rolls down the field and climbs easily into the air, and the passenger is on his way.

Flying over continents, passengers may have their luncheons in the air

Another phase of back-stage activities which the passenger does not see is the operation of the "block-signal" system of radio control which guards the plane over every mile of the course, just as the railroad train is directed on land.

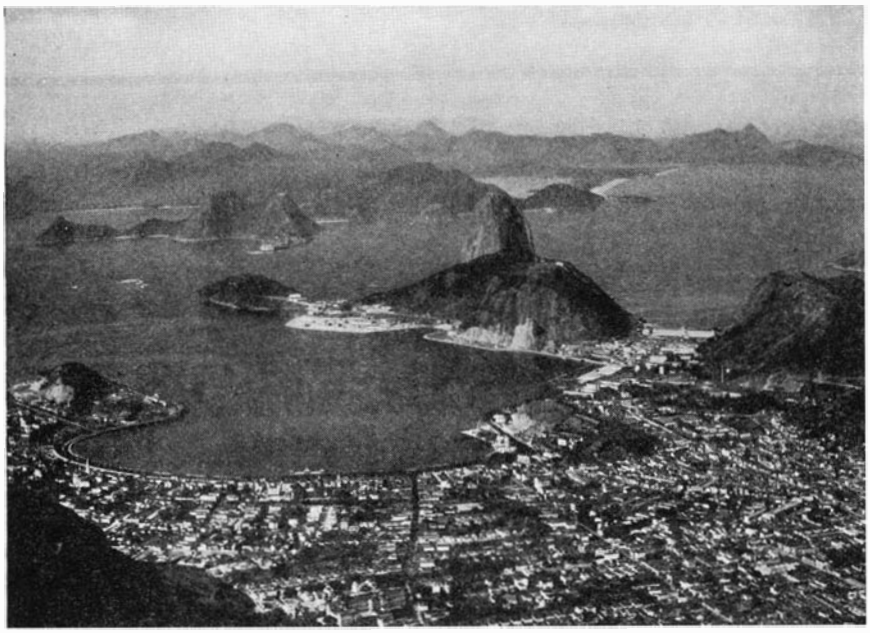
Not a little of the effort of the operators has been to improve conditions for the passengers and the international airliners provide luxurious comfort for air travelers. Even in the tropics, the cabins of the planes are delightfully cool a thousand feet above the earth. Passing meal-hours in the air means no hardship since full course luncheons are served from the buffet.

At destinations, attendants care for the passenger's luggage, arrange it for inspection by customs officials, and the whole process is speeded up to hardly more than a minute for the air passenger. The steward, who now becomes the passenger's guide on land, is trained to supply any desired information about foreign ports, see that he is well cared for at the hotel, and arrange sightseeing trips if desired.

While the endless world these international airlines open to the tourists strikes a romantic appeal, the spectacular also rides with the air mail to these score and a half lands below the Rio Grande. Aboard the passenger transports, tons of business correspondence —speeding the tempo of trade and commerce—wing their way between the industrial centers of North America and the great commercial centers of the southern continent. Financial documents, on the wing, save 15 days interest between southern capitals and New York; transportation of orders, sales reports, plans, blue prints, construction bids, deeds, commercial instruments and the like by plane saves weeks over the fastest previous transport time.

WITH the recently established international air express service in operation, export merchandise has likewise taken wings through the Americas. Coffee samples from Brazil and automobile parts from Michigan; assay ore from Chile and radio tubes from New Jersey; diamonds from British Guiana and advertising literature from New York—these and a thousand other items pass each other along the highways of the sky, each on its own important mission for the furtherance of inter-American trade and commerce. For a dollar and fifty cents a pound the Kansas manufacturer can speed his samples into Rio to beat his European rival to a keenly competitive market by a full week. The air express rates range from one dollar and fifty cents a pound to Rio de Janeiro, one dollar a pound to Panama, down to 25 cents a pound to Havana.

In six weeks, while the tourist may cover countries that would take him a full year to visit by any means other than the airplane, the business executive can survey, and do business in, 20 different countries with ample time for conferences in the larger cities. The same trip, with similar stop-overs, would require more than 16 months of steamer travel and twice the expenditure of money for transportation.



No one could mistake "Sugar Loaf" Mountain in the harbor at Rio de Janeiro, an impressive sight which greets the aerial traveler to eastern South America

SCIENCE LENDS A HAND TO THE RED CROSS

WHILE science, that essential factor in the advancement of civilization, can be held partially accountable for some forms of disaster, its application, likewise, can be credited with minimizing distress when calamities occur. Its progress has been marked by an increase of casualties in warfare, mine explosions, aviation, and so on, but its toll has been many times offset by its value to mankind. That fact is boldly in evidence in reviewing disaster reports and other activities of the American Red Cross, an organization which is constantly applying science in the prevention and relief of human suffering.

This year marks the fiftieth anniversary of the Red Cross in this country. In tracing that organization's history, we get a perspective of numerous scientific discoveries that are beneficial in disaster relief work, and life-saving and first aid services.

Contrast, for example, the facilities for transportation and communication existing 50 years ago to those in use today. Consider the forward strides medicine has taken in the last half-century. Only in that way can the generous contribution of science to Red Cross relief operations be fully realized.

IN the relief agency's infancy it often required many days for relief workers to reach the scene of disasters occurring long distances from National Headquarters. Since that time man has, to some extent, conquered distance. Now, news of a disaster is flashed across the nation and Red Cross relief arrives by airplane or train in one third the former traveling time. Instantaneous communication and rapid travel have resulted in saving the lives of thousands injured in many disasters. Modern methods have made it possible to save hours when hours count the most. In no other way is this more strikingly shown than in the speedy delivery of antitoxins by air which often prevents the spread of disease in disaster-ridden sections.

Many of the dangers in water sports have been removed by the application of scientific methods by the Red Cross life saving service. The society's first aid service also relies on science in its teaching of artificial respiration, emergency treatment, sanitation, and other health measures.

The first American Red Cross came into being May 21, 1881, when a group of prominent men and women gathered in Washington, D. C., at the home of Miss Clara Barton, widely known for her volunteer work during the Civil War. The meeting was an effort to secure this government's approval of the Treaty of Geneva of 1864, when delegates of 12 nations met and created the first international Red Cross organization. At the Washington meeting, Miss Barton was elected the first president of the young American society. In less than one year from the date of that meeting, March 1, 1882, during the administration of President Arthur, the United States formally adhered to the Treaty of Geneva, which guaranteed protection of wounded in battle and provided a neutral flag for doctors, nurses, and hospitals during warfare.

Twenty-five years later, in 1905, Congress issued a charter to the American Red Cross. Miss Mabel T. Boardman, President Roosevelt, and Secretary of War Taft were largely responsible for the Congressional Charter. Miss Boardman still is secretary of the organization. In the Congressional Charter of 1905, the powers of the American Red Cross were broadened to include duties in peace-times, such as disaster relief, health and safety work, and service to members of the nation's armed forces. Nearly all Red Cross societies of the world now include peace-time work as well as service during warfare.

At the age of 83 years, Clara Barton, who had headed the American Red Cross for 23 years, resigned. She had seen her goal reached, her efforts realized, and termed her retirement, "laying down her heavy burdens."

The American Red Cross today has 16,200 chapters and branches. Membership has exceeded 4,000,000 annually for the last several years, with more than 7,000,000 boys and girls of school age enrolled in the Junior Red Cross.

John Barton Payne, American Red Cross chairman, also is the chairman of the board of governors of the League of Red Cross Societies which was created after the World War.

OBSERVANCE of the fiftieth anniversary was begun in Washington on the evening of May 21. President Hoover, who is president of the American Red Cross, was the principal speaker. Other addresses were delivered by Chairman Payne, who has headed the society for 10 years; Judge Max Huber of Switzerland, head of the International Committee of the Red Cross; and Miss Boardman, American Red Cross secretary.

The greatest peace-time emergency in the history of the nation was handled by the Red Cross early in 1931. That disaster was the recent drought which affected more than a score of southern states. At the peak of the relief work more than 2,000,000 drought sufferers were receiving assistance in some form from the Red Cross. Prior to the drought, the relief agency's biggest assignment was the Mississippi flood of 1927 which left several hundred thousand persons dependent upon Red Cross aid. A few decades ago no society in the world would have tackled such difficult relief jobs. But science has contributed generously to Red Cross operations. With its aid, the Red Cross has completed every task it ever undertook in its 50 years of service.

Courtesy The American Red Cross

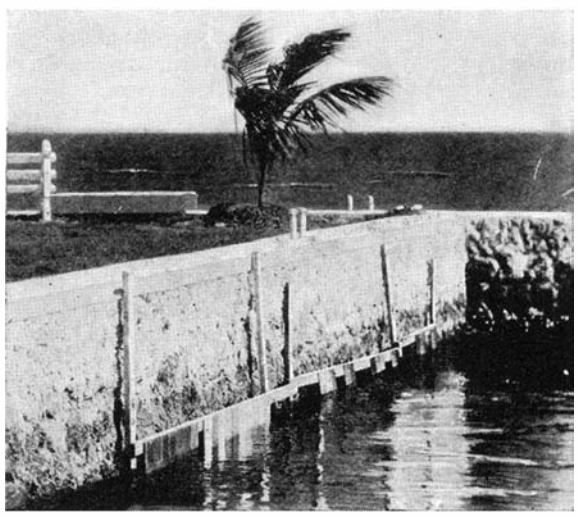
American officers and soldiers watching the effects of blasting to stop the progress of fire following the recent disastrous earthquake in Nicaragua

NEW PAINTS FROM SYNTHETIC RESINS

By D. H. KILLEFFER

WHEN Mother Nature put oil in the seed of the flax plant and gave trees the power to heal their own wounds with balsam, the fickle old dame was probably not planning either of these things for use in the manufacture of paint and varnish. Fortunately, they chanced to be good for such purposes and for a great many centuries they have served very well, better at least than anything else. Better they were until, be it noted, just a little more than a decade ago when things began to happen in paint manufacturing circles.

Many fundamental changes have recently been revolutionizing the industry of paint and varnish, and now the development of new synthetic resins to replace natural ones in varnish gives new values to protective coatings. From time immemorial varnish has been made by dissolving natural resins in hot drying oils. The result has yielded a coating of great beauty and value, but it has not met every requirement. The effect of weather on varnishes has been particularly detrimental and few coatings have possessed both beauty and permanence under out-of-door conditions. In interior work such coatings have been much more satisfactory, but ordinary cleaning has materially shortened their lives because soap destroys them.



A group of panels under test coated with various paints and exposed to sun and salt water in Florida

TO get the story of this newest development straight, one must get something of the background of the synthetic resin industry. Perhaps it is unfair to go back so far, but synthetic resins came into being as a result of a series of failures. First, there was the effort to make a super-disinfectant by combining formaldehyde and phenol (carbolic acid) which resulted instead in a gummy mess fit only for the waste can. Later this failure was resurrected and an attempt made to convert it into a substitute for shellac. This, too, failed for instead of being a tractable, fusible, soluble resin, the product was none of these. On the other hand, its very drawbacks became advantages when properly applied, and thus the now important business of synthetic plastics, of which the most familiar is Bakelite, came into being.

The fact that these resins possess the inherent characteristics of being hard, infusible, resistant to most chemical agents, and generally insoluble, led to the natural conclusion that if they could be incorporated in a varnish they might impart some of these desirable qualities to it. The problem of persuading them into a varnish mixture was a poser and for many years the only method of utilizing these valuable properties was by the use of a baked-on enamel or varnish which had a very limited field of usefulness. Imagine baking the finish on a house or a steamship!

Recently, however, ways have been found of so modifying the resin that it is soluble in china wood oil, for example. This combination yields a varnish similar in all respects to ordinary varnishes but possessing greater durability, hardness, elasticity, resistance to washing, and so on. Not only does the new type varnish possess these valuable qualities, but it can be made to dry hard for a second coat in a time comparable with that required by lacquers.

The following points about the new varnishes are of considerable importance:

It is applied and handled in just the same way as ordinary varnishes. No special methods are required. Varnish made with synthetic resins is quite waterproof. The lady pouring hot water on the dining-room table in the advertisements has sufficiently impressed us all with the importance of this property. As a matter of fact, the coating stripped from a plate of glass and properly dried can be made into a bag both strong enough and tight enough to hold a pint of water for a week or more without leakage. This property is especially important since one of the essential requirements of paint and varnish is protection of the material beneath from the weather. It is practicable to use a varnish of this new type on boats or other woodwork that is continually in contact with water, thus preventing the wood from becoming waterlogged.

Ultra-violet light is one of the most potent agencies in the destruction of protective coating films and the fact that the new synthetic phenolic resins will not allow it to pass greatly prolongs the life of varnishes made with them when exposed to the sunlight. It seems that ultra-violet light greatly accelerates the destruction of paint films transparent to it by increasing in some way the activity of the oxygen in the air with which they are in contact.

SINCE this new type of varnish is resistant to water, it is also highly resistant to the action of any destructive agencies dissolved in water. For example, ordinary floor coverings such as linoleum are likely to be seriously damaged if the charwoman who is washing them stops in the midst of her task to gossip with the elevator man. The protection of such a floor covering by a quick drying varnish of this kind will prevent any damage to the floor even though the cleaning solution be left on it for several hours instead of minutes, as in the example cited.

Already reference has been made to the flexibility of the coating. This is an extremely important point as most varnishes of high luster made in the ordinary way from natural materials are relatively brittle. The combination of brilliance and flexibility found in the new varnishes makes them equally applicable to wood or metal for indoor or outdoor use.

One of the most striking peculiarities of the new varnishes is their resistance to damage by marine growths, such as barnacles, seaweed, and so on. An ordinary finished surface is quickly attacked and destroyed by these agencies, but it has been shown by severe exposure tests between high and low water on the

Florida coast that phenolic resin varnishes retain their luster and resist the destructive action of growths for as long as a year.

Many of the recent industrial innovations have required that entirely new industries be set up to carry them out. This one is unique in this respect. The new resins are being produced by an established manufacturer of phenolic resins, while the varnishes are being made by established varnish makers in equipment to which they are already accustomed. They are applied in the same way as other oil varnishes and may be used with similar well known limitations as the vehicle for grinding pigmented paints. It is hardly fair to suggest that the new varnishes are a cure for all ills, but certainly they represent an important advance in the paint and varnish industry.

Data on eight Varnishes, each containing 200 parts China Wood Oil and 100 parts total resin, the resin content consisting of varying proportions of Bakelite Synthetic Resin and Ester Gum

Sample No.	1	2	3	4	5	6	7	8
% Bakelite XR-254	100	75	50	25	10	5	2	0
% Ester Gum	0	25	50	75	90	95	98	100
Drying Time	1 hr.	1¼ hrs.	1¾ hrs.	2¾ hrs.	3½ hrs.	5 hrs.	6¾ hrs.	7½ hrs.
Hardness—8 hrs.	60	54	57	33	19	17	18	16
Hardness—24 hrs.	157	139	125	114	111	130		129
Hardness—72 hrs.	181	164	149	139	139	152		159
Elasticity(Kauri Reduction)	145	125	110	80	70	65	60	60
Durability Rating*	10	9	8	6	4	2	1	1
Resistance to Boiling 5% Ivory Soap Solution	Unaffected after 2 hrs.	Unaffected after 2 hrs.	Slightly soft after 2 hrs.	Soft—80 min. Removed 120 min.	Soft—27 min. Removed 55 min.	Soft—22 min. Removed 44 min.	Soft—19 min. Removed 35 min.	Soft—15 min. Removed 30 min.
Resistance to 5% NaOH Solution at 70° F.	Practically unaffected after 24 hrs.	Practically unaffected after 24 hrs.	Slightly soft after 24 hrs.	Soft—24 hrs. Not removed after 24 hrs.	Soft—10 hrs. Not removed after 24 hrs.	Soft—4 hrs. Not removed after 24 hrs.	Soft—1 hr. Removed—3 hrs.	Soft—1 hr. Removed—3 hrs.
Resistance to Boiling Water—15 minutes	No whitening Film hard	No whitening Film hard	No whitening Film hard	No whitening Film hard	Slightly white Film hard	Slightly white Slightly soft	White Soft	White Soft
Resistance to Boiling Water—1 hour	No whitening Film hard	No whitening Film hard	Very slightly white Film hard	Slightly white Slightly soft	Medium white Slightly soft	White Soft	White Soft	White Soft

* Figures indicate relative freedom from checks, cracks, or other sign s of failure, 10 being the best and 1 the poorest. Exposure was from June 15 to November 15 on roof at 45° angl e at Bloomfield, N. J. on maple panels.

An interesting summary of results obtained with different varnishes

TO fit this new development into the economic picture, one must consider the serious changes recently wrought in the paint industry by the development of nitro-cellulose lacquers. Having their origins in the huge manufacture and use of smokeless powder during the World War, several factors contributed to the development of new uses for nitro-cellulose of which lacquers are of outstanding importance. Excess supplies of nitro-cellulose in the form of smokeless powder, multitudes of men trained in the technique of making and handling it, quantities of solvents for use with it, and a rudimentary knowledge of lacquers gained through the manufacture of dopes for airplane wings—each of these contributed to the original development of the lacquer industry.

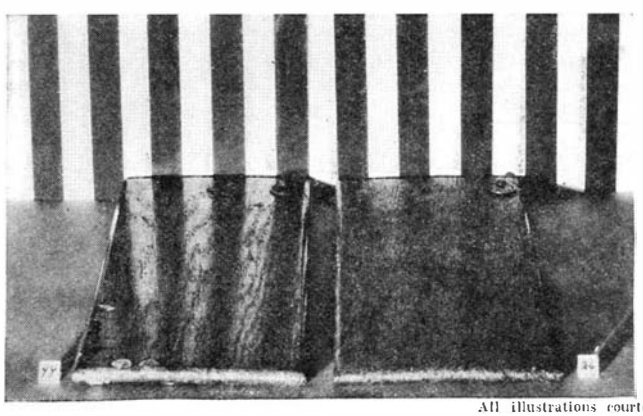
If one considers these causative factors, it is perfectly obvious that this development from its very nature had to proceed originally outside of the established paint and varnish industry. Its growth has been rapid and the older industry has been hard put to it to keep itself abreast of affairs and prevent the new-comer from getting beyond control. The effort has been to acquire as large a part of the new business and technique as possible to prevent it from growing out of bounds.

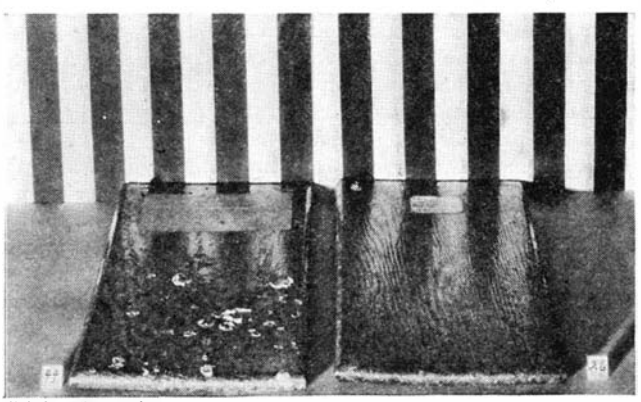
In spite of this, oil varnishes and paints have been to an extent replaced by the more convenient lacquers, and much equipment for the manufacture and handling of the former has been rendered obsolete.

The claim of lacquers to special favor has been based on their convenience in use and now that new types of varnishes based on phenolic synthetic resins have been shown to possess not only many of the convenience values of lacquers, but at the same time other valuable qualities not found in them, the rate of obsolescence of varnish and paint manufacturing equipment is likely to be much reduced. It is too early yet to say how far the new varnishes may go in reviving and rehabilitating the older industry and it seems probable that their effect will be rather to prevent oil paint and oil varnish from giving further ground to lacquers. Like everything else lacquers have distinct limitations and also like everything else when newly introduced they have been promoted without as careful thought to these limits as should have been the case. Their greatest advantage has been their speed of drying, amounting practically to a couple of hours where the older oil varnishes sometimes required as much as a couple of days.

This handicap of slow drying oil finishes is almost, if not entirely, offset by the peculiar effect of the new synthetic resins on oils. It is possible, using them, to prepare a varnish whose drying time is barely longer than that required to evaporate out the solvent embodied in it. This is not always necessary but that it can be accomplished places such varnishes at least nearer to the lacquer class than the older, natural resin varnishes and their other valuable properties—elasticity and resistance to weather, water, alkali, and marine growths—give them a place of real importance in the field of finishes.

All in all one may look upon this latest development as of great, perhaps vital, value to paint manufacturers.

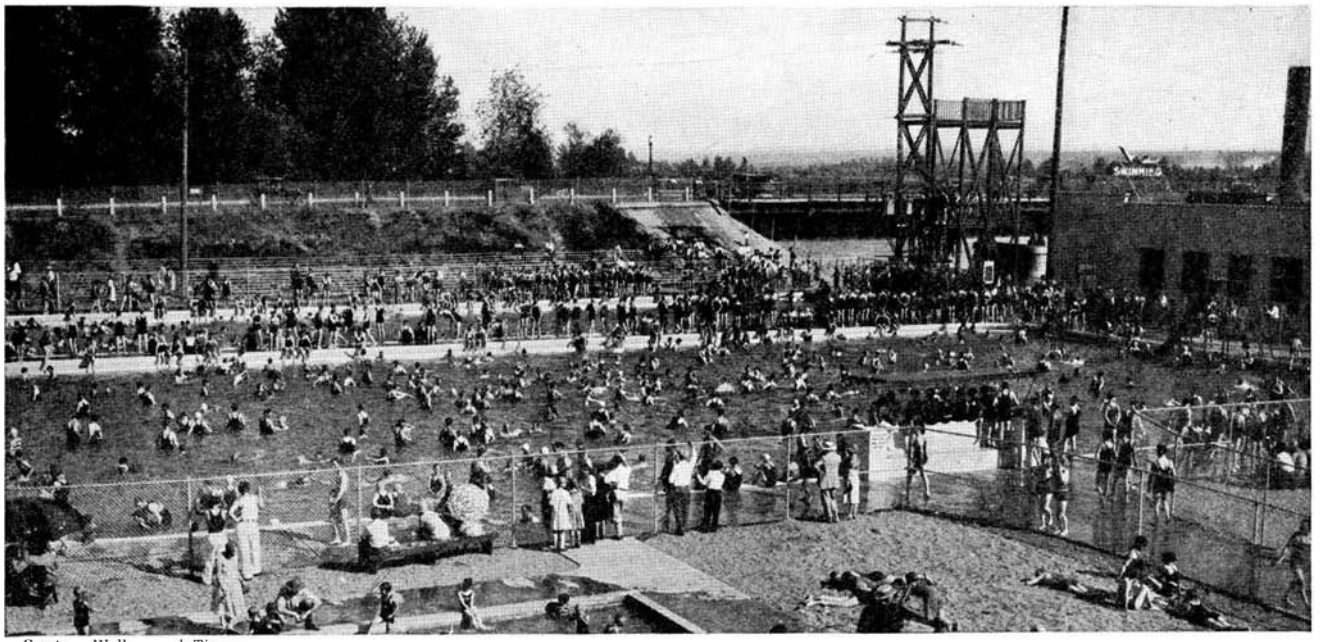




All illustrations courtesy Bakelite Corporation

Panel at left was coated with a synthetic resin varnish and exposed to salt water, air, and sunlight in the rack shown on the opposite page. In 10 months the finish was unimpaired, while that of the panel at right, coated with spar varnish, exposed only five months, was practically ruined

Rear of panels shown at left, numbers indicating finish used. On panel 44, tenacity of film is indicated by the adherence of marine growths. On panel 26 the growths have formed and fallen off, taking the varnish with them. Because of lack of exposure, there is little difference in gloss



Courtesy Wallace and Tiernan

Even where large numbers of bathers use a swimming pool it is possible to keep the water sanitary as a whole. Some doctors believe, however, that germs from the nose and throat may reach other bathers before being killed by the germicides used

ARE SWIMMING POOLS A HEALTH MENACE?

By ORSON D. MUNN

PERHAPS you have your own private swimming pool or hope to have one. Perhaps you swim in a friend's pool. Or you may make use of a public or semi-public pool. It makes no difference where you swim—rich man's private pool, public pool, or even river, lake, ocean, or the old swimmin' hole—you are always exposed to a certain amount of risk of infection by disease germs.

SWIMMING pools have been rather severely criticized by physicians within recent years. It generally is difficult or impossible to trace a given infection definitely to a pool—one can always claim it was acquired elsewhere at about the same time. Nevertheless many infections, some of them serious, unquestionably do come from that source. For example, the swimmer—not necessarily in a pool, either, for natural bodies of water are often as badly contaminated as artificial pools—may pick up some intestinal or skin infection. He may pick up typhoid fever. Without being aware of it he may be boarded and captured by any one of a variety of staphylococci floating on or in the apparently clean water. Infections of the eye and nose are not uncommonly acquired through bathing, especially nose infections due to inadequate knowledge of correct breathing. You will derive no added satisfaction from a stubborn infection of the middle ear because your rather expensive specialist pronounces it a case of *otitis media*. Again a persistent sinus infection may be your lot. There is no such thing as a 100 percent sanitary swim and, in fact, there never has been. Relatively speaking this applies to pools good, bad, and worse, and to natural bodies of water as well. In all there is some risk.

NOW that bathing pools are so rapidly becoming accessible to almost the entire population and private pools are being installed by the hundreds, the subject of swimming pool sanitation has come to the front. People who seldom or never have given the matter a definite thought are inquiring whether swimming pools are safe and sanitary or a health menace. An attempt was made to look into the question, with the outcome that no generalization could be made; some pools are sanitary and some are not. If the accompanying article sets the reader thinking and investigating it will have served its original purpose.

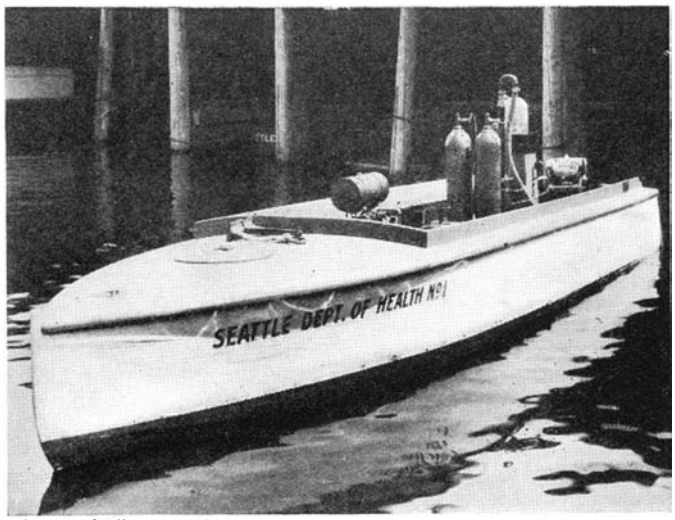
In large measure this is due not to the swimming pool, private or public, but to the swimmer. Man is not naturally a swimming animal; he is distinctly a land animal. In fact he even has to learn to swim, pointing to a long evolution wholly on land and in the trees. This in itself would make no difference were it not that his body carries none of the natural protections possessed by aquatic animals.

TAKE, for example, the alligator. This animal's breathing tubes are closed at the exterior of his body by special muscles. Man cannot voluntarily close his nostrils, though the boy who pinches them together on jumping feet first into the water aids nature in avoiding forcible infection. The alligator's ears have little flaps or valves which close when he submerges, and keep the water out. Our ears remain wide open—unless we plug them, which is more or less of a nuisance. Even the respiratory tract of the 'gator is closed by a trap. He is corked up as tight as a bottle, the instant he dips beneath the surface. The alligator is naturally adapted to an aquatic environment in which man, lacking the same adaptations, is handicapped. Parts of his body—nose, throat, and so on, which are not meant to be exposed to water (saliva is not the equivalent of water)—when assaulted by waterborne germs may gradually weaken, especially if the assault is long and frequent.

The aquatic mammals—seals, whales, walruses, porpoises, beavers, and so on

—nearly all have special apparatus for excluding the water. Man has no such provision whatever. To equal the aquatic animals he would be forced to wear tampons in his ears, a clothespin on his nose, and keep his mouth shut. This he cannot do.

No sane, practical person will urge people to stop swimming because their ancestors climbed trees instead of living half the time under water. Only a crank would insist on this. What is "indicated" in the case, is a clearer realization of the fact that there is an infection risk connected with going swimming, particularly in some artificial places, and that there is need of a reasonable amount of intelligent co-operation with nature.



Courtesy Wallace and Tiernan

When small natural bodies of water are used as natatoriums they may be protected by chlorination from a "chloro-boat"

It is unfair to generalize very freely about the risk of infection connected with swimming pool bathing. There are all kinds of pools. A little investigation shows that very many make some such assumptions—glittering generalities—as the following: (1) A swim in a lake or the ocean is perfectly safe and sanitary; (2) Public pools used by large numbers of people (especially if these are of all sorts) are risky; (3) Private pools are relatively safe.

ALL three of these generalities are fully as unscientific as the notion that water is uncontaminated if it bubbles forth from the earth as a spring. First, it is quite possible to pick up some infection at a crowded beach or even in the old swimmin' hole. Secondly, germs do not distinguish between the general public on the one extreme and the social register on the other; putting aside prejudices based on class feeling, Mr. Vandercleef may be as great a menace to the other swimmers in a pool as Tom, Dick, and Harry, provided he carries the right germs. Thirdly, some of the most carelessly conducted pools are privately owned (and privately mismanaged) while many of the public pools daily used by thousands are the safest risk because their management is under constant compulsion to keep them as sanitary as possible despite the large numbers who swim in them.

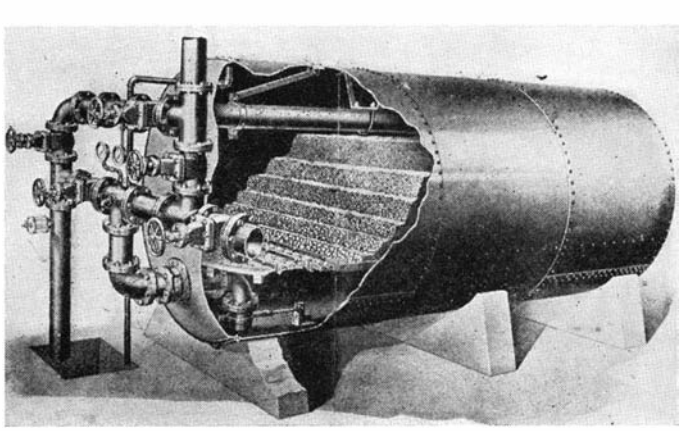
It is safer to use the same water in a pool—and this is done all over the country—for six months or even more, provided it is kept scientifically treated, than to use untreated water from some sources no matter how often it is renewed. By many it is believed possible to control the sanitation of a large public pool, even when used most intensively by the least intelligent, least cleanly class of persons, within the limits of risk of ordinary life. Of course there is always a risk. But too, there is always a risk in everything—in lying in bed or in walking downtown. In other words, if more than very occasional infection results from the use of swimming pools it is pretty certainly somebody's fault. At least, this point of view reflects the statements of many of the defenders of swimming pools.

To maintain a pool in sanitary condition against heavy odds—against the expectoration of the swimmer, derived from his whole respiratory tract and certain to be heavily loaded with any germs he may carry; against uncleanliness if he has taken only a perfunctory shower bath before entering the pool; against open sores if he is willing and able to conceal them from the watchful eyes of the pool attendants; against the very common practice of urinating in the water (unconscious if not otherwise in a major proportion of all swimmers of whatever status) and against other contamination—seems almost an impossible attainment.

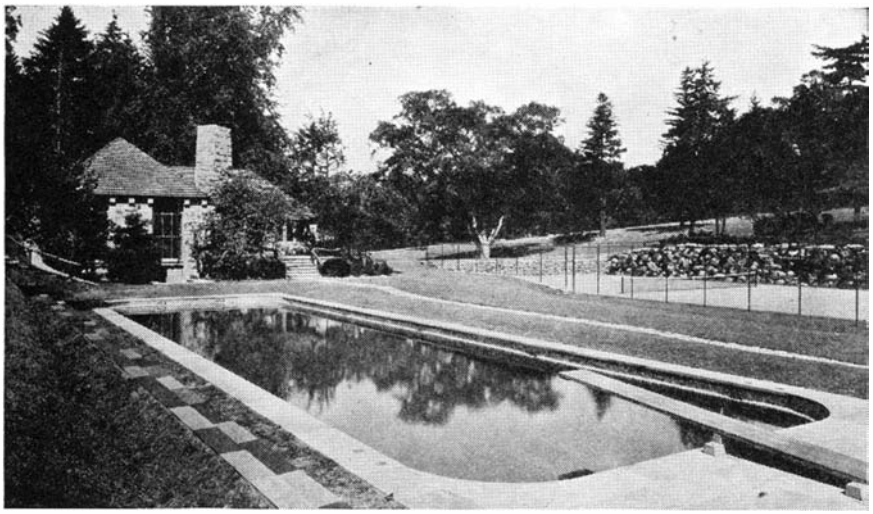
If he has not already done so, let the reader visit a large public pool, see thousands bathing at once, the water almost hidden by the bathers, note the wide variety of human types and realize the equally wide variety of personal cleanliness or lack of it inevitably involved, and then wonder how it is possible to avoid an epidemic. Filtering, sterilization, and constant good housekeeping are relied on to accomplish this end. In the majority of pools the water is filtered. Others employ either the "fill and draw off" system or the "continuous flow through" system. Still others combine these methods.

FOR sterilization the methods most in use are the addition of chlorine to the water, or of ozone, or the use of the ultra-violet ray. For housecleaning, various devices are used. These mechanically pick up the more conspicuous matter which lodges in the bottom of the pool. A suction cleaner called a squeegee is drawn across the bottom by means of lines without the need of emptying the pool. Green scum or algae—small aquatic plants—are removed by the addition of small amounts of copper sulfate or common blue vitriol, a practice employed in city reservoirs for the same purpose. Alum coagulates fine particles suspended in the water, causing them to sink more rapidly to the bottom where they are removed by the squeegee and the suction of the outgoing water. The same chemical has long been used in city reservoirs to hasten the settling of suspended mud particles. What the bather really does is to swim in a mild solution of chemicals. It would seem that no ordinary germ could long survive in such a place.

Caring for a pool is a trade in itself, one requiring attendants who are capable of taking pains and actually interested in doing so. The commodity known as intelligence is also required. Unremitting diligence is demanded. Not every workingman is capable of caring for a pool. In the case of municipal pools local politics may prove as deadly a menace as the well known *bacillus coli*. This statement may be an indiscretion but, if classed as a scientific observation, it may be left standing.



In many pools the water, in addition to germicidal treatment, is continuously filtered through sand and gravel filter beds



A private pool. However beautiful and attractive, unless a private pool is managed scientifically it may become a menace to one's family and friends

What do the doctors say about swimming pools? They have said a great deal—perhaps fully as much as the makers of pools and pool apparatus. These two groups are not always in full agreement but doctors do not condemn the swimming pool out of hand; nor, on the other hand, do the manufacturers obscure all their dangers.

Most of the discussion by medical men has appeared in medical journals which the general reader seldom or never sees. The reader who is especially interested may search the back files of the *Journal of the American Medical Association* (Chicago). A still more special journal is the *Journal of the American Association for Promoting Hygiene in Public Baths* (New York).

A great many physicians are rather doubtful about swimming pools. Here is a statement made at a meeting of the American Medical Association by Dr. Frederick E. Hasty of Nashville, with reference to diseases of the paranasal sinuses, middle ear, and upper respiratory tract. "These infections," he says, "have become so frequent in recent years that almost every family has in one way or another been brought to grief as a result of swimming." Continuing he says, "The water in the pool during the time of swimming represents the combined washings, so to speak, of the mucous membrane of the nasal chambers and mouth of every swimmer." Further, "water in the majority of swimmers gets well into the nasal chambers, therefore carrying with it the contamination of the pool and at the same time adding to the pool whatever bacteria may be present in the particular swimmer's nose. The infections are likely transmitted from one individual to another during the swimming period *before the sterilization process has time to influence the bacterial count materially*." (The italics are ours.)

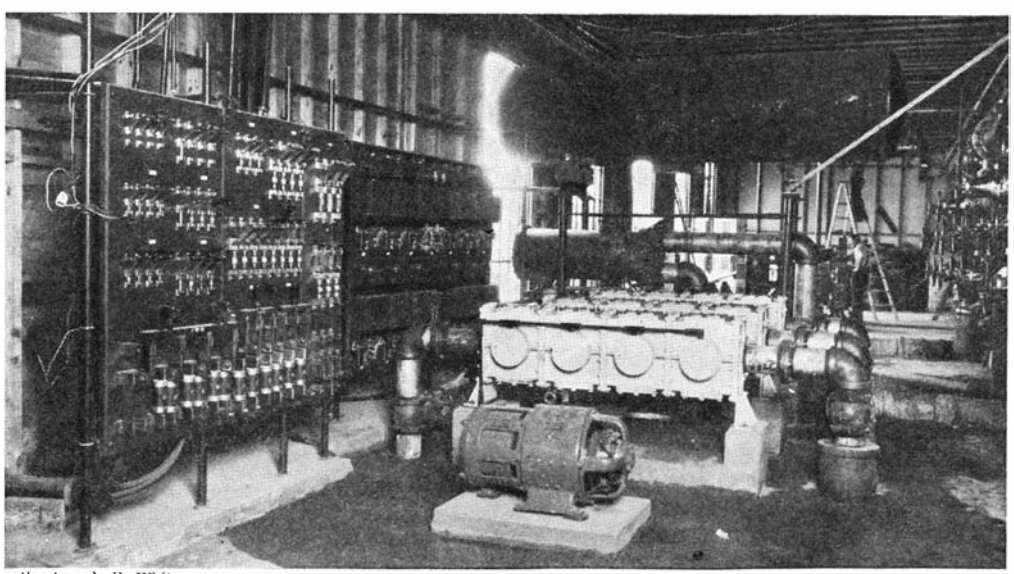
We may place this last statement in juxtaposition to the statement previously made, that the water of a properly cared for pool is really a mild chemical bath, sterile because germs cannot survive in it. Since it takes an appreciable *length of time* to kill germs in most cases, antiseptics often being rated in value on the basis of the *time* they require to do the killing, it seems to boil down in final analysis to a question of whether it is good logic and good science to assume that bacterial tests made on water which has lain chlorinated or ozonated for many hours in a pool and which really has had time to become sterile, may be taken as assurance that disease germs spat out of the mouths and blown out of the noses of the hundreds of bathers crowded into a pool such as is shown in one of our illustrations will not remain virulent *long enough* to be picked up in that condition by the other bathers. Apparently Dr. Hasty thinks they may be picked up before they are killed, and many other physicians agree with him.

What happens, according to Dr. Hasty, is something like this: The water temporarily shrinks the mucous membranes adjacent to the openings of the sinuses, water then gets in and brings bacteria to a region where in all probability there is not a natural local resistance to the bacteria. The same shrinking causes congestion of circulation and obstructs drainage from the sinuses that have become infected. The situation is then favorable for the development of the bacteria. When the nose is next blown vigorously the infection is spread to other cavities.

THUS the swimmer now has a fine sinus infection, but when anyone ascribes it to swimming in a pool he may say it was only a coincidence. Of course, it might actually have been a coincidence. He cannot prove it was, but others cannot prove it wasn't. It is here, right between these two positions, that a lot of swimming pool dirty work (literally) gets by.

In the meantime we have some 12,000 or 13,000 swimming pools in the United States of America and the chances are we shall keep them, together with whatever germs they present us. The pools are not likely to become very bad, but they probably never will become very good, this side of Heaven and perfection.

Careful persons may, however, use the judgment nature gave them and avoid a large part of the risk of infection, without making such a bogey of swimming that it is no longer any fun.



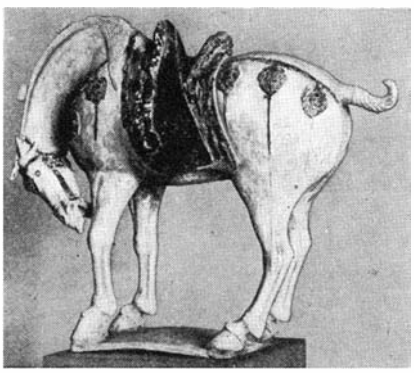
Courtesy J. F. Whitman

The sterilizing room of a swimming pool where the germicide is ultra-violet radiation. The water passes before special lamps, and the rays kill the bacteria on which they impinge

FROM THE ARCHEOLOGIST'S NOTE BOOK

A Chinese Funereal Horse

THE Chinese horse in the collections at the Museum of Fine Arts, Boston, dates from the T'ang Period (618-907 A.D.) and was probably made originally for the tomb of an emperor. The rich green and orange glaze characteristic of T'ang pottery is enhanced in beauty by the opalescence acquired through burial. Among many known



This Chinese horse in faience was made for the tomb of an emperor

models of horses recovered from ancient Chinese tombs this one is unique in the position of the animal. It is a cross between the Arabian and the Mongolian steed, with an exquisite Arabian head. It is two feet high.

Early Persian Inventions

SIX leaves from the famous treatise on "ingenious geometrical contrivances" compiled by al-Jazari in 1206 A.D. by command and for the Urtuqid Sultan Mahmud, Malik-as-Salih, who reigned in Amida from 1200 to 1222, are in the collection of the Museum of Fine Arts, Boston. The author was an inventor and seems to have been first and foremost a craftsman and secondarily an author. The importance in which this book was held in the 13th and later centuries is attested by the many copies made of it.

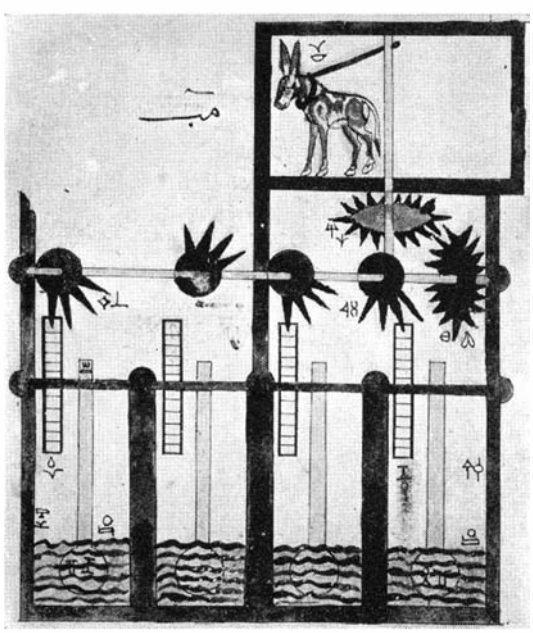
All photos courtesy Boston Museum of Fine Arts

The original treatise, of which six leaves are in the Museum, contained articles on the construction of clocks; the construction of vessels and figures suitable for carousals; the construction of ewers and cups for bloodletting and washing; the construction of fountains in tanks, which change their form; perpetual flutes; the construction of instruments for raising water from shallow bodies of water, and from running water. The leaf shown (the sixth) represents an apparatus for raising water by animal power. Al-Jazari prides himself that by means of this device the donkey is made to work all the time.

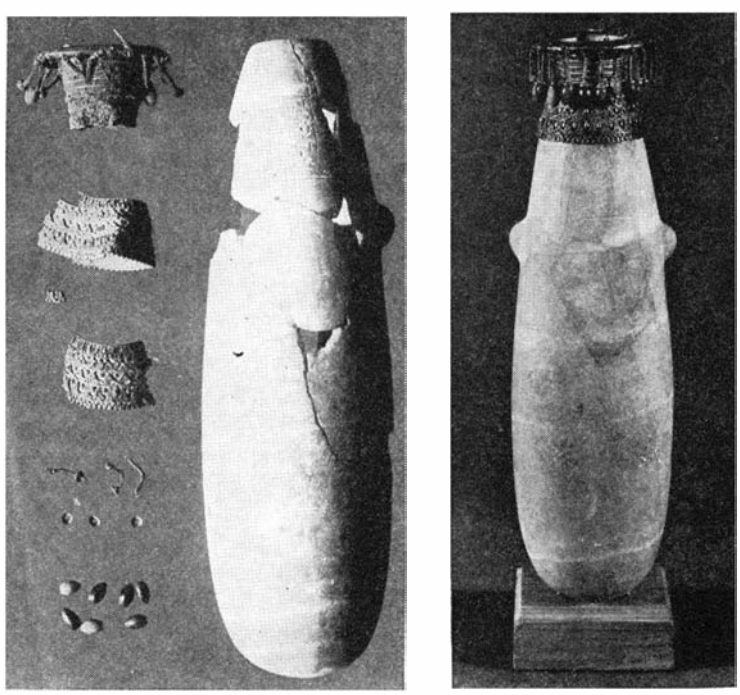
Silicate deposit was removed from vase (*left*) by refiring in kiln, releasing the beautiful design (*above*)

Difficult Restoration

THE Museum has a British Museum trained restorer of antiquities, Mr. W. J. Young. He succeeded in removing an encrustation of silicates on a fine Greek vase. He fired it in a kiln heated to 450 degrees or just below the melting point of the glaze. The encrusting salts were reduced and brushed off. A less dramatic but no less exacting piece of work was the reconstruction of an Ethiopian alabaster vase from the Soudan, discovered by Prof. Reisner. The silver top was badly crushed and corroded. The salts were reduced in an electrolytic bath, the fine detail was restored and the whole was reshaped.



A donkey draws water. A leaf from an old Persian book of inventions written by an inventor



The Ethiopian alabaster vase found in the Soudan was badly damaged. The encrustation of the silver top was removed electrolytically

A SOLAR OBSERVATORY FOR THE AMATEUR

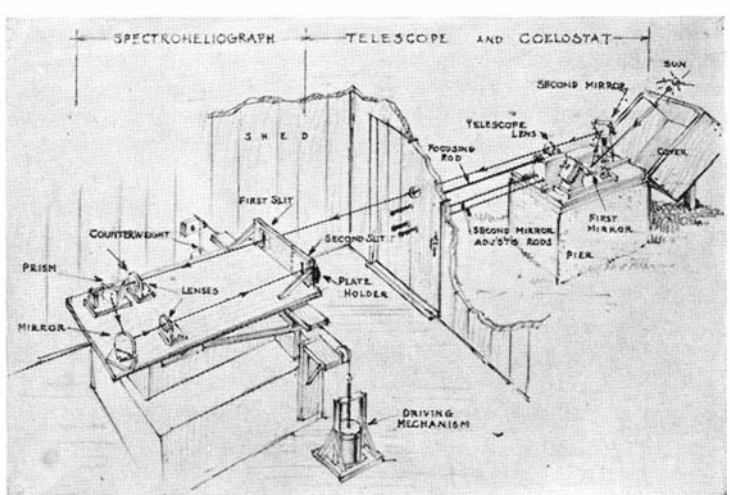
Simple Instructions for Photographing the Sun and Its Eruptions

By GEORGE E. HALE
Honorary Director, Mount Wilson Observatory

BROADCASTS of solar eruptions, like the more familiar radio programs, are sent out on radiations of certain wavelengths. These wavelengths are fixed by the nature of the luminous gases shot from the sun into space. Many leading astronomers, basing their opinions both on observation and theory, believe that such eruptions sometimes shower the earth's atmosphere with electrified particles which set aglow the streamers of the aurora, produce intense magnetic storms, interfere with some forms of telegraphic communication and probably affect radio transmission. But the whole problem bristles with unanswered questions and thus offers splendid opportunities for research, in which amateurs with the simplest equipment may take an important part.

In several papers I have given observations and illustrations of such solar eruptions and explained how a spectrohelioscope for detecting them visually can be constructed at moderate cost. Since describing one form of spectrohelioscope in the SCIENTIFIC AMERICAN[1] I have published a detailed description of an improved spectrohelioscope, already built for use in more than 25 observatories distributed around the earth.[2] All parts of this instrument except the grating can be made by amateurs, several of whom have undertaken the work. For those who want a still simpler and less expensive photographic outfit, which can be built without the aid of machine tools, the following account of a small horizontal telescope and spectroheliograph may be of interest. In spite of the low cost, these instruments can be used for work of great importance in its bearing on the nature of solar eruptions and their possible influence on the earth.[3]

The wavelengths used in radio communication are, of course, far too long to affect the eye. The red line of hydrogen, of much shorter wavelength, is brilliantly visible in solar eruptions. This is the wavelength chiefly used with the spectrohelioscope, where we "tune in" by rotating the grating until this hydrogen line (*Ha*) falls on the second slit and forms the monochromatic image we observe. At the extreme violet end of the visible solar spectrum, where the wavelength is so short that it affects the eye too feebly for visual observations, are the calcium lines known as *H* and *K*.[4] These lines are easily photographed, and our spectroheliograph must be so designed that one of them (*K* is the stronger) can be isolated by a narrow slit. Our purpose is therefore to make photographs of the sun with calcium light, which is more intense than any other radiation in the flocculi scattered over its surface and of exceptional brightness in the eruptions mentioned above. For this reason the spectroheliograph is our only means of recording these invisible calcium clouds in the solar atmosphere.



All drawings by Russell W. Porter

Figure 1: **A general view of the apparatus, which constitutes a complete little solar observatory available to the average amateur**

We must have a fixed image of the sun, given by some such coelostat telescope as that described in the papers already referred to, or by the still simpler and smaller instrument shown in Figure 2. I am indebted to Mr. Russell W. Porter for the drawings in this paper and for his help in designing these instruments. They were built by my assistant, Mr. L. R. Hitchcock, to whom credit is due for many elements in their design.

BRIEFLY stated, the coelostat telescope consists of three parts. The first of these is a piece of plane plate glass (C), about three inches square, selected by the method described by Mr. Porter on page 52 of "Amateur Telescope Making" (second edition), and mounted with its face parallel to the earth's axis. In most large coelostats this mirror (silvered on its front surface) is circular, but it is shown square in the sketch to save the necessity of cutting out a circular disk. Any glass cutter can provide such a plate, but several pieces of glass must be tested in the manner described by Mr. Porter in order to find mirror blanks with a sufficiently flat surface.

To reflect a beam of sunlight constantly upon the second mirror, the coelostat mirror must be mounted on a polar axis and rotated by a small clock-movement. The polar axis, as Figure 2 shows, is a very simple affair, consisting merely of a straight steel rod (A) about 3/16 inch in diameter, attached to a square plate of brass or hard wood (B) that serves as a support for the mirror (C). A piece of sheet metal, bent in the shape shown in the drawing, is bored through its upper face to fit the polar axis, which rests against its lower face at (D). The upper end of the polar axis passes through another piece of sheet metal and carries at its extremity a pinion which engages with another pinion attached to the hour-shaft of a small brass clock movement. If the pinion on the

[1] "Solar Research for Amateurs", I and II, *Scientific American, 140,* 302; and *140,* 436. See also "Amateur Telescope Making", 2nd ed., Scientific American Publishing Company, 1928. [The latter contains a full reprint of the former.—*Ed.*]

[2] "The Spectrohelioscope and Its Work", I and II, *Astrophysical Journal, 70,* 265, 1929; *71,* 73, 1930.

[3] For accounts of these eruptions and the accompanying auroras and terrestrial magnetic storms see "Signals from the Sun", in *Scribner's Magazine* for July, 1931; and Part III in the series of my articles on the spectrohelioscope, in the *Astrophysical Journal* for June, 1931.

[4] These are the two strongest lines in Figure 7, near the center.

polar axis has four times as many teeth as that on the hour-shaft of the clock, the polar axis will revolve once in 48 hours and the beam of sunlight from the coelostat mirror will be reflected in a fixed direction.

As the drawing shows, the polar axis is inclined at an angle (L) equal to the latitude of the place where it is to be used. Its two sheet brass bearings are mounted on suitable blocks of metal or wood, which are attached to a rectangular base arranged to slide north or south on the underlying support, a straight strip of wood serving as a guide. By fitting the pinion to a sleeve on the polar axis tight enough to drive by friction, but not too tight to permit the axis to be turned within the sleeve, the mirror can be rotated to the proper angle to reflect the beam to the center of the second mirror, where it will be maintained by the clock.

THE position of the coelostat, which may be used east or west (before or after noon) of the second mirror (H) and lens (I), depends upon the altitude of the sun, and hence upon the latitude of the site and the time of year. In the drawing, the sun (E) is shown high in the heavens, as in summer; in winter the sun is low, as indicated at F, and the first mirror must be moved south to some point near G in order to reflect the beam to the second mirror.

The second mirror, three inches square, also carefully selected for flatness and silvered on its front surface,[5] must have two motions, both controlled from a distance. (See Figure 1.) It can be tipped about its horizontal axis by an arm projecting down behind and ending in a fork which sits astride a curved cam. By rotating the cam-support the mirror is inclined slightly, thus causing the sun's image to move up or down the slit of the spectroheliograph. Rotation of the vertical mirror-support by means of a second rod gives a slow east or west motion of the solar image. Thus any part of the sun can be centered on the slit.

As the coelostat and second mirrors are nearly plane surfaces, they serve only to reflect a parallel beam of sunlight constantly in a horizontal line to the north. The telescope proper consists merely of a single plano-convex lens (I) about one or two inches in diameter, of from 9 to 18 feet focal length, depending upon the size of the solar image desired. A lens of 18 feet focal length will give a solar image about two inches in diameter, the size of the original photograph from which Figure 8 is reproduced. This is too large to be photographed as a whole by this spectroheliograph, but as most of the calcium flocculi are confined within two zones covering a moderate range in solar latitude, and as the more important eruptive phenomena (for our purpose) usually occur not far from the center of the sun, a two-inch image can be used if it is desired to show the smaller flocculi on a larger scale than a shorter focal length would give. However, a one-inch image, given by a lens of nine feet focal length, may be used if preferred.

Perhaps it should be added that a single lens, even of this small aperture, cannot be expected to show very sharp details in white light, though sun-spots may be seen with it. If of fairly good figure it serves perfectly, however, for the photography of objects like the flocculi with light of a single wavelength, because there is no overlapping of the countless images formed at increasing distances from the lens by light ranging from violet to red.

It is evident that when the calcium flocculi are to be photographed the violet image corresponding to the *K* line of calcium must be focused on the first slit of the spectroheliograph by the method described below. For this purpose a focusing screw, with rod reaching to a point near the spectroheliograph, is provided. As for the telescope lens itself, it may be mounted in a wooden[6] support (with the convex surface toward the second mirror), attached to a sliding block, as shown in Figure 2.

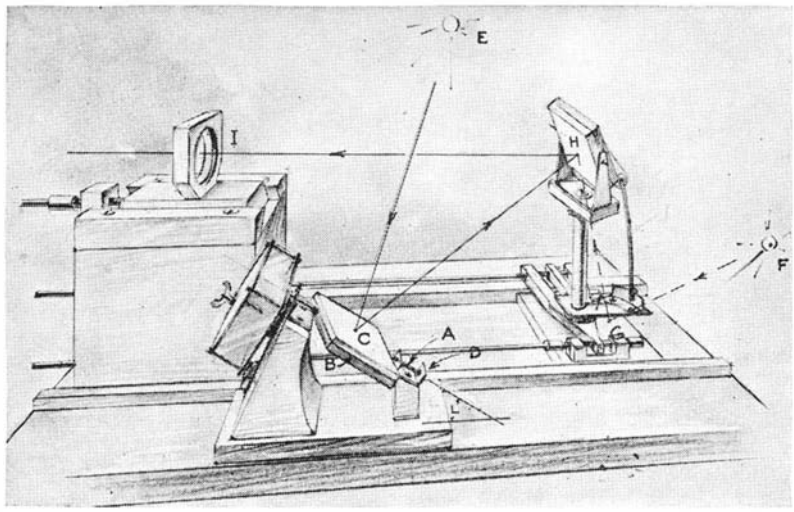


Figure 2: **The coelostat telescope in Figure 1**

THE coelostat telescope should stand in the open air on a pier about three feet high, as illustrated in Figure 1. To protect it from the weather a waterproof wooden box, arranged to lift off or to turn out of the way on hinges, may be used. A heavy box rammed full of earth will serve very well for a pier, though a concrete pier, on a wider concrete base "floated" on sand to absorb vibrations, is preferable. The spectroheliograph, which must now be described, stands in a small shed to the north, at a distance fixed by the focal length of the telescope lens.

Figure 3, which shows the optical parts of the spectroheliograph, should serve to make its operation clear. The image of the sun, entering the shed through an opening, falls on the slit S_1, seen here (and in Figure 4) from the inside, and in Figure 5

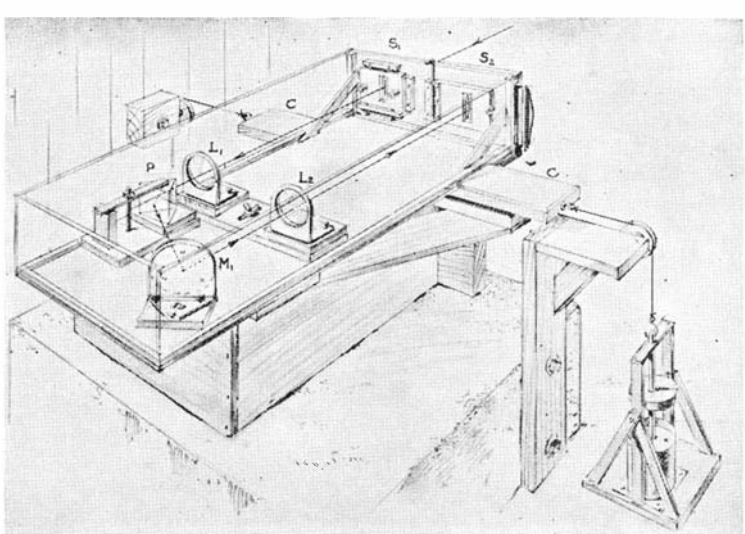


Figure 3: **The spectroheliograph in Figure 1**

[5]Complete silvering instructions will be found in "Amateur Telescope Making," page 130.

[6]All parts made of wood may be prevented from warping by soaking the wood in hot melted paraffin until its pores are saturated.

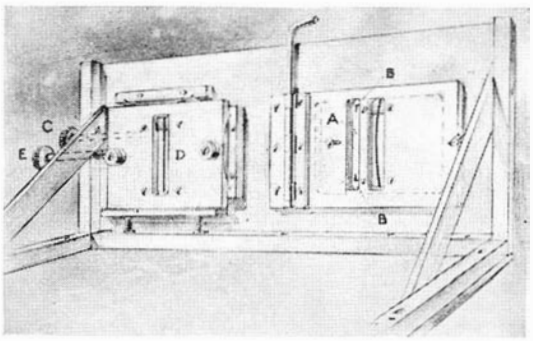


Figure 4: **First and second slits, from north**

from the outside. The diverging beam of white light then meets the plano-convex spectacle lens L_1, about 1½ inches in diameter and of 15 inches focal length, mounted with its convex face toward the prism P. As the lens is supposed to be set at a distance from the slit equal to its focal length (for the violet light of the *K* line), a parallel beam emerges from it, and is dispersed by the prism. The short diffuse spectrum thus formed falls upon the mirror M_1, a square or circular piece of selected plate glass, silvered on its front surface. This sends the dispersed light to the lens L_2, which is exactly similar to L_1, and is mounted on the same support, so that both can be moved together toward or from the slits for focusing. A distinct image of the spectrum is thus formed on the brass plate, hinged at one end, that carries the second slit S_2. When this plate bearing the second slit is swung out of the way, the spectrum falls upon a photographic plate held in a plate-holder mounted at a fixed position beyond it. In this way, with the whole apparatus at rest, photographs of the solar spectrum can be taken.

BEFORE describing the adjustments in detail, let us see how the instrument is used. All of the parts enumerated above, excepting the support for the fixed photographic plate-holder, are fastened to a flat plate, which may be of three-ply wood, stiffened by the wooden sides and ends (shown here as transparent for clearness) of the enclosing box that excludes extraneous light, but more advantageously of metal. Under this box, near the slit end, is the cross-plate CC, carrying below it two wooden Vs, lined with sheet steel. The metal faces of the Vs rest on one inch steel balls, shown in Figure 6, which runs in similar Vs on this fixed base-plate, fastened to the supporting pier. Near the other end of the base-plate are two more steel balls, in this case running, not in Vs, but on horizontal plates of sheet steel. Stops at the ends and two parallel guides prevent the balls from dropping out, but do not constrain them in position. Above them is a flat strip of sheet steel screwed to the underside of the box that carries the optical parts. Thus this box can be moved on the balls smoothly across the solar image by any driving mechanism giving uniform motion. A very simple hydraulic device for this purpose is described below.

Let us now imagine the image of the sun focused on the slit S_1 and the slit S_2 set exactly on the calcium line *K*, after this region of the spectrum has been focused on its jaws.[7] The plate-holder is put in position, the slide drawn, and the driving mechanism started. As the slit S_1 passes over the sun's image it crosses the various invisible calcium flocculi, in each of which the dark calcium line *K* is traversed by a bright line determined in length by the width of the area of luminous vapor.

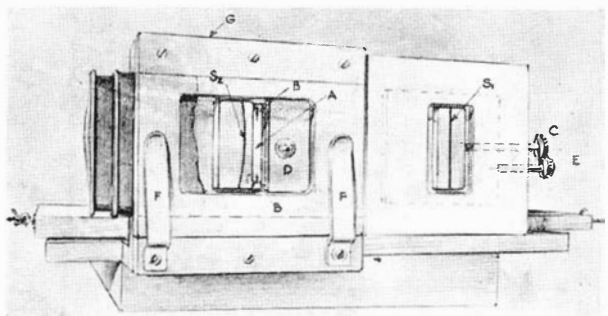


Figure 5: **Slits and plate holder, from the south**

Thus a monochromatic image of the sun in calcium light will be formed on the plate by the countless successive images of the narrow second slit, which excludes all light except that due to calcium.

Certain details of construction and adjustment may now be given.

First Slit. As the second slit S_2 is not adjustable, the first slit S_1 must be provided with several adjustments. The jaws are straight, about 1¼ inches long, bevelled at an angle of 45 degrees on their inner faces (toward the prism), one jaw fixed, the other movable with a fine screw (C, Figures 4 and 5). In practice, the width of the slit is about 0.003 inch. The brass plate (D, Figure 4) that carries the whole slit is movable horizontally by a second screw (E) working against a spring. This is for setting the *K* line on the second slit, so that a range of motion of one eighth inch will suffice. To make the *K* line exactly parallel to the second slit, this brass plate rests on the ends of two screws (shown in Figure 4) against which it is held by a spring pressing on its upper side. When the lid of the prism box is removed a slight adjustment of one of these screws will suffice to secure parallelism, as explained below.

PRISMS and Mirrors. The flint glass prism is of 60 degree angle, 1½ inches high, with faces one inch wide. It can be purchased from the Gaertner Scientific Corporation, 1201 Wrightwood Avenue, Chicago, where lenses (and mirrors if desired) of a better quality than those generally supplied by oculists can also be obtained.[8] Its simple mounting is shown in Figure 3. After loosening the bar that clamps it in place, the prism is rotated back and forth until the violet end of the spectrum falls at the position of minimum deviation on the photographic plate. This adjustment is easily made by forming an image of the sun on the first slit S_1, (opened widely so as to give a brilliant spectrum), removing the cover of the prism box, and placing a piece of white card in the plane of the photographic plate. Assuming the plane mirror M_1 to be in the right position to intercept the dispersed beam from the prism, and set at such an angle as to reflect it through the camera lens L_2, the image of the spectrum on the card is watched while the prism is rotated. The spectrum will be found to move toward the slit S_1, then to stop, and then to move in the opposite

[7] Dust on either slit causes horizontal lines on the photograph. The slits should be cleaned frequently with a thin wedge of soft wood, which may be cut from a match.

[8] Editor's Note: In a private communication the author states that "the telescope lens (I, Figure 2) should be of somewhat better quality than ordinary spectacle lenses, but the demands on the short focus lenses and the mirror of the spectroheliograph are not severe. The prism should be fairly good." The manuscript of the article was submitted to the Gaertner Scientific Corporation, which stated that a telescope lens for the coelostat, of the quality mentioned, may be had in 1½ inch diameter at approximately $2.50; the spectacle lenses for L_1 and L_2, 1½ inches in diameter and 15 inches focal length, will cost 60 cents each; while the 60-degree flint glass prism 1½ inches high, with faces one inch wide, will cost about 18 dollars. One inch balls, priced at a retail hardware store in New York, were quoted at 15 cents each.

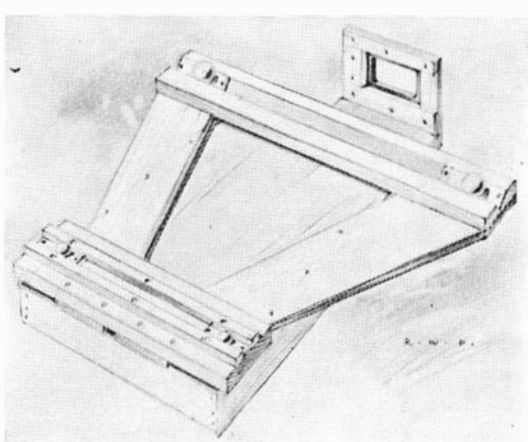


Figure 6: **Base plate to carry spectroheliograph**

direction, as the prism continues to turn in the same direction. The point where the violet end of the spectrum stops before reversing its motion is the position of minimum deviation. The mirror M_1 should be set so as to receive all of the violet light and to send the extreme violet to the second slit when the prism is thus adjusted. The final visual adjustment should be made by watching the spectrum through a magnifier, after narrowing the first slit. As *K* is not easily seen by most eyes, a region in the violet nearer the blue will serve for this adjustment and the next, which is to move the two lenses until this part of the spectrum is in sharp focus on the second slit. The next step is to incline the first slit toward right or left until the lines of the spectrum are nearly parallel with the second slit. As the lines are curved, the second slit must be curved to match them.

ADJUSTMENTS at Second Slit. At this point we may turn to photography. The hinged plate carrying the second slit having been swung out of the way, a few exposures are made to learn the time needed to give the right density at the *H* and *K* lines, where ordinary plates are less sensitive than in the blue. Then a second series of exposures, between which the lenses are moved about one eighth of an inch each time, will quickly bring these strong lines into sharp focus on the plate. With the aid of a pair of dividers the radius of curvature of the *K* line can be determined and the jaws of the second slit S_2 formed to fit the line. It should be added that these jaws are bevelled on the *outside* (toward the photographic plate), so as to present a plane blackened face to the incoming spectrum and thus prevent reflections.[9]

As the *K* line is practically invisible, the problem of setting it on the second slit remains. The two jaws of the second slit are fixed in position, at a distance apart of about 0.003 inch. To the right, (toward the first slit, Figure 5) is a small rectangular window (A) in the brass plate that carries the second slit, through which the violet region of the spectrum can be seen. The line selected for setting is the iron line λ 4325.9, (Figure 7), in my instrument about nine sixteenths of an inch to the right of *K*. This distance is accurately measured on a photograph of the solar spectrum, where λ 4325.9 and *K* are practically at the same focus. A pair of small wire pointers (B, B, Figure 5), (pieces of wire bent to a right angle), attached to the upper and lower ends of the right-hand slit-jaw and projecting to the right just far enough to place their vertical tips at the correct distance from *K*, are observed through a magnifier. The first slit is moved as a whole by the screw (E) and the spectrum moves with it. When the two pointers coincide with the line λ 4325.9 the *K* line must be on the second slit, assuming the measurements and adjustments to be correct. A small brass plate (D, Figure 5), moving easily and made to slip under a groove at the base of the right slit-jaw, is then slid over the window to exclude from the plate all light except that of the *K* line, which now passes through the second slit.

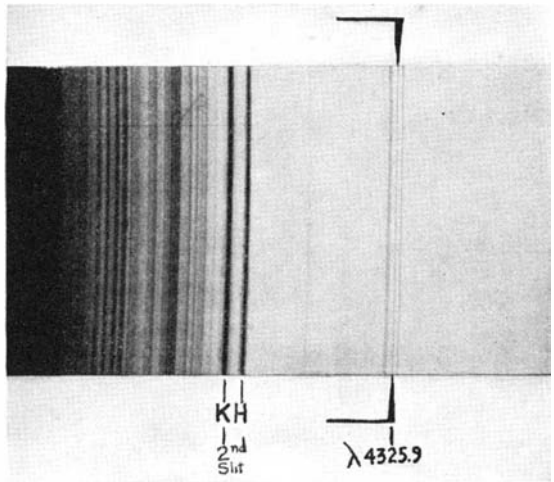


Figure 7: **The violet end of the solar spectrum, showing ultra-violet region to the left, strong *H* and *K* lines (center) at the limit of the visible region, and iron line at wavelength 4325.9 angstrom units on which the pointers are set when the calcium line *K* is on the second slit. Enlarged nearly three diameters from original negative**

Focus of Solar Image. The solar image must now be focused on the first slit for calcium (*K*) light. Look at the image on a white card held against the slit-jaws through a piece of red or yellow glass, and focus the lens of the coelostat telescope until it appears sharply defined. Then move the sun's image until its lower edge is at the middle of the first slit, which should be radial to the disk. Look at the upper edge of the spectrum with a magnifier, and focus the coelostat lens (by moving it north) until this edge appears sharp in the violet. Proceed from this point photographically, moving the lens north about one fourth of an inch between exposures, until an image of the spectrum is obtained which is sharp on this edge at the position of the *K* line.

Plate-holder. In order to keep the plate as close as possible to the jaws of the second slit, a thin plate-holder is needed. A very good one for this purpose is of light sheet metal and takes a plate about 2¾ by 4¼ inches. This is mounted in a wooden support (G, Figure 5) which holds it in contact with a piece of felt cemented to the brass plate that carried the second slit, but cut away opposite the slit-jaws over an area large enough to transmit the images of the spectrum and the sun. The pressure of the springs (F, F, Figure 5) that hold the plate-holder against the felt must not be great enough to interfere with the smooth and uniform motion of the driving-mechanism.

DRIVING Mechanism. It is not as easy as one might suppose to produce perfectly uniform motion. The spectroheliograph, because of the narrow slit before the photographic plate, has an uncanny way of showing any irregularities, which appear as lines or bands across the monochromatic image of the sun. After using many driving devices at the Kenwood, Yerkes, and Mount Wilson Observatories, I recommend for the present instrument an extremely simple hydraulic arrangement similar to that employed in my earliest work with the spectroheliograph 40 years ago. It consists of a vertical cylinder (Figure 3), in its simplest form merely a circular brass tube about 3½ inches in diameter and 4½ inches high. In this a piston of lead slides easily. A piston rod, passing loosely through a hole in a bar above it, carries the lead driving weights and serves as a guide and as a means of communicating motion to the spectroheliograph by the aid of a thin steel tape or wire. The cylinder is nearly filled with liquid, which may be a thin oil or a half-and-half mixture of glycerine and water, which will not freeze. A counterweight, hanging from a pulley on the opposite side of the spectroheliograph, keeps the tape taut. The speed is regulated by three holes

(*Please turn to page* 283)

[9] A straight first slit and curved second slit necessarily mean a distorted solar image. A circular image can be obtained by giving each slit half the curvature (twice the radius) found as above for the second slit.

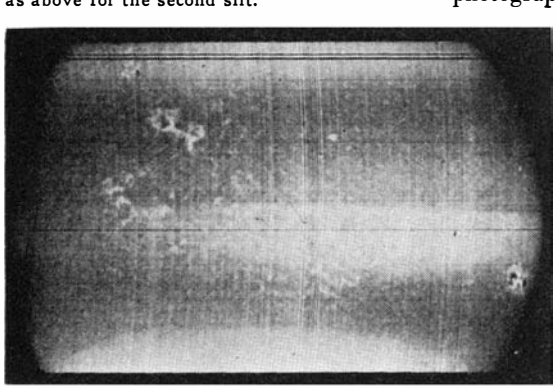


Figure 8: **Photograph of sun, showing calcium flocculi and bipolar sun-spot (near right edge)**

COTTON STALKS, A NEW SOURCE OF RAYON

By PETER A. CARMICHAEL

THERE was a time when the southern cotton planter was of the wealthiest class of American citizens. To-day he has to struggle to make ends meet, and it is by no means uncommon for him to wind up his year with a loss. So adverse were the conditions he had to face the past season that in some cases, as the winter traveler to Florida may have observed, he did not even trouble to gather his crop.

The great development and popularization of rayon has been largely responsible for these changes. But where rayon has been the rival of cotton in the past, it now promises to be the rescuer of it.

In a series of experiments directed by the University of North Carolina the past year, and still in progress, it has been found that the entire cotton plant is capable of utilization in the manufacture of rayon. Lint cotton is a highly desirable source of cellulose, the basic material from which rayon is produced, but because of its cost, the use of it in the rayon industry at present is comparatively slight. The North Carolina experiments, however, give promise of an output of cellulose costing only about one twentieth of what it now costs to supply that material from the lint. The successful application of the method followed in these experiments, which are now well advanced and which have yielded results believed to be of great importance, would revolutionize the cotton-growing industry.

THE great majority of rayon manufactured in the United States comes from wood pulp. The process, briefly described, is to extract the pulp, or cellulose, by means of a chemical treatment which dissolves out the lignin, fats, resins, and other materials; then to treat the cellulose with other chemical agents—the principal one of these now used is sodium hydroxide—and finally to force the resulting viscous substance through exceedingly fine perforations somewhat like those of a sprinkler. Tiny threads emerge, are dried, and then are so nearly like silk in appearance that it is almost impossible to distinguish some varieties of them from silk. These are woven into rayon fabrics.

It happens that the wood best suited for rayon making is spruce, and the supply of that, while ample for present needs, is by no means so abundant as to leave the rayon industry without thought of future sources. To grow a spruce tree to the size at which it can best be utilized for rayon manufacture requires many years. It is evident that with the industry expanding at its present rate—and just now there are prospects of great new advances for rayon, which promise an altogether new textile resembling wool—something may soon have to be found to supplement spruce. With cotton cellulose available at one twentieth of its present cost, it would appear that the problem of a source of raw material had been permanently settled.

Mr. Dockery, whose cotton stalks are being made into rayon in the experiments

In the chemistry department of the University of North Carolina, near the cotton-producing lands and the rayon-manufacturing centers, the work is now in progress which promises to supply a material that will not only supplement wood pulp but may take its place altogether. The experiments, directed by Professor Frank K. Cameron, are being carried out simultaneously in the university's laboratories and on a cotton plantation of several thousand acres near Rockingham, North Carolina. This plantation is owned by one of Professor Cameron's students, Nicholas W. Dockery, and the latter's mother. Young Mr. Dockery is in charge of the experiments on the farm and, to facilitate the work, he has established a well equipped auxiliary laboratory there.

BY present methods, cotton is produced only with considerable care and expense. It must be planted in rows some four feet apart. It requires much cultivation, in the form of thinning and plowing, during the growing season. When harvest time comes it is picked, almost entirely by hand—a very tedious process—and then ginned. The stalks are left standing in the field, being thought worthless except for refertilizing the soil out of which they grew.

This is changed from first to last in the North Carolina project. In that project the whole plant—stalk, lint, seed, and all, except the roots—is utilized. It is mowed like hay and then baled without either picking or ginning. The mass in its entirety is then available for conversion into its constituent substances, of which the main one is cellulose, and thereafter the cellulose is ready to be turned into rayon.

The stalk is no problem in the production of cellulose, being itself high in content of that material, but the seeds have raised considerable difficulty for the experimenters, just as they did for cotton growers and manufacturers before Eli Whitney invented the cotton gin. The cotton seed is very valuable for the fats and oils which it contains, as it is one of the chief sources of material for making soap, glycerine, and cooking oils. Besides these, it yields a variety of other products, ranging from fertilizer and cattle feed to a substitute for olive oil. To-day the seed is worth about one fifth as much as the lint, yet there was a time when it was thrown away or destroyed—before scientific re-

search had found ways of reclaiming the oily center which it contains.

It is because of their value that the seeds are a problem. Their content must either be recovered from the pulping process or else preserved by some other means, in order that the utmost may be realized from the present undertaking.

It is possible, though exactly how practicable is yet to be determined, to put the whole plant, including seeds, through the pulping process and then recover the seed oil. The latter is then available for soap making. By further chemical treatment and refinement the experimenters hope to restore it for all of its present uses.

ON the other hand, the seed can be saved by ginning, without, however, the necessity of continuing the slow and expensive operation of picking the cotton. In this case the entire harvested plant is put through a gin. Considerable trash from the stalk may be mixed with the lint when the latter comes out, but that is of no consequence, since the whole mass, exclusive of the seeds, is then turned into the pulp mill. This has been found practicable, in these experiments, with the use of an ordinary gin.

Lint cotton is probably the richest of all sources of cellulose. It is in fact almost entirely cellulose, showing, on the Carolina plantation, a content of about 95 percent of that substance. In tests performed there and at the university on samples gathered by the hundred each week during the 1930 growing season, a content of approximately 60 percent for the whole plant, lint included, was found. The yield from spruce is approximately 52 percent.

All the tests so far made in these investigations have been made on cotton plants grown in the manner now almost universally followed. That is, these plants were grown in rows of the usual width and with the customary amount of cultivation. However, the experimenters propose an entirely new way of producing the crop, and this is one of the features of their project.

Instead of planting in rows as at present, they are going to sow or broadcast the seed, like small grain. Now, plants that are crowded mature faster than others, as do animals and human beings as well. This means that the cotton stalks should produce more lint, relative to the size of the plant, than they do now, and as a consequence the experimenters believe the cellulose yield from the whole plant will be increased to about 65 percent. There already exists some experimental evidence in support of these expectations.

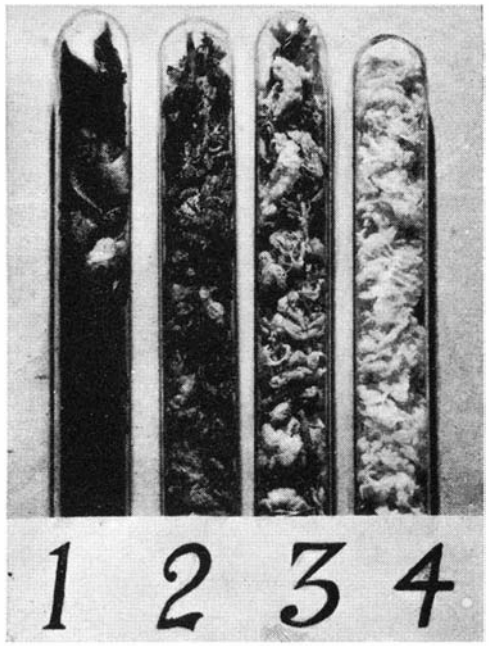
Under the present methods of cultivation young Mr. Dockery's lands averaged some 2300 pounds of cotton and stalk per acre the past season. Under the broadcast-planting method it is conservatively estimated that the yield will be 5000 pounds. If the present yield of lint alone were turned into cellulose, the output of the latter would be about 330 pounds per acre. But if the stalks and all were thus converted, the cellulose yield, counting 5000 pounds of crop to the acre, would be some 3250 pounds—or 10 times as much.

Another way of planting is also to be tried next season. The seeds will be drilled into the soil in rows very close together, like wheat.

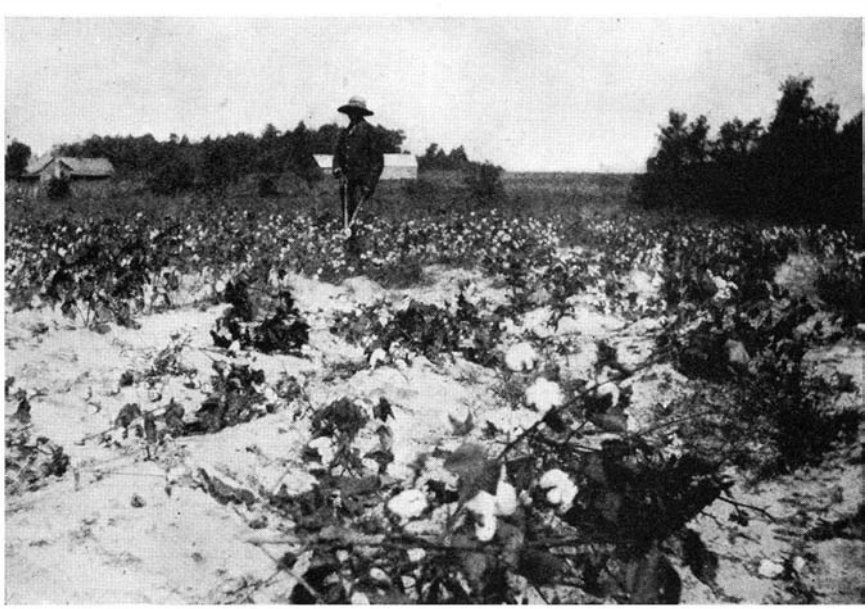
Under either broadcasting or this kind of planting, it will be unnecessary to do any cultivating whatever. But without cultivating, the soil is likely to produce a big crop of weeds amidst the cotton, and so reduce the output of the latter. The experimenters are ready to meet this obstacle, however, by planting broom sedge or some similar grass along with the cotton to rout out the weeds. Broom sedge, being a hardy, fast-spreading plant, dwarfs weeds; moreover, it is high in cellulose content, and will be harvested along with the cotton and turned into cellulose also.

IN addition to the immensely increased yield expected from either of these ways of planting, there is a prospect of a great saving in the method of harvesting. Instead of picking the cotton by hand and leaving the stalks standing in the field, it will be possible, as was found last year, to gather the whole plant by mowing it down with power-driven reapers. It will then be compressed into bales and shipped to the pulp mill. All this will be done by a few hands in only a small fraction of the time that it now takes a field full of hands to accomplish the same result.

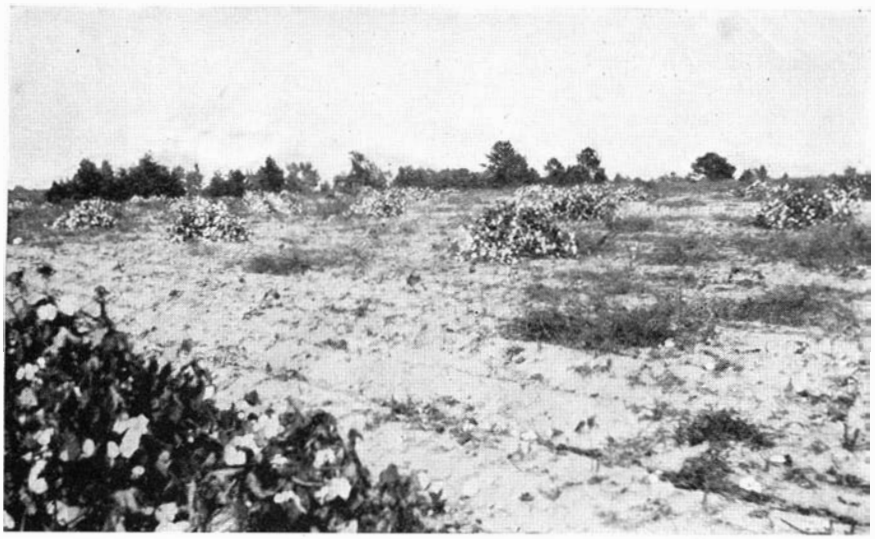
On the lands where the investigation was made during the past season, it costs an average of approximately 23 dollars an acre to produce the crop by the old method. After making all reasonable allowances, based on considerable experience in cotton growing, Mr. Dockery believes that production in the new style will cost only about one half as much. Since a cellulose output nearly 10 times that of lint is promised, and since it is expected to cost only half as much, the net effect should be a cellulose costing just one twentieth, approximately, of the present figure. It is not difficult to judge the advantage this would mean to the rayon industry.



Test tubes showing steps in the conversion of entire cotton plants into rayon



In the experiments, the cotton—bolls, stalks, and all—has been cut by hand. Should the process prove commercially practicable, machines would do the work



After mowing, the cotton plants are hauled away and baled without either picking or ginning. The process of harvesting is thus greatly simplified

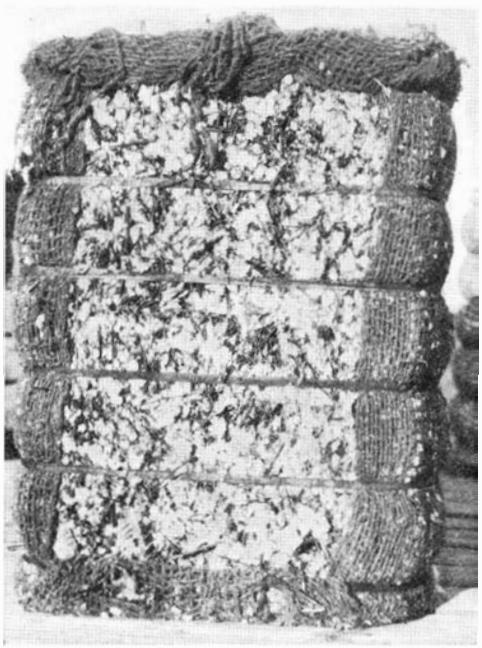
Nor is this all. Cotton is regarded as the choicest raw material for the production of rayon, but the cost of it has heretofore restricted its use to the production of the more expensive rayon goods. Should it prove a competitor with wood pulp, as the Carolina venture strongly indicates it can do, then a generally higher quality of rayon could be expected. In addition to this, the investigators are of the opinion that an even higher grade of cotton cellulose can be produced by their methods.

THE development of this enterprise to anything like the degree that appears open to it, would mean nothing less than a revolution in agriculture in most of the cotton-growing states. At the present time cotton culture in the southeast, the region where it had flourished for a hundred years prior to the World War, is in an alarming state and one that promises to grow even worse. Three different conditions threaten to make its successful continuance in the southeast impossible.

One of these is the above-mentioned exploitation of rayon itself. The rapid development of that textile has cut heavily into the use of cotton fabrics, with the result that the demand for raw cotton has greatly declined.

A second such element is the now probable development of a machine for picking cotton. This machine is said to operate best on level lands. It would be especially adaptable to the plains of the southwest, where cotton more desirable because of its longer fiber than that of the southeast is already a leading crop. The saving from it would be immense, and the section that could best employ it would be the section to supply the material for the future manufacture of cotton goods.

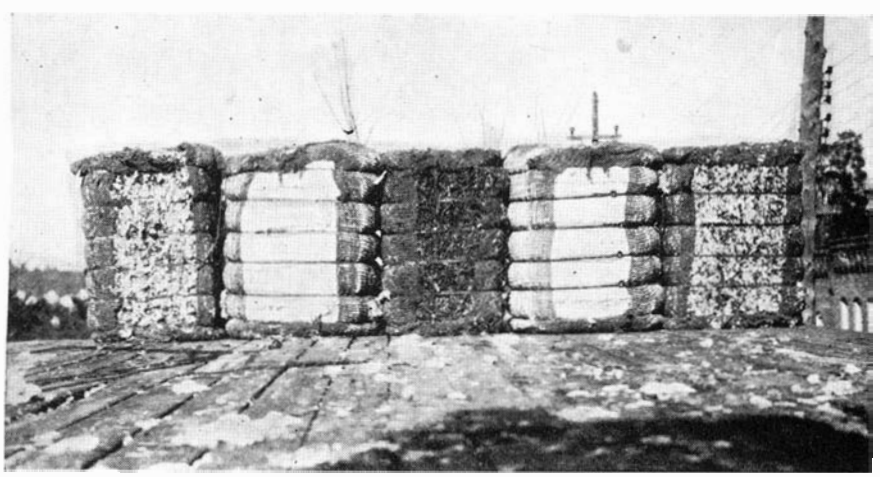
Finally, there is the growing threat of the expansion of cotton production abroad. We are still one of the world's chief sources of cotton. Our exports of it exceed those of anything else we send away—including automobiles, oil, wheat, and machinery. But India and Egypt have long been competitors with us, and to-day Russia is making a bid for the same status. It is believed likely that still other parts of the world where very cheap labor can be had will before long turn to the production of cotton. These include portions of Africa outside of Egypt; Spain, where experimental production is reported under way; and possibly South America.



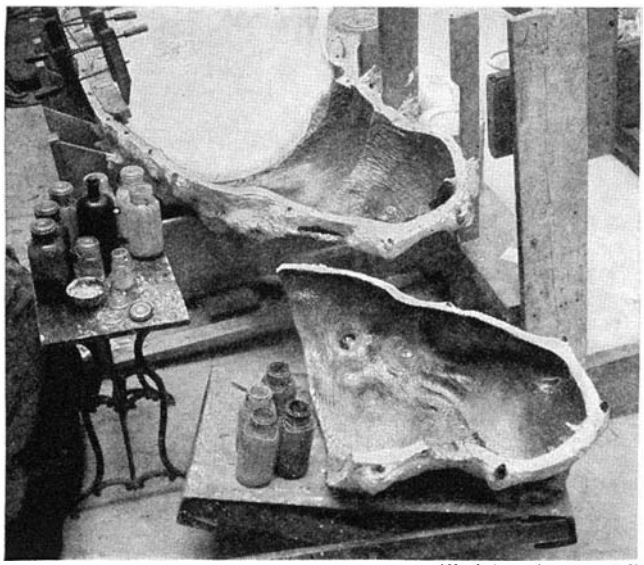
WITH the demand at home dwindling and with the prospect of losing our export markets to rivals abroad, it is evident that the outlook for cotton is anything but bright. But if some new use could be found for it, and if some means were discovered whereby it could be produced at less cost, the whole complexion of the problem would change. And if such a project as the North Carolina chemists have under way should turn out to be the success which the results so far indicate it will be, the problem would vanish.

Exploitation of this project would also mean the replacement of many farm hands by machinery and, in consequence, probably some fundamental change in the tenant system, a bane which has given the southeast no end of tribulation. Tractors and mowing machines would be used where common labor now does the work. Most of the labor that would then be needed would probably move from farm to farm, following the course of the crop's development, as is done in the western wheat fields.

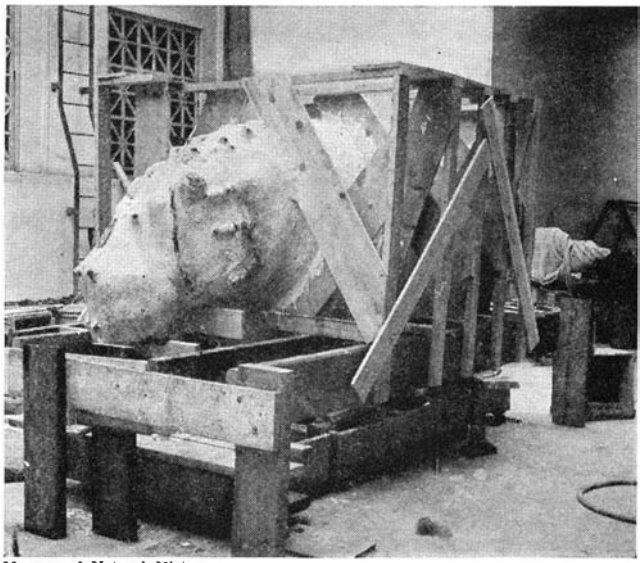
This and the other changes which would be brought about by the new methods would put cotton farming on an entirely new basis. Altogether, these changes would doubtless be the biggest thing in the history of cotton since the invention of the gin, more than a century ago.



Bales of plants as they come from the field compared with bales of lint and, in center, with bale of stalks. *Above:* Close-up of bale of unpicked cotton

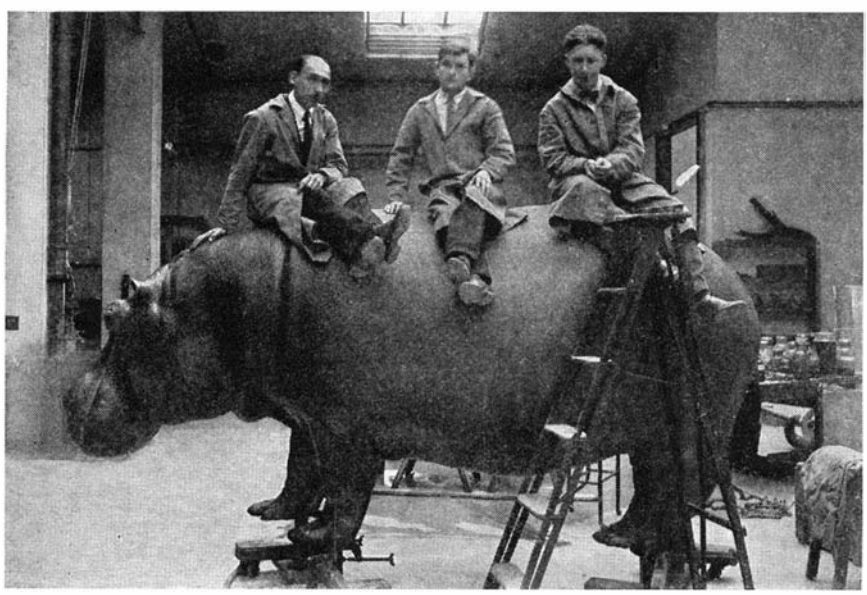


A partially completed artificial skin is in the foreground. To rear, coating is supported by wire and papier mâché

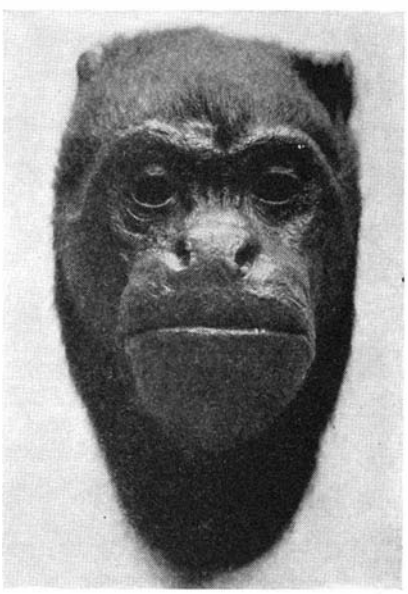


All photographs courtesy Field Museum of Natural History

The plaster mold encloses the model. The heavy wooden framework prevents warpage and aids in handling parts



A completed hippopotamus exhibit, showing the great strength of the model. The colored translucent artificial skin makes possible perfect reproduction



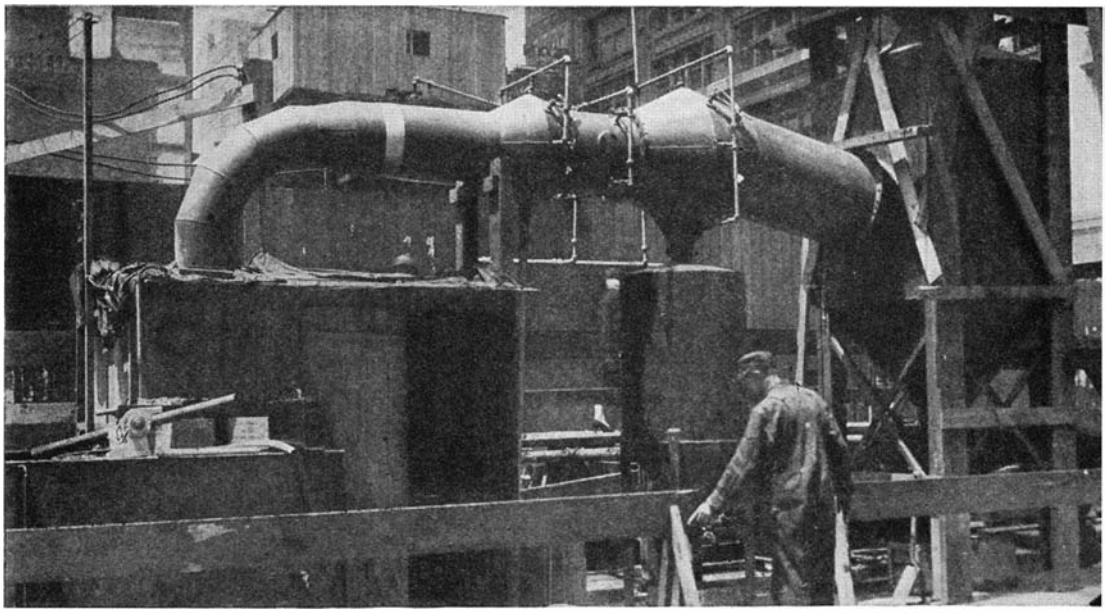
By a special de-hairing treatment, the hair is transferred to celluloid

CELLULOID TAXIDERMY

A MEMBER of the technical staff of the Field Museum of Natural History, Mr. L. L. Walters, has discovered that, in taxidermy, the conditions of natural coloration can be produced by using pigments added to a translucent material. This is generally known as the "celluloid process," although, strictly speaking, celluloid is only one of the materials that have been employed.

The colors are prepared by adding pigment to a cellulose solution; cellulose nitrate, cellulose acetate, or pyroxylin is generally used. The color is thus applied in the mold and not to the finished cast. Each colored mixture is applied or painted in its proper location on the interior surface of the mold. After this work is completed, layers of other materials such as cloth and wire-cloth are added for further strength and support. The replica, entirely complete as to coloration, is then removed from the mold.

To extend these methods to mammal work, the variation from the regular procedure requires a method which provides for the correct transference of the hair. It first calls for the construction of an armature or frame and a clay figure in the ordinary way. The skin, in a freshened, soft, plump condition, is adjusted on a form. The molding material entirely surrounds the individual hairs and takes an exact impression of the skin surface between. When the mold is completed and reinforced and the interior clay structure removed, the skin remains attached to the mold by the embedded hair. Through de-hairing treatments, such as are in use in tanning operations, the tissues surrounding the hair roots are acted upon and the skin detached and removed from the mold. The mold then presents an accurate negative of the skin surface with the root of each hair protruding and exposed. The colors are prepared and applied in the usual manner, the liquid cellulose acetate or nitrate surrounding each hair root. On the evaporation of the solvent, the hair is left embedded in the solidified material.



The rock dust from the drills is impounded by the cap and is removed by suction to a receiving tank. The air is then deflected, sprayed with water, filtered, and the sludge returned to the settling tank

TAMING A DEADLY OCCUPATIONAL DISEASE

SILICOSIS, defined by the doctors as a "fibrosis of the lungs induced by the inhalation of dust containing free silica," is perhaps the most important of all our occupational diseases and one of the most deadly. An occupational disease has been defined as "morbid results of occupational activity traceable to specific causes or labor conditions, and followed by more or less incapacity for work." In a city like New York, which is indeed "founded on a rock," the rock driller and blaster are essential to construction work. These men carry on their noisy operations year in and year out, with the full knowledge that in the end they may be seized by tuberculosis, an aftermath of silicosis. What they probably do not realize is that if they remain in this occupation even a few years, the injuries they sustain may be permanent.

SILICOSIS is not limited to rock drillers, but also occurs in workers who do hard rock metal mining, granite cutting, metal grinding, and sandblasting. Much attention has been given to the subject by eminent doctors and industrial hygienists, and New York has proved to be an ideal place to carry on practical investigations, owing to the type of rock which gives the greatest possible chance for injury. The highly variable micaceous schist is very massive and rich in quartz.

The Silicosis Committee, composed of nine doctors and experts, made a study of 208 rock drillers, blasters, and excavators and found that silicosis was present in 118 men, or 57 percent. Their recommendations were as follows:

"1. The prohibition by law of all dry drilling, making it compulsory for employers to discard the present dry jack hammer and supply the rock drillers with jack hammers having water supply attachments; 2. Installation of dust and sludge collectors, or attachments to drilling machines; 3. Adequate ventilation in tunnel work; 4. Proper spacing of drillers so as to reduce the dust concentration in given areas."

Dust cap at the base of each drill is attached to an air suction system by a hose

It is interesting to note that 27 patents for dust and sludge collectors have already been issued.

Mr. George S. Kelley, construction engineer for the George J. Atwell Foundation Company, New York City, attacked the problem and has succeeded in making a "man size" demonstration with the co-operation of the State Department of Labor; the Industrial Department of Hygiene, Metropolitan Life Insurance Co.; and the Harvard School of Public Health. The expenses of the installation were borne by the Metropolitan Life Insurance Co. and the tests were conducted through the courtesy of Starrett Brothers and Eken, contractors for the excavation for a new building for the life insurance company. The work involves the removal of 80,000 cubic feet of rock.

AROUND each jack-hammer drill is a casing or hood in the shape of a truncated cone with a flat top. It is made in two parts, which are kept closed by a spring. A piece of two-inch pipe is fitted to the cone and adapted to receive the clamp of a suction hose. The drill steel rotates freely in a one and one-quarter inch hole in the top.

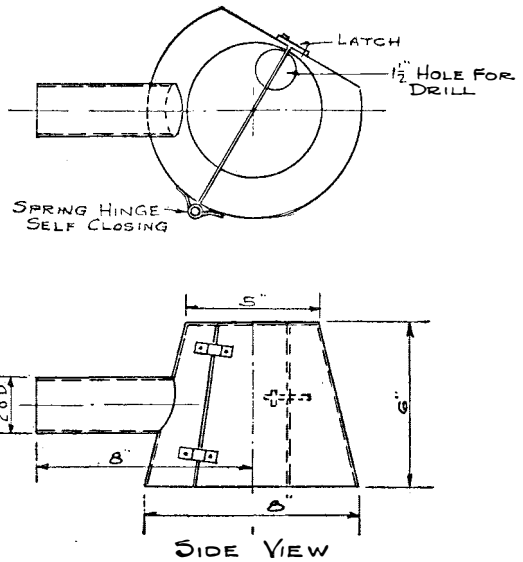
Mr. Kelley employs a high suction

to form an air seal so that not only is the air which issues from the hole withdrawn, but in addition a very strong current of air is drawn through the space between the hood and the drill. With this strong suction it was found that the cuttings can be removed from the hole so rapidly that the cutting speed of the drill is increased and the particles are of large size because they do not drop back into the hole to be ground under the face of the bit. In addition there is no dust lying on the ground surface to be stirred up by the operator's feet or subsequent blasting operations. The exhausted air discharges into a dust collecting system which removes the fine material so as to present no health hazard at the street level.

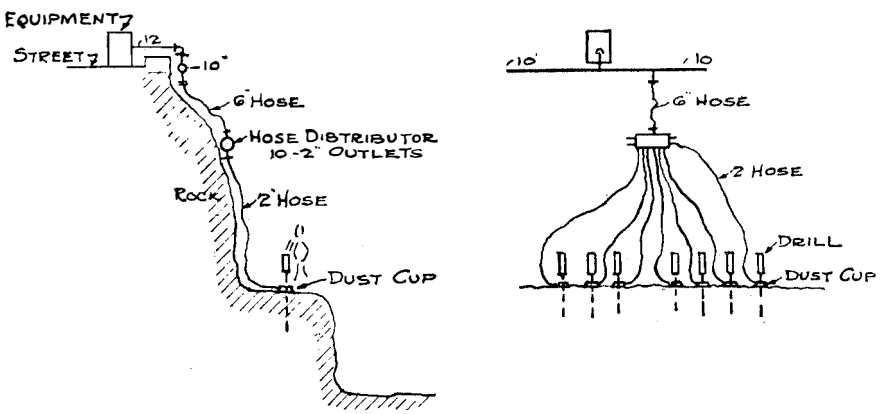
Our diagram shows the way the drills are hooked up. The lot which is being excavated is completely surrounded by a 10-inch pipe. At every 40 feet in this line is a 6-inch outlet which leads to a distributor, or manifold which has ten 2-inch outlets, to which ten hoses for the individual drill hoods are attached. The air suction is provided by a General Electric centrifugal compressor with a capacity of 3500 cubic feet per minute at one and one-quarter pounds pressure.

The plan view shows the mechanism of the dust collector. The dust-laden air is drawn into the receiving tank where the heavier particles fall by gravity. The air, still laden with its freight of fine rock dust, passes through air chambers having deflectors and water sprays. Part of the dust falls into a sludge tank immediately in front of the workman in our illustration at the top of the opposite page. The air, now laden with only the finest dust particles, passes through filters in the square column at the right and is passed out into the open air, purged of all its dust. The sludge passes from the sludge tank and the filtering tank to the open sludge tank at the left for ultimate disposal.

Using a standard of safe dust concentration determined from previous studies of the health hazard associated with rock dust it was found that a minimum flow of 60 cubic feet per minute was necessary to control the dust hazard associated with rock drilling. Operating at this air flow the efficiency of the collection of cuttings from the drill was very high and with 25 drills operating, as much as two tons of ground material have been collected in eight hours. This by-product is worth 40 dollars a ton as an abrasive.



Dust cap showing method of attaching the air suction hose. It requires no adjustment

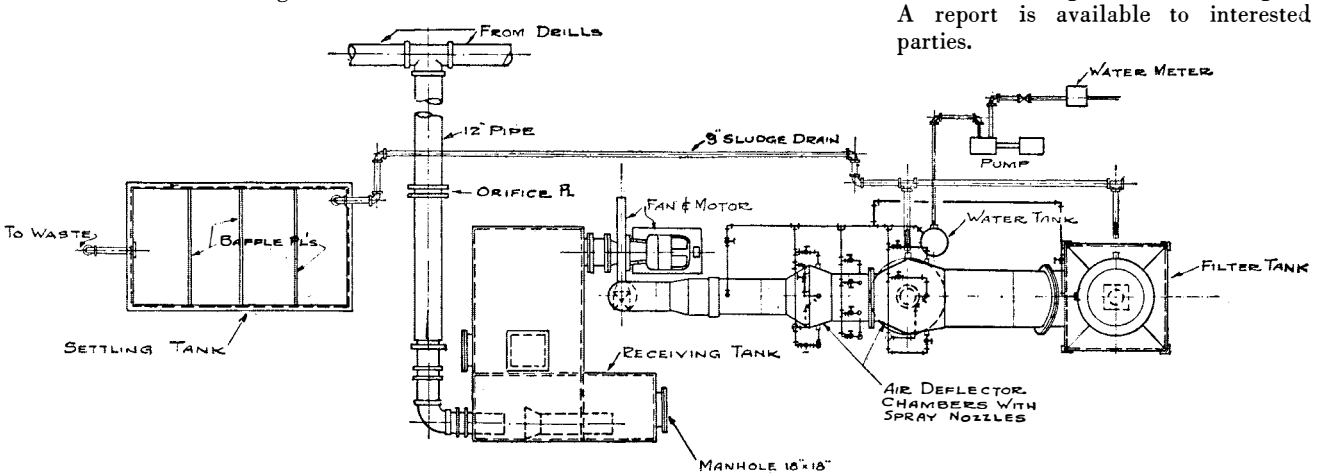


Section showing edge of excavated area and the location of dust control equipment, hose distributor with outlets, and hose running to dust caps and drills

It was demonstrated that dry drilling with this system is superior to wet drilling for the prevention of silicosis. This method also allows for the use of the full available pressure.

As soon as the Department of Labor is satisfied that the results are entirely satisfactory and after checking by the scientists who have been watching the experiments, it is well within the limits of probability that this method of drilling will cause a new code to be ordered requiring the use of this or a similar method in all rock-drilling operations. If, as is often the case, the new plan saves the contractor money, so much the better.

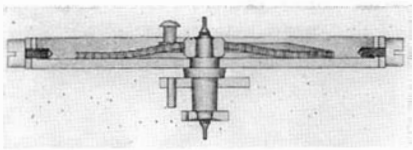
The Altman Foundation has furnished the necessary funds to conduct the elaborate studies carried on by the Silicosis Committee. The study was instigated and the physical examination of the workers carried out by the Industrial Department of the Institute of Public Health of Columbia University. The medical report was prepared by Dr. Adelaide Ross Smith of the above named department. The New York Tuberculosis and Health Association was the co-ordinating and financial agent. A report is available to interested parties.



Plan of equipment showing the path of the air-laden dust to the receiving tank and ultimate disposal

COMBATING MAGNETISM IN WATCHES

By GEORGE P. LUCKEY
Director of Research,
Hamilton Watch Company



Magnetism in an ordinary watch attracts hairspring to balance arm

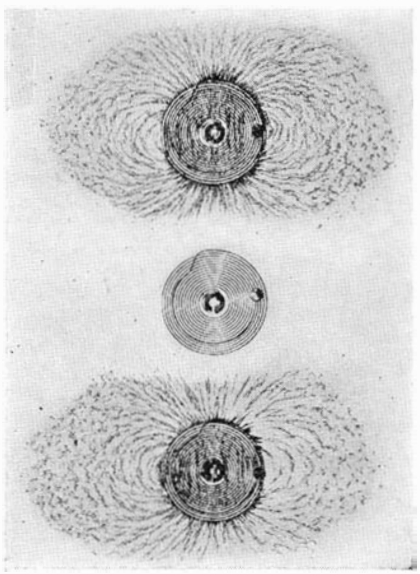
CONSIDERING the delicacy of their works and the continuity of their operation, year in and year out, watches are given perhaps the least attention of any mechanism in wide use today. The owner of any reasonably good watch will carry it in the warmth of his person during the day, through all his varied duties and exercises, no matter how arduous, will wind it at irregular intervals, lay it upon a cold dressing table, and expect it still to keep fairly good, if not perfect, time. Fortunately it can do this, for watchmakers have combined in modern watches ruggedness and good time-keeping qualities; and for many years have so constructed the balance wheel and hairspring—the watch's heart which oscillates at the almost unbelievable rate of 157,680,000 times annually—that they withstand normal changes of temperature. The question of magnetism, however, has been more baffling.

There is no surer way of obtaining poor time-keeping quality from a watch than to place it for a fraction of a second in a magnetic field strong enough to magnetize its steel parts permanently.

ONCE a watch has been magnetized, its usefulness as a time-keeper is destroyed until it is demagnetized. Such demagnetization can be accomplished by placing the watch in an air-core solenoid excited by alternating current and then drawing the watch rapidly away from the solenoid. However, in order to demagnetize the watch completely, it is usually necessary to disassemble the entire watch movement and demagnetize each part separately. Because of the extremely harmful effect of magnetic fields, anyone owning a high-grade watch has always been warned against carrying it near electrical apparatus where it may be influenced by strong magnetic fields.

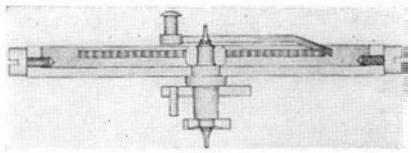
A watch consists of essentially four elements: (1) the driving power or the mainspring; (2) the train of gears that transmit the power from the mainspring; (3) the escapement; and (4) the balance wheel and hairspring. The most essential part of a watch is the balance wheel and hairspring, a periodic system which, in the standard watch of today, oscillates with a frequency of 18,000 vibrations per hour. The time-keeping qualities in a watch are determined by the constancy of the vibrations of the balance wheel and hairspring, and the rate at which the power is released to the balance wheel and hairspring is governed by their period of oscillation. Anything which disturbs this period of oscillation directly affects the time-keeping qualities of the watch.

A watch to pass railroad inspection must keep time within 30 seconds a week. In a week there are 604,800 seconds and thus a watch to keep time within 30 seconds a week is operating with an accuracy of .005 percent or better. From this it can be seen that relatively slight disturbances affecting the period of the balance wheel and hairspring may cause a considerable effect in the time-keeping accuracy of a watch.



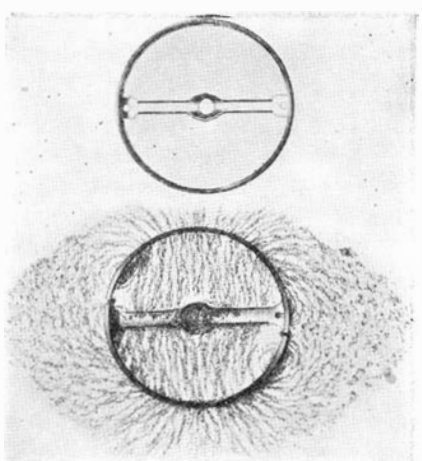
Magnetism of steel hairsprings and lack of magnetism of Elinvar springs —subjected to same magnetic field

A watch movement of necessity contains a large number of steel parts used both as springs and as bearing and wearing surfaces. Such parts, in the conventional watch, are the mainspring, winding and setting mechanism, stem work, pinions, parts of the escapement and balance, and the hairspring. Steel was heretofore necessary in these parts both because of its elasticity and because no other material could be practically used to furnish the long wear necessary.



There is no harmful magnetic effect between Elinvar watch parts

The hairspring of the watch has been made of steel because of the elastic qualities which are required. The steel used has the defect common to practically all metals: its elasticity is influenced by temperature, becoming stronger when cold and weaker when warm. This defect, which would make a watch run fast when cold and slow when warm, is compensated for by making a balance wheel in which the arm of the balance and the inside of the balance rim are made of steel and the outside of the rim of brass. The rim of the balance is cut on opposite sides near the arm so that this rim acts as a bi-metallic strip, the free end moving in towards the center when warm and moving out when cold. Then by properly weighting the balance wheel with screws a watch movement is obtained which will keep perfect time independent of normal variations in temperature.



Steel filings cluster about bi-metallic balance wheel but not about a solid ring mono-metallic wheel

If a watch is magnetized in a strong field, the most striking effect observed is that between the hairspring and the balance arm. In order that the mechanism may be contained in a small space, the hairspring is placed directly above the balance arm. If the balance and hairspring become magnetized to their fullest extent, the balance arm will attract the hairspring with such force

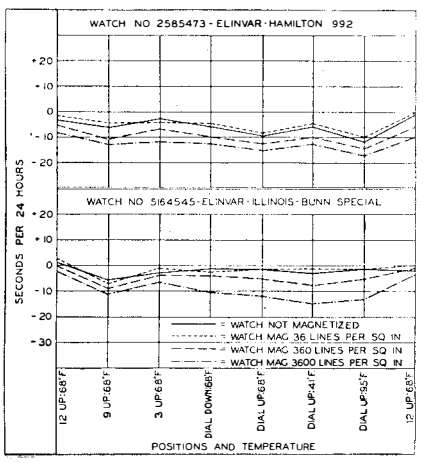
that the hairspring lies directly on the balance arm and stops the movement of the balance.

In case these steel parts are not so highly magnetized, a few coils of the hairspring may touch the balance arm or at certain times or in certain positions a coil of the hairspring may rub on the balance arm. When this occurs, the time-keeping becomes extremely erratic. Even if the hairspring is not magnetizable, there would still remain a strong effect due to magnetism between the balance arm and any magnetized steel parts.

IT can be seen, then, that in order to construct a watch movement which would not be strongly affected by magnetism, the first essential would be to obtain a balance wheel and hairspring containing no material that could be permanently magnetized. However, such material must have the same or better physical characteristics than those used in conventional watches. As stated above, the predominating effect of temperature on a watch is due to the change in the elasticity of the steel hairspring. In case the elasticity did not change, the change in size of the hairspring due to an increase in temperature would cause the spring to become slightly stronger so that the watch with such a hairspring would gain about a second a day for a change in temperature of 1 degree Fahrenheit. The expansion of the balance wheel, due to the same increase in temperature, would cause the watch to run slow approximately the same amount. These two effects could, by proper choice of the material of the balance wheel, be made to compensate each other. Thus if it were possible to obtain a hairspring in which the elasticity is not changed with temperature, it would be possible to use a non-magnetic material of the correct coefficient of expansion for the balance wheel and the worst effects mentioned above as due to magnetism would be eliminated.

A HAIRSPRING material which has these qualifications is found in Elinvar, a nickel-chromium-steel alloy developed by Dr. Guillaume, Director of the International Bureau of Weights and Measurements, who is well known because of his invention of Invar. Elinvar has the elastic qualities of the best grade of hairspring steel, and further, its elasticity over the normal range of temperature experienced by watches can, by proper selection, be made practically constant so that when it is used with the proper type of non-magnetic solid balance wheel, the errors due to the effect of temperature are as slight as, or less than, those experienced with high grade watches using a split bi-metallic balance wheel to compensate for temperature effects on a steel hairspring. Elinvar though attracted by a magnet will not become permanently magnetized. Since a non-magnetic balance wheel can be used, the major effects of magnetism can be eliminated.

In addition to minimizing the effect of magnetism, the combination of an Elinvar hairspring with a solid non-magnetic balance wheel has other advantages over the conventional bi-metallic balance and carbon steel hairspring.

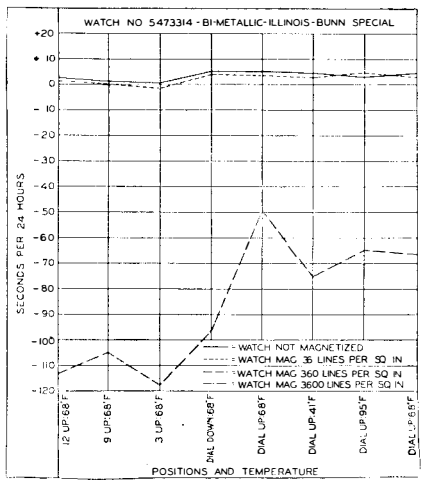


Elinvar will not rust and hence eliminates one of the serious difficulties experienced with steel hairsprings. In order to obtain proper time-keeping quality in a watch held in any position, it is essential that the balance wheel be accurately poised to obviate any influence by gravitation. A bi-metallic balance has a split rim and because of the movement of this rim with changes in temperature, it is difficult to poise this balance wheel properly and keep it poised when affected by jars, vibrations, and changes in temperature. These troubles are eliminated when, because of the Elinvar hairspring, a solid balance wheel can be used.

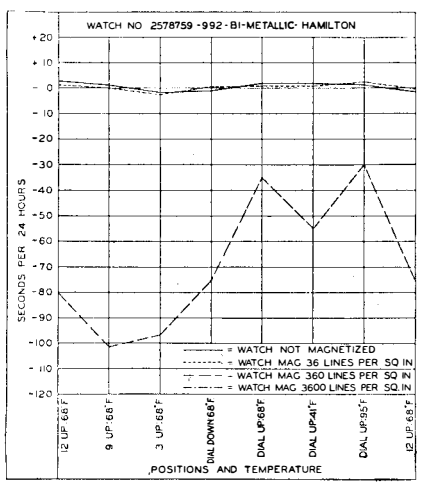
EXPERIMENTS have been carried on for a number of years with Elinvar hairsprings and mono-metallic balances with the view of eliminating, as far as possible, the effects of magnetism and, at the same time, retaining the necessary good qualities of the steel used throughout the watch. These experiments have resulted in the production of a watch movement which is only slightly affected even if all the steel parts in the watch are permanently magnetized to the greatest degree.

The Elinvar watches, after magnetization, have all their steel parts magnetized to the greatest degree and such a watch is sufficiently magnetized so that if it is placed in proximity to a watch with a bi-metallic balance, it will greatly influence the latter's rate.

It must, of course, be considered that the watches used in the experiments mentioned have been tested after magnetization and not while remaining



Self-explanatory graphs showing the reaction of Hamilton and Bunn bi-metallic and Elinvar watches to magnetism at various temperatures



continuously in a strong magnetic field. It is very doubtful whether a watch can be constructed from conventional materials and be made to run and keep time in the strongest magnetic fields. The effect of the eddy currents alone, induced in the balance due to its high speed of rotation, would in all probability cause sufficient retardation to affect the time-keeping of a watch greatly. It should be remembered, however, that no watch is apt to be placed permanently in a magnetic field and that an Elinvar watch when momentarily placed in a magnetic field will not be noticeably affected.

From the results of the tests it has been shown that the Elinvar hairspring and mono-metallic balance equipped watch offers to the electrical engineer or to men working around electrical machinery a new possibility in obtaining accurate time. It is no longer necessary to avoid carrying such a watch into the close proximity of a magnetic field and even though the watch may be slightly influenced while in a strong magnetic field, it will keep as good time afterwards as before, whereas the ordinary watch would be useless.

WHEN A SUNBEAM SPLITS

By Z. MOOR

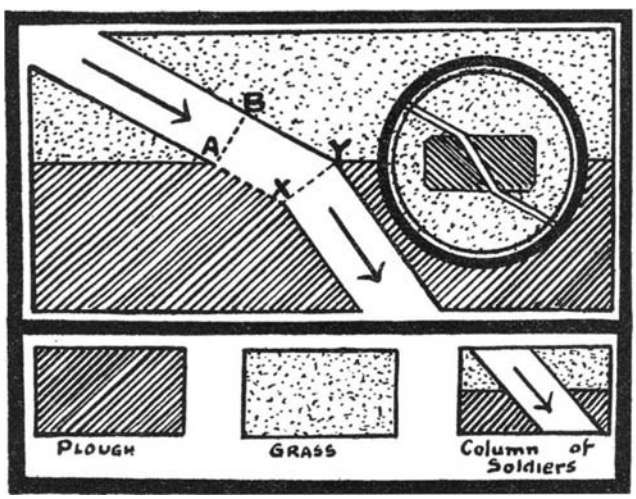
OUR readers may think the accompanying article somewhat juvenile. It is. The *Scientific American* has relatively few juvenile readers, not being aimed at them. Despite these facts we publish this elementary article because we like it ourselves. The author's neat drawings caught our attention and his analogy between a beam of light entering a denser medium and a rank of soldiers entering obliquely on rough ground struck us as fortunate. If you have ever drilled soldiers you will know.—*The Editor.*

MOST people in using a magnifying glass, or in looking through a badly glazed window, will have noticed that the outlines of objects become not only blurred, but colored. They appear to be surrounded by a belt of light, red at one edge and violet at the other. When bright sunlight shines obliquely through a window it often casts similarly colored lights on the wall. This colored belt is, in a very imperfect form, what is called the spectrum.

Actually, sunlight is composed of seven different colors, all blending to form white. The perfect spectrum, secured by directing a beam of light through a series of lenses and prisms, shows seven parallel belts of red, orange, yellow, green, blue, indigo, and violet.

Securing a perfect spectrum is really a simple business, provided the formation of the spectrum is understood. It is due to the fact that the rays bend when passing from one medium into another of different density, as from air into glass. Its action in passing from air into glass may be compared to that of a platoon of soldiers marching obliquely across the borderline between a smooth grass field and a plowed area. The body moves in a straight line until it reaches the plowed ground, but as soon as the first man finds himself on more difficult ground his pace decreases. As a result the outside man gains a little before he too encounters the rough patch. Then his pace decreases in the same way. The result is that the front line has wheeled slightly around the first man to compensate for the fact that the outside man has moved a little farther, as shown in the diagram. As each line crosses into the plowed field, the same thing occurs, so that when half the troop is on the grass and the remainder on the plowed part, the long line of soldiers is bent toward the center of the field. When the troop passes from the plowed field back again to the grass, the line bends again, this time in the opposite direction, as walking becomes easier.

Precisely the same thing happens to a beam of light passing through a block of glass. It strikes the surface of the glass, and bends toward the normal—a line drawn at right angles to the surface of the glass at the point where the light enters. It passes through the glass in a straight line, and then comes out into the air, when it is bent again, this time away from the perpendicular line.



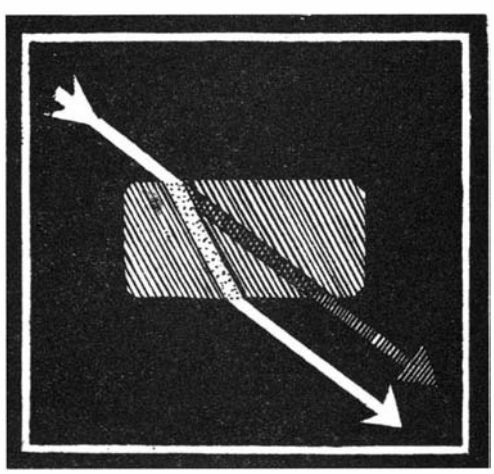
An exact analogy: When light enters a denser medium, like glass, at an angle it is bent or refracted; for the same reason a "column of squads" entering on rough ground at an angle is partly turned—because the velocity is less

In each case, it is bent through exactly the same angle, though of course in opposite directions. If the block of glass has parallel edges, the ray emerging therefore takes the same direction as the ray entering, but it has been pushed, as it were, to one side. The same would happen in the case of the soldiers.

The seven colors making up sunlight all have different wavelengths, red having the longest and violet the shortest. The result is that in passing through glass they are all bent in differing amounts, giving the colors of the rainbow. A crude analogy of this can be made if you think of the colors as seven men, the man on the extreme left being very powerful, and on the right, very weak, the intermediate men being arranged according to strength. If these men walk side by side across our old friend the plowed field, the weakest will find his strength taxed most by the sudden change from smooth grass to broken sod. He will turn toward the normal a little more than the next man, who is slightly stronger, while the strongest man will turn least. The result is that the seven spread out.

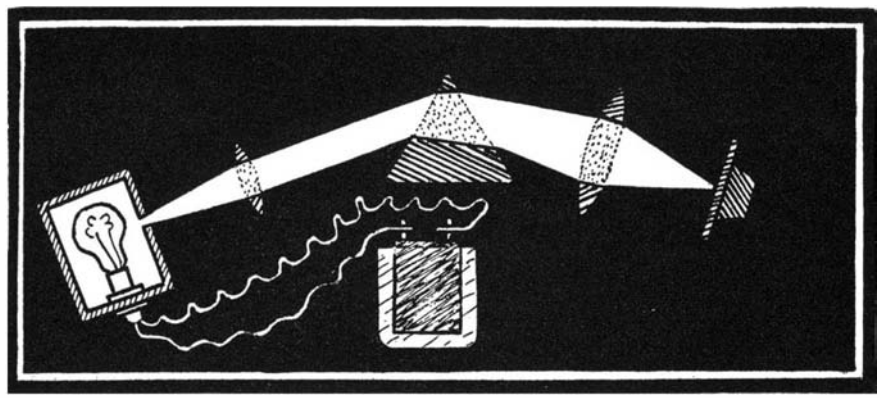
This is what happens to the seven colors in sunlight in passing through a plate of glass. If the walls of the glass are parallel, however, the divergence rectifies itself as the light emerges. The obvious thing to do, then, is to use a glass block with sides that are not parallel, a triangular glass known as a prism. By shining a light through such a glass we secure the same effect as we should by marching our soldiers across a triangular plowed field: the line is bent twice, once in going on it and again in leaving it, and both are in the same direction.

To secure a perfect spec-



When the beam of light leaves the glass its original direction is restored to it

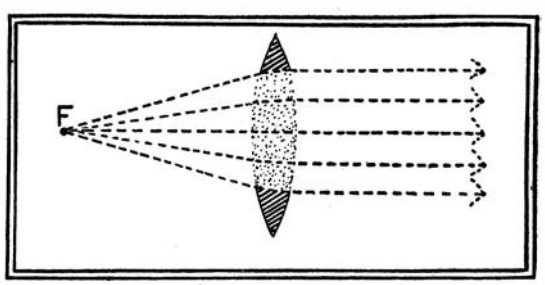
trum, a beam of light is directed through a prism. Sun rays are most suitable, as these are always practically parallel, but often it is inconvenient to use daylight, and a parallel beam must be produced artificially. An electric bulb is enclosed in a box (see diagram) with a narrow slit in it and the bright beam of light from the slit is made parallel by using a convex lens placed at a distance from the light equal to its focal length. (At the correct distance the circle of light transmitted through the lens will have about the same diameter as the lens itself.—Ed.)



For this simple experiment a common frosted bulb will work. Place lamp within an old cardboard box, cutting narrow (about 1/16 inch) slit opposite filament

THE parallel beam now passes through the prism, which splits it up into its seven parts, and if the light is allowed to fall on a white screen the seven colors will be seen, though very blurred and overlapping in places. In order to sharpen the outline, the light passes through the second lens which focuses it on the screen. The result is seven little belts of light, each one, as a matter of fact, a colored reproduction of the original slit of light. This is the true spectrum.

Such an arrangement of lenses with a prism is combined into the more refined instrument known as the spectroscope, which is also fitted with an eye-piece. By looking through this at any light the spectrum can clearly be seen.

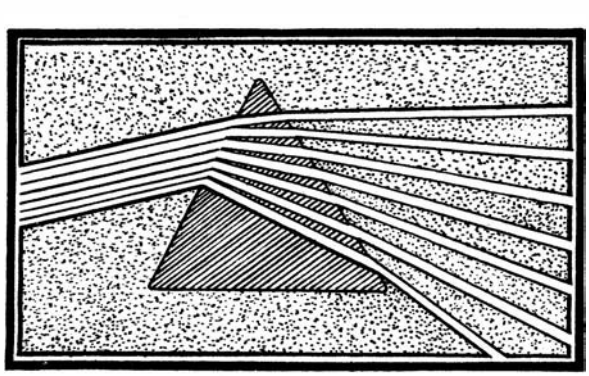


Showing how the rays which diverge from the slit may be made parallel by means of a lens

The importance of the instrument lies in the fact that all light is not composed of the same seven colors. If you look through the spectroscope at the flame of a burning piece of sulfur, you will see only one color, a solitary yellow streak. The fact that all burning elements have different spectra, either in the color or positions of the lights, has proved of great value to analysts. When chemical analysis fails, a spectrum of the substance will often reveal its constituents. In some cases the spectroscope reveals such tiny traces of a substance as to be otherwise indiscernible. In others, the instrument is used to study the constituents of a body unattainable for close inspection, for example, in the stars.

The constituents of the sun were discovered in this way. Indeed, the presence of helium on the sun was made known long before the gas was ever discovered on earth, for a spectrum of the sun showed a little belt of light which no known substance could produce.

The fact that ordinary light is made up of seven different colors is of considerable importance in photography. In making a camera great care must be taken to insure that the light shall not split up in passing through the lens, giving a blurred image. The simplest reliable lens is the achromatic as used in the cheap box cameras, while finer lenses, the anastigmats, are really a combination of two lenses. Red and orange light, with the longest waves are, photographically, as good as no light at all, while at the other end of the spectrum violet and blue are almost as potent photographically as white light. The result is that red and orange objects, photographed on an ordinary plate, look black on the finished print, as the amateur who has photographed red poppies will testify, while blue or violet objects, such as the sky, come out perfectly white. Color filters which weaken the strong colors more than the weaker ones, thus balancing the spectrum to suit the photographic plate or film, can be used to overcome this difficulty, but the use of orthochromatic and panchromatic plates or films makes this expedient quite unnecessary.

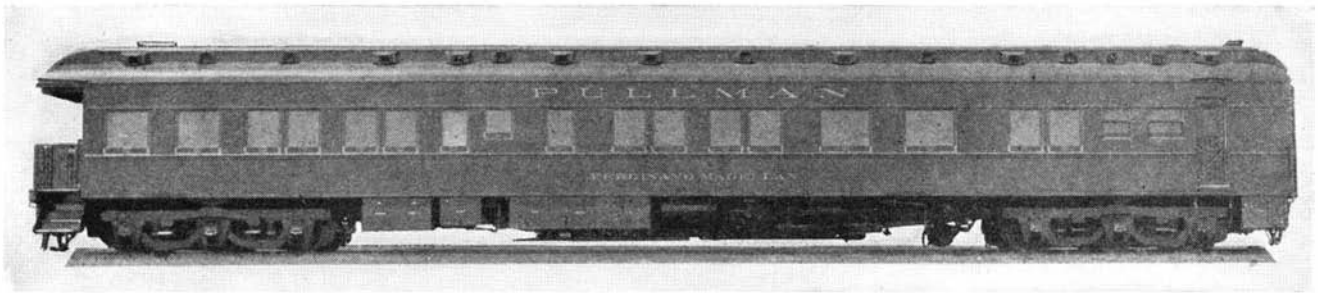


How a prism bends the various wavelengths of light: red (at top) the least, violet the most

THIS knowledge of the division of light into seven parts goes far toward solving a problem which has always puzzled scientists, the problem of color. Why is my note book blue and yours red? All color is reflected light. The only reason you can see this page at all is that the light from the sun, or some artificial imitation of it, is falling on to it and being reflected. Take away the light, and you can no longer see the page. The suggestion is that an object is blue or red or green because, for some reason, it absorbs all the other six colors and reflects only blue or red or green. Thus, strictly speaking, your car is not blue. It reflects particular waves of light, and the sensation thus given to the retina of your eye is called "blue." Why a particular object should absorb six colors and reflect the seventh has yet to be discovered.

●

To ascertain how easily the average amateur might expect to perform at home the little spectrum experiment which the author describes above, the editor tried it without special conditions or materials, except that a prism costing about one dollar was used. A common 40-watt lamp was slid into a square cardboard case removed from a dry cell (the nearest thing handy) and a slit about an inch long and 1/16 inch wide was cut in the box opposite the brightest part of the lamp. The lenses were simply two common reading glasses, a small one and a large one, but almost any lens should suffice. After a few minutes of "juggling" with the distances between the apparatus a neat spectrum was had. If the screen is moved farther to the right than the author indicates the spectral colors should be recombined, giving an image of the original slit in white light. The darker the room the better will be the experiment.



The private car which can be chartered combines the facilities of the private yacht. It includes bedrooms, dining room, kitchen, lounge and baggage compartment. All the cares of the mobile household are assumed by The Pullman Company

THE PRIVATE CAR, YACHT OF THE RAILS

By JUDSON C. WELLIVER

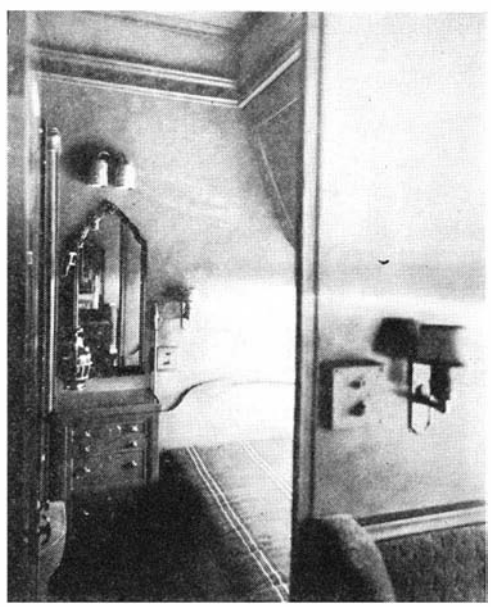
Assistant to the Vice President, The Pullman Company

IT is seen in the railroad yards, on the rear end of the express as she roars through the countryside, on the siding near a millionaire's hunting or fishing camp. Resplendent in shining paint and gleaming metal work it stands as a symbol of luxury on land—the private railroad car, the yacht of the rails.

During the last half century, approximately 350 private cars have been built, according to the best information available. About 225 of these are business cars, while the rest are properly private cars and those owned by The Pullman Company. Of the latter there are 23, all fully equipped with china, glass-ware, silver-ware, kitchen utensils, linen, and the rest. A car may be hired for two days or less for 175 dollars; three days to twenty-nine days inclusive, 75 dollars per day; thirty to eighty-nine days inclusive, 65 dollars per day; ninety days or more, 50 dollars per day. The charter fee includes the services of a cook and two attendants. The company also assumes the responsibility of stocking the car with food stuffs, charging the actual cost plus 25 percent. The rental is of course in addition to the regulation 25 railroad tickets for transportation, plus 10 percent surcharge; and the 25 tickets must be forthcoming whether the car carries only one passenger or the full number.

WHEN one leases a car from The Pullman Company, he has the assurance that a highly efficient organization will look after it and all its relations with the railroad while it is *en tour*, thus relieving him of many onerous responsibilities in this regard.

Nearly everybody who goes in for his own private car opens up the subject with the general notion that nobody else ever had an adequate conception of what that sort of vehicle ought to be; *he* is going to produce something different, something better, something calculated effectively to impress the world. A car meeting all the grandiose requirements would have to be a completely appointed hotel, including a moving picture palace, ball room, swimming pool, nine-hole golf course, state dining room, sun parlor, bath rooms, conservatory. But when he comes face to face with certain blueprinted mechanical and engineering limitations that are imposed on the car builder, the enthusiast finds that much of the striking originality in his scheme will have to be eliminated. Even a solid gold car with decorations of emeralds and diamonds couldn't be more than 10 feet, 1 inch wide by 14 feet and 11/16th of an inch high; beyond these dimensions it would be too big for the clearances at platforms, bridges, and tunnels.



Staterooms in private cars are appropriately furnished to give maximum comfort

Within the limitations of height, width, length, weight and strength, the designer of a private car still has considerable latitude for the exercise of his notions about arrangements, comfort, decorations, and so on. An honest-to-goodness fireplace, in which to burn real logs, has been built into a private car, with a fan arrangement which insures an excellent draft.

THE builders of private cars would be positively shocked to receive specifications that did not include a few strictly secret drawers and lockers. These are seemingly as necessary and inevitable in a private car as secret chambers and blind stairways in a medieval castle where a mystery murder is to be staged. People who specialize in astonishing electrical contraptions find that a private car affords particular opportunities for the exercise of their ingenuity. Some of them have put curious annunciator and phone systems inside the car; many provide telephone instruments with arrangements to plug in a connection with the local telephone system whenever the train is standing at a railroad station. Practically all recently built private cars have had aerials stretched along the roof, as equipment for radios.

In a general way, the purchaser of a private car has the privilege of dividing up his interior pretty much as he likes. Some cars have a long lounge room at the rear, which is also used as a dining room; others have a dining compartment in the middle of the car so that the rear lounge section will never have to be invaded by the dining arrangements. The amount of space that can be given to these public rooms depends, of course, on the number and size of sleeping rooms that are provided. There are usually three, four, or

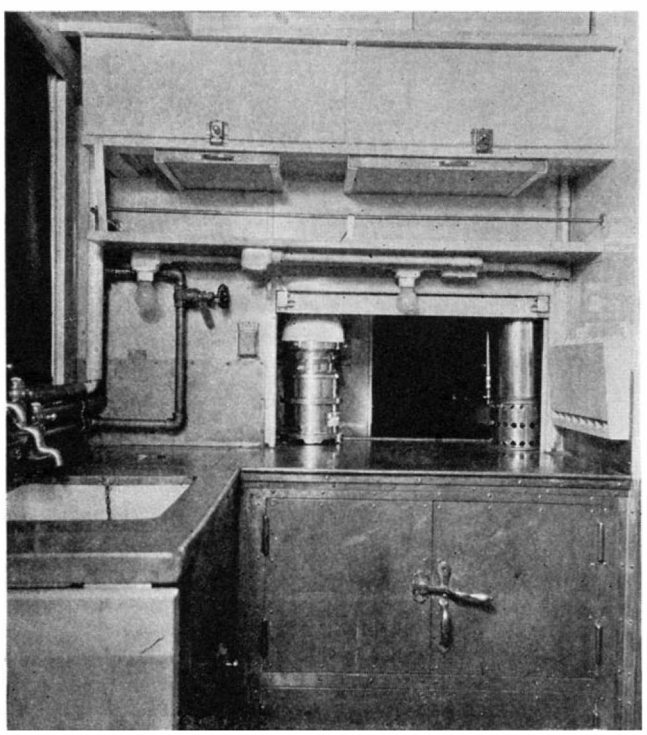
five state-rooms; probably the majority of cars have the four-room arrangement. The kitchen, pantry, refrigerator, and the storage spaces are patterned very much after that of a dining car but on a smaller scale as fewer people have to be served. All private cars are built with the passage-way along the side.

In the matter of interior finish and decoration there is a wide range for individual taste. Most of the cars are finished in either mahogany or walnut, the latter being at present favored; in some a finish in imitation of grained wood is applied. A trunk and baggage room is commonly included in the arrangement, and of course there must be a complete bathroom with tub as well as shower. Some private cars have two bathrooms. The railed-in observation platform at the rear may be open, semi-enclosed, or entirely enclosed in glass, its dimensions according to the wishes of the owner.

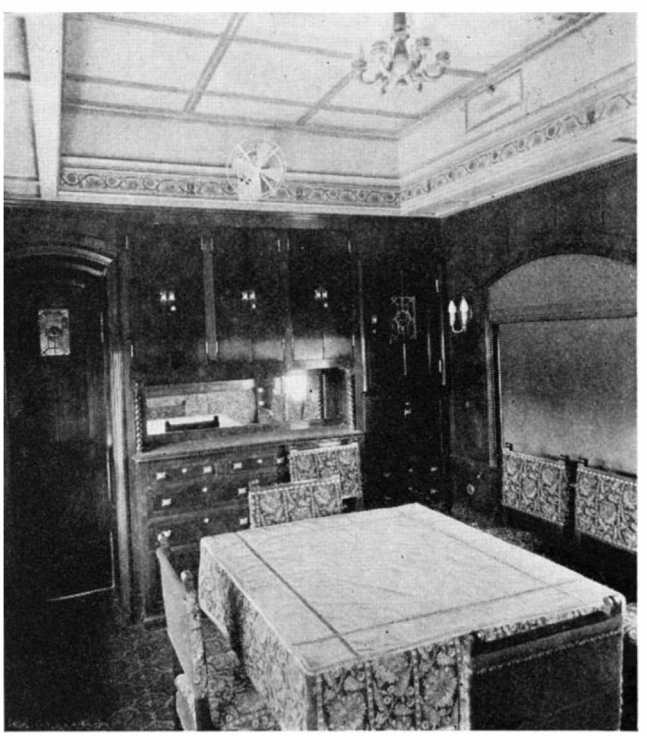
Next to an invitation for a yachting cruise, the tender of hospitality for a select private car tour is about the *beau jeste suprème* among the social amenities. The skipper of a private car can always be reasonably certain of good company whenever he wants to use it. The private car dinner party is always an attractive form of entertaining. For sight seeing, hunting, and the various modes of "roughing it" in complete ease and comfort, the private car offers unsurpassed privileges. Consequently, in times when people feel comfortable about the stock market and their balance at the bank, there is a pretty active demand for cars.

The family drawing room exists in private cars as well as on limited trains. Here children can have a happy time of it as a private car gives many chances for playing hide and seek

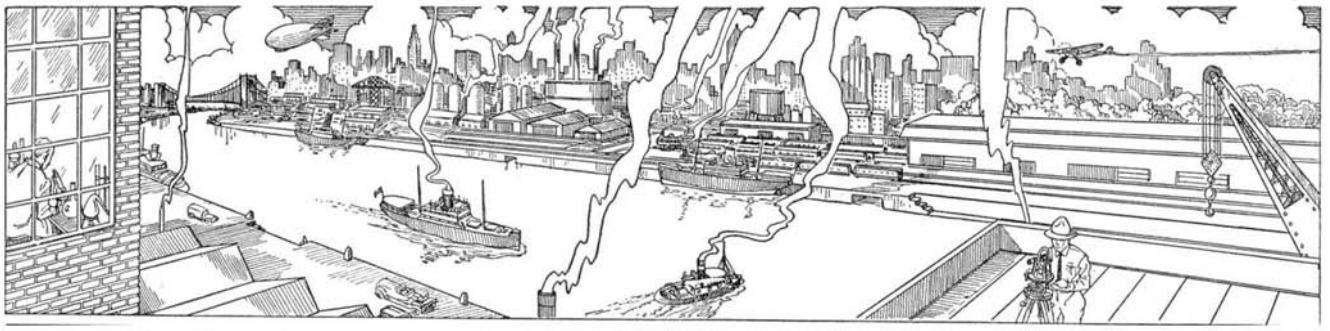
Private cars afford space for boudoirs for our ladies, who can find adequate facilities for bathing and making an elaborate toilet. The car can of course accommodate a ladies' maid



The Pullman Company furnishes a competent chef and does all the catering at cost plus. Here is the galley



The dining room appointments in the way of napery, silver, porcelains, and crystal equal those of a mansion



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

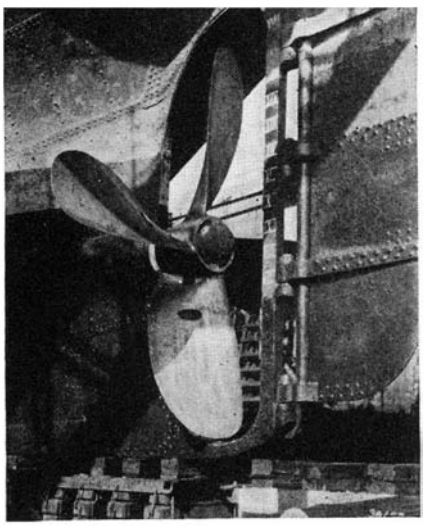
In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.

Lehigh University

Anti-Cavitation Marine Propeller

THE Canadian National freighter *Cornwallis* recently sailed from the British West Indies for Quebec and Montreal, completing the first of two voyages during which she is testing a novel propeller with which she was equipped a short time ago in Montreal. Aboard the freighter were two engineers, one connected with the Canadian National Steamships and the other with the Master Propeller Company



The new marine propeller showing water holes through the blades

of Canada, promoters and world controllers of the new propeller. Weather conditions so far have been so unfavorable that a precise estimation of its merits has not been made but the Canadian National's intention is to keep the propeller in operation for some time before pronouncing its verdict.

This new propeller differs from the standard type inasmuch as the Master propeller has channels cut in the blade in such a way as to eliminate, at least to a large extent, cavitation, which is defined as "a condition in water in which the space immediately behind the propeller is rendered more or less empty by the rapid cleavage of the water by the propeller." Elimination of cavitation will do away with much of the vibration which occurs in present day vessels.

The Master propeller has channels cast in each blade for a distance of about one third of the ridges from the boss. These channels extend from the face of the propeller blade to outlets situated on the face at the rear boss and are so arranged that the water outlet passes between the outer periphery of the boss and the external surfaces of the shaft tail end nut. A suitable opening is provided on the thrust side of the propeller blade. Water passing through these channels fills the space that would otherwise be partly empty due to cavitation, and thus the desired end is achieved.

Since a large proportion of the propeller thrust is waste energy due to cavitation, the idea embodied in the Master propeller is believed to minimize this loss and therefore give a much higher efficiency.

Chemistry Imitates Reptile Skins for Women's Shoes

NEW types of coverings for wooden shoe heels, which are proof against scuffs, have just been developed by the duPont Viscoloid Company. They are made of Pyralin and are produced in a number of opaque colors to match standard leather colors.

The new covering is used not only in plain effects but for obtaining other popular modes. Through this new process, shoe heels may be fashioned in all styles. Embossed designs can be readily applied, producing effects simulating kid or calfskin, and snake, lizard, or other reptile skins. This new method of covering heels permits the making of snakeskin and other leather effects to match the shoe exactly. In obtaining reptilian effects, that part of the leather most suitable for heel coverings is reproduced.—*A. E. B.*

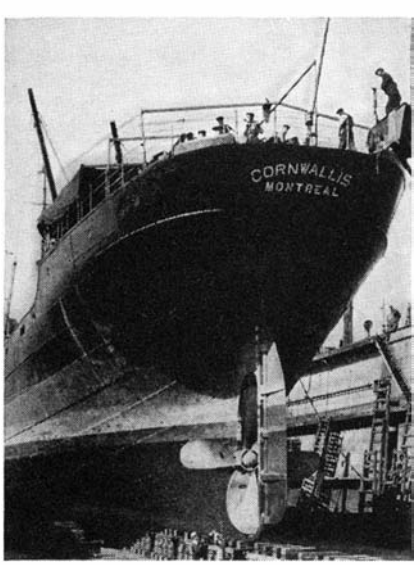
B. C. G.

A TOTAL of 250 parents will be behind the public prosecutor in a trial at Lübeck, Germany, in October, which gives promise of becoming famous. These are the parents of children who were killed by "B. C. G." something over a year ago. B. C. G. is the Calmette treatment for tuberculosis and is an attenuated or weakened strain of cultured tuberculosis germs which has been administered to thousands of children in Paris and elsewhere in cases where the parents were tubercular and where there was therefore a likelihood that the children would acquire the disease from them.

The whole affair has attracted much attention within the medical profession, not alone because of the tragedy at Lübeck but because the future of B. C. G. seemed at stake. The Pasteur Institute in Paris, of which Dr. Calmette is Director, claims to have sent to the Lübeck hospital a quantity of uncontaminated culture. It is claimed that the cultures were not correctly made in the German institution. The Pasteur Institute thus far seems to have exonerated itself before the medical profession, but the citizens of Lübeck are not inclined to take the incident lying down, and this is understandable whatever the outcome of the case before the court.—*A. G. I.*

Package Bees

THE industry of raising and selling bees began in California about 1913. Some 400 pounds were shipped in that year. The industry is based primarily on the existing climatic conditions. The spring and summer begins earlier in California. The plants from which bees gather nectar begin to blossom earlier than those of northern and middle-western states. In consequence beekeepers of California build up their



The Canadian National freighter which is testing the new propeller

colonies on the first nectar flow and thus have a surplus of bees to sell.

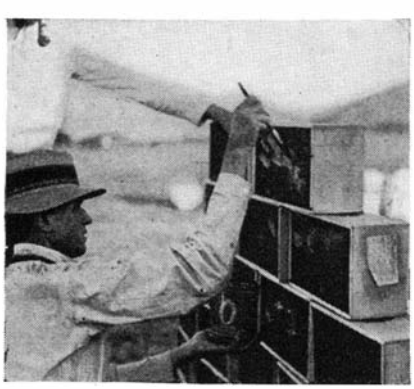
The bee colony is a model of balanced operation. The queen lays her eggs in proportion to the number of workers needed. During the honey flow the life of a worker bee is from six to ten weeks. Figuratively speaking, a bee is born with a definite ability to do work and when its energy is expended the bee dies. At the beginning of spring the queen's laying activity depends upon the abundance of nectar. As the flowers bloom and become plentiful the queen lays between 1500 and 3000 eggs a day, and within six weeks the bees are ready for work.

Young bees emerging from the cell are placed at work in the hive at such tasks as cleaning the hive, and assisting in storing the honey. As they become older they go out for honey. A continual stream of new workers is available as the older bees die off. Thus, if the flowers continue to blossom the honey is gathered by increasing numbers. In case of a dry spell or an interval between flowered crops, the queen lays fewer eggs in order to adjust the number of new bees to the amount of work to be done.

The early spring in California permits the building up of colonies to full strength. A full strength colony weighs 12 pounds or more as compared to an overwintered colony which weighs only three or four pounds. As a rule there is an interval between flower crops, and this permits the beekeeper to divide his colonies and sell the surplus bees.

The industry has increased very rapidly in the last few years. During the past six years the number of packages shipped increased 300 percent. The standardization of packages, development of proper food in transit, and the increased use of packages to strengthen overwintered colonies in other states have contributed to the development. At present California ships about 60 tons of bees a year valued at over 100,000 dollars. Some idea of the large number of individual bees this represents may be had when we consider there are 5000 bees per pound.

Bees are shipped in packages weighing seven pounds including food and bees. The net weight of the bees in this standard



Coating bee cages with syrup to feed the bees upon their arrival

package amounts to three pounds. The use of standard shipping cages which measure 16 by 9 by 6 inches has been adopted, and is in general use by California shippers.

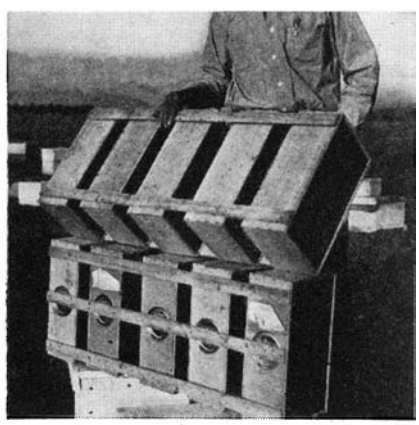
By the use of standard packages and the perfection of food for use in transit, the condition of arrival of bees has been greatly improved. Some years ago only 75 to 80 percent of the shipments arrived in usable condition. At present about 99.5 percent of the bees arrive in good condition.

The shipment of bees in packages is confined to California and such southern states as Alabama, Georgia, Florida, Louisiana, and Mississippi. These two areas, California and the southern states, produce and ship practically all of the bees in the United States that enter into commercial trade.

A recent market survey shows that the markets for California package bees are found in the Canadian Provinces of British Columbia, Alberta, and Saskatchewan, and 11 western states of the United States. Idaho and Utah are the largest consuming areas, with Washington, Montana, and Oregon next.

It is estimated that the total potential demand for California package bees is between three and four times the present shipments. The further development of such markets is dependent upon (1) the reduction of the delivered cost of bees, and (2) the return of honey prices to more normal levels.

The market survey for California package bees was undertaken jointly by F. H.



The cages of bees are crated together with ventilating spaces between

McElfresh, Jr., of the Bureau of Commerce, and F. E. Todd, formerly of the State Department of Agriculture.—*William R. Gage, Chief, Bureau of Commerce, State of California.*

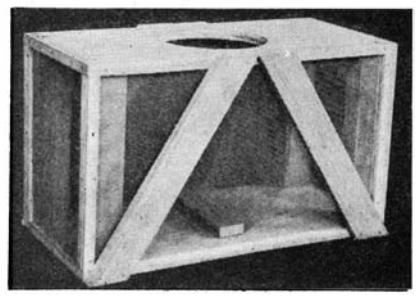
New Plastic from Sugar

UNDER the name "Sakaloid" a new plastic has been announced, the principal constituent of which is polymerized sugar. This desirable combination of a new product and a pure, inexpensive raw material with hitherto restricted use has been reported by a British engineer, Arthur F. Ford, who developed it in a search for a more satisfactory electrical insulating material eight years ago.

The process involves the use of any commercial sugar, molasses, or glucose, which is boiled to a thick syrup, filtered, and then treated with an aldehyde or similar polymerizing agent, with or without the presence of a catalyst, depending on the properties desired.

This product varies from a water-soluble gel to a hard, brilliant, water-white solid which can be molded by casting in open forms or by reducing to shreds and then molding under pressure, either hot or cold. Although experimental results have not yet been released for publication, it is said to have a light-permeability ranging through the ultra-violet, and does not discolor with age, since the transmitted light tends rather to bleach any color that may have been originally present. Pigmentation gives color stability, of course, but eliminates transparency.

By virtue of its mechanical properties, it



Empty bee shipping cage showing the opening for insertion of feed can

can be produced through a long range of flexibility, beginning with the softness and elasticity of crude rubber, and reaching a glassy hardness. Any condition throughout this range can be permanently produced. Machining of all kinds is easily performed, but it also can be supplied in solution for coatings. Furthermore, it can be extruded through spinnerets for artificial fiber. —*A. E. B.*

Nicotine's Enemy, the Sun

THE sun is an enemy of nicotine, it is shown by experiments reported to the American Chemical Society by Dr. K. R. Natarajan of Madras, India.

Five tobacco-curing processes were investigated in a series of tests made by Dr. Pusa, imperial agricultural chemist of India, who discovered that sun-curing reduces the nicotine content to a minimum.

"Dr. Pusa's recent experiments have yielded some very valuable information on the nicotine content of tobacco which will interest cigarette manufacturers and chemists the world over," declares Dr. Natarajan.

"Previous research had already shown that tobaccos cured on racks were better in color and more suitable for cigarette manufacture than ground-cured tobaccos, which were darker and contained a larger portion of volatile nicotine. Now we know that sun-curing will produce the finest results of all, there being an improvement in color and texture as well as an even greater reduction of nicotine."

Investigate New German Cartridge

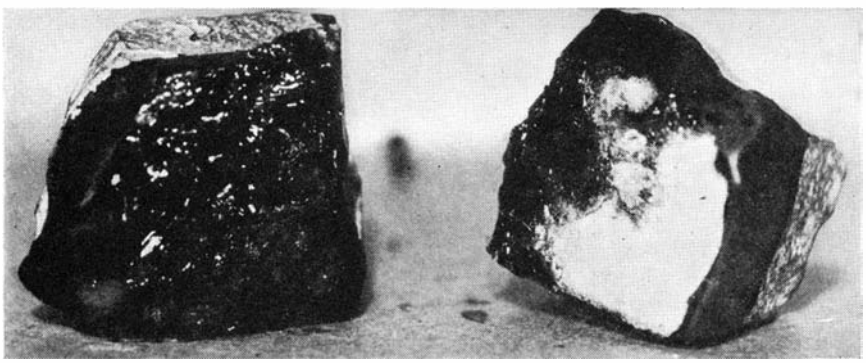
ORDNANCE officers of the United States Army are investigating the claims of H. Gerlich, German arms inventor, to sensational new velocities obtained with his newest cartridge, enabling a rifle-armed infantryman to put a tank out of action. Steps have been taken to obtain one of his rifles, which will be subjected to tests.

Herr Gerlich is well known as the developer of a line of successful high-velocity sporting rifles, which depend on small-calibered bullets moving at high speeds for their effects, rather than on slower, heavy, smashing missiles. Tests have been made in the past with a .28-caliber bullet at velocities of around 4000 feet a second; the present claim is to an increase in velocity

up to more than 5000 feet a second.

Ordnance officers expressed considerable curiosity and some doubts regarding the price at which such velocities can be obtained with present type rifles and without a radical change in type of propelling powder. Velocities of 5000 feet a second and more can be obtained, even with much larger projectiles than the ordinary small-arms bullet. The long-range gun that shelled Paris during the World War gave a muzzle velocity of more than 5000 feet a second to its eight-inch shells. This velocity, however, was purchased at a price: after about three dozen shots the lining of the gun, particularly near the powder chamber, was so eroded by the intense heat and pressure of the firing that the piece had to be re-lined.

With present types of steel for barrels and powder for propulsion, this war between powder and gun is bound to be intensified every time the velocity is raised, with inevitably shorter life for the gun. Until American ordnance men can see at least a fairly long life for a high-velocity small-arm such as Herr Gerlich's weapon, they apparently intend to remain on the fence.—*Science Service.*



To illustrate the tenacity of asphalt to oil-coated stone, the stone at left was oil-coated and the one at right uncoated. When they were pulled apart, the asphalt pulled away from the uncoated stone and left a bone-dry surface

Oil Coating of Stone in Pavements

THE discovery and demonstration in the road laboratories of Warren Brothers Company, Boston, Massachusetts, that asphalt will penetrate the mass of stone in a street pavement much more evenly when the stone has been previously oiled than when the stone is unoiled promises much for American highways in the creation of a durable yet inexpensive highway pavement. It also was found that the asphalt will adhere more strongly to the oiled stone and more completely cover oiled stone than unoiled stone, thus binding the stones of the pavement more strongly together.

In the laboratory tests, from 15 to 20 percent of the asphalt poured on a three-inch layer of unoiled stone in a test pan, at a rate of two gallons per yard, was found to escape to the bottom of the layer and to fall through the perforations in the bottom of the pan. Only 2 percent of the asphalt was found to reach the bottom of the pan when the stone had been previously oiled. It was found that the asphalt adhered much more strongly to the half of a stone which had been oiled than it did to the unoiled half.

It was also found that when asphalt is poured over a layer of stone that has not been oil-treated, the asphalt naturally covers the tops of the stones, and then drips over the edges as vertically as possible considering the position of the adjacent stones. The sides of the stones are only partially coated with asphalt or are not coated at all. Similar tests using oil-coated stone show that the asphalt follows the oil film, coating the sides of the stones as well as the tops. In all tests the same kind and quality of stone was used. In the tests with the stone that had not been coated with oil, a soft asphalt such as is commonly employed in asphalt macadam roads to secure greater penetration of the stone mass, was used. But the oil coated stone was poured with a hard asphalt, with greater cementing strength. This was made possible by the oil film on the stone.

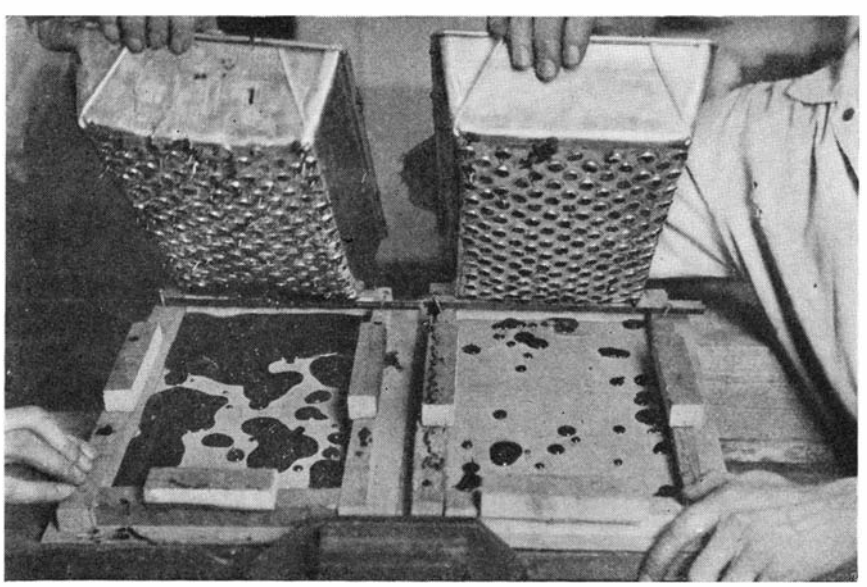
The explanation of the results of these experiments lies in the fact that the oil offsets the effect of the dust or moisture present on the surface of the stone; the asphalt cannot obtain a good "grip" or adherence to stone which is moist, or dust coated.

This apparently simple, though valuable discovery, means that the cementing strength of the asphalt in street work is thereby greatly increased. The asphalt adheres strongly and completely to the stone and consequently effects a strong binder, stone to stone. In cold and wet weather, raveling may occur in asphalt macadam, where stones are unoiled, due to insufficient adherence of the asphalt to the stone and consequent breakage of the stone bond. If fissures develop in the surface and water penetrates into the street pavement, the raveling may develop into a hole. In warm weather asphalt macadam may show a tendency toward "bleeding" caused by the movement of the stones under traffic, squeezing pocketed asphalt to the surface. This results from the asphalt's uneven distribution. Waving of the surface of the pavement is due to lack of stability of structure, largely because of the soft asphalt used.

In the new process which has already been applied in a number of states, the oil coating is reported to prevent raveling and excessive movement of the stones, and to lessen "bleeding." Briefly, this construction consists in providing a layer of oil coated stone which is compacted sufficiently to prevent serious rutting by the trucks used to convey materials to the work and then coated in place with a bituminous cementing medium in the usual manner. After the asphalt has been applied to the first layer of stone, a very thin layer of oil-coated smaller stone is spread and compacted in place, thus keying the larger stone firmly in position. This layer of smaller stone is then coated in place with asphalt. Finally the top is covered with a thin layer of oil-coated small stone.

New Microporous Rubber Makes Unique Absorbent

H. BECKMAN, of the Technische Hochschule, Hanover, Germany, discussed a new product—microporous rubber—at a recent meeting of the Deutsche Kautschukgesellschaft, in Eisenach. With respect to hardness, microporous rubber is similar to paper pulp, or perhaps soft chamois. It is characterized by extreme fineness in physical structure, and is penetrated by innumerable pores, which have an average diameter of about 0.0004 of a millimeter. The material can absorb moisture equivalent to about 60 percent of its vol-



The test pan at the left was filled with uncoated stone and the one at the right with oil-coated stone. When asphalt was poured over the stone in both pans, it clung to the coated stone but much of it leaked through the other pan

ume. Under the name "Mipor-Scheider," it finds application as diaphragms in the accumulator industry.

In the chemical industry Mipor-rubber is used as a covering for large filter presses. Because of its resistance to oil, this new material is useful as a packing to supply the bearings of ships and machinery uniformly with lubricant. Sheets of microporous rubber are suitable for blotters, and can be used for sanitary purposes, since they may be sterilized by boiling. Inasmuch as it can be dyed easily, microporous rubber may be used for veneering and wall covering. In the form of hard rubber it may be pulverized and used in air and water filters, and so on.—*A. E. B.*

Temperament and Health May Be Linked

CERTAIN physical make-ups are associated with certain types of temperament, it is indicated by a report made recently to the Association of Consulting Psychologists by Drs. L. P. Herrington and W. R. Miles.

Of a group of 550 Stanford University men, it was found that those classed by psychologists as introverts, or having a self-centered personality, had less athletic ability, had required more medical service, and had undergone more major surgical operations.

The investigation was made by Dr. Herrington at Stanford, under the direction of Dr. Miles, who was then at Stanford, but is now spending his sabbatical leave at Yale's Institution of Human Relations.—*Science Service.*

Stainless Steel in the Navy

THE gasoline storage tanks for the Navy's new airplane carrier, largest vessel of its type in the world, and for the scout cruisers *Portland* and *Indianapolis*, as well as for four cruisers now being built in government Navy yards, are to be made of Allegheny metal, the non-corroding chromium-nickel-steel alloy.

It is the practice to pump sea water into these tanks as the gasoline is drawn off, in order to preserve the trim of the ship. The gasoline floats to the top of the water and is readily drawn off as needed. A metal that will withstand the action of the salt water is required, and the Navy department specified the chromium-nickel-steel alloy sometimes known as "18 and 8."

The new airplane carrier, which will surpass in size the *Saratoga* and *Lexington*, at present the largest vessels of this class, is being built by the Newport News Shipbuilding Co. The *Portland*, now known as *Scout Cruiser 33*, is being built by the Bethlehem Shipbuilding Corporation and *Scout Cruiser 35*, which will be named the *Indianapolis*, by the New York Shipbuilding Co. Contracts for the gasoline storage tanks for these ships, as well as for the four cruisers being built in government yards, were awarded to the Blaw Knox Company of Pittsburgh, Pennsylvania, which is furnishing Allegheny metal, the product of the Allegheny Steel Company of Brackenridge, Pennsylvania, on all seven jobs. The airplane carrier will have 12 of these tanks and the cruisers two tanks each. The 20 tanks will require about 175,000 pounds of the alloy.

A Motor Boat Built on Airplane Principles

THE modern high-speed motor boat, traveling at top speed resembles an airplane far more than a boat, because it depends on the dynamic reaction of the water for its support, rather than on water displacement.

Thomas E. Lake has gone a step farther. He has frankly accepted the application of airplane principles to water craft and has successfully constructed a hydroplane-float boat. The body of the boat is truly a seaplane fuselage, housing the occupant, fuel tank, and so on, but having no contact with the water. A powerful outboard motor is placed ahead of the operator. Three hydroplane floats are provided. Each side float is carried at the end of a short "wing." These two floats can, by suitable mechanism, be tilted about the longitudinal axis of the craft. Their sideways tilt gives more "lift" on one side and less "lift" on the other. Therefore they act just like the ailerons of a flying machine and can "bank" the craft. The float at the rear can be turned and therefore acts as a rudder.

The Lake hydroplane with a boat distinct from its three supporting floats. The side floats can be turned to "bank" the craft on sharp turns

While tests must be awaited before a definite conclusion as to the utility of the new craft can be made, it does seem as though Mr. Lake has possibly achieved something really worthwhile.

Since his flotation system is divorced from the passenger body, he can design the flotation system for its purpose, and the body for its purpose, thus achieving maximum efficiency with both. The body can be aerodynamically streamlined (which is important for racing purposes), and the floats can be designed for most effective lift with little water drag.

Since the two side floats are so far apart and since the rear float is so far behind, there will be provided a maximum stability both laterally and longitudinally. Here is a real safeguard against capsizing.

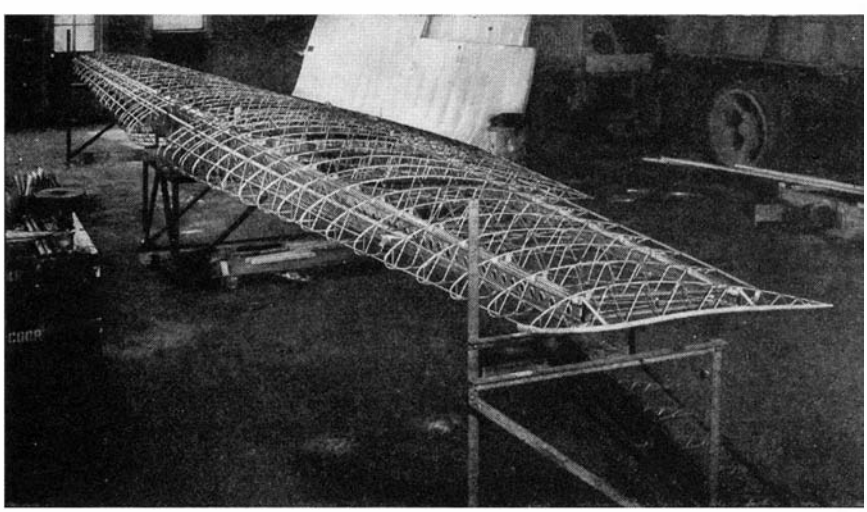
To make a fast turn it is necessary to "bank," but here the bank would be controllable at the will of the pilot.—*A. K.*

Dural or Stainless Steel?

FOR some time it was thought that duralumin, the high strength aluminum alloy, would replace wood on the majority of airplanes, but now stainless steel is proving to be a strong competitor to dural in metallizing the airplane. Dural has a tensile strength of 55,000 pounds per square inch and weighs about one third as much as steel. But the new stainless steels, such as Allegheny metal, which is an alloy of steel, chromium, and nickel, have a tensile strength of 190,000 pounds per square inch. Therefore stainless steel is stronger, weight for weight, than dural.

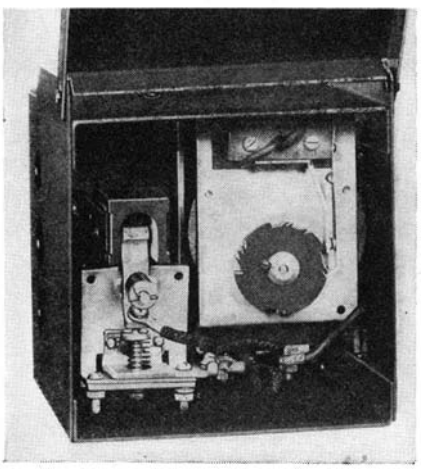
Another great advantage of Allegheny steel is that it is non-corrosive and, therefore, requires no coating of any kind. A third advantage claimed is that the steel receives its high tensile strength from cold working, not from heat treatment, and therefore it can be obtained from the mill with the required physical strength and does not require heat treatment after fabrication into spars or other airplane parts.

We illustrate a cantilever monoplane wing built with real success by Fleetwings. Every part of this wing is of chrome-nickel



One answer to the question discussed in the accompanying column: a Fleetwings cantilever wing built of the strong, non-corrosive Allegheny metal. The structure is very strong despite its lace-like delicacy and apparent fragility

steel, and fabrication is by a process of spot welding, for which less skill is required and more regularity is claimed than for oxy-acetylene welding. The metal is supplied in the form of thin strip, 8 to 12 thousandths of an inch in thickness, which is drawn into tubing or simple U channels. Thinner gages of metal are used at the tip of the wing than at its center where loads are heavier. The spars are built of two channels, one top and one bottom, with two side webs of strip, punched with holes to lower the weight. The photograph indicates the almost lacelike delicacy of appearance of this type of construction, which is nevertheless extremely robust because of the inherent strength of the material employed.—*A. K.*



Electric code beacon flasher which identifies an airport by flashes sent in the International Morse Code

Airport Code Beacon Flasher

THE Department of Commerce requires that definite code signals must be flashed by the auxiliary beacons at airports. Where more than one International Morse Code character is assigned as the symbol for the airport, the symbol can not be flashed by a cam on the rotating beacon if the duration of the complete cycle of flashes is more than 10 seconds.

In a new type of flasher developed by the General Electric Company there is embodied a cam which revolves once a minute, allowing more than sufficient time to flash any combination of two or three characters. Accurate timing of the code character cycles is assured by a Telechron motor, similar to that employed in Telechron clocks. In operation, the cam shown in the photograph actuates silver contacts which close the circuit in a contactor, and this, in turn, closes the circuit to the two lamps in the auxiliary beacon. The whole apparatus is enclosed in a compact steel cabinet, six inches square.—*A. K.*

A Portable Mooring Mast

IF airships are to navigate as freely and as unrestrictedly as airplanes, they must be freed from the restrictions of mooring masts, large handling crews, and so on. Realizing this fact, the Goodyear-Zeppelin Corporation has developed what may be termed a portable mooring mast, which is illustrated in our photograph.

The mobile mast or "traveling harbor," as it has been picturesquely named, consists of a tripod adjustable to a height of 10 to 12 feet and is mounted on top of a ground-crew bus. At the top of the mast is a groove into which a locking device, built into a 16-inch disk in the forward part of the ship, is slipped and fastened. The mast has been given thorough tests and the mooring operation has been effected several times in less than a minute. A Goodyear airship attached to this mast can outride a 35- to 40-mile wind in safety, as the ship can pivot around the bus in response to the buffeting of the wind.

When not in use the mast is folded and clamped down to the roof of the bus, the out-riggers being detached and packed inside the bus in the rear. The bus provides substantial anchorage for mooring the ship, as without a load it weighs more than three tons and when carrying the usual cargo of bags of sand and an outfit of tools and the crews' baggage the total weight is approximately five tons.—*A. K.*

An Invention Needed to Beat Fog

IN a paper presented before the American Society of Mechanical Engineers, Dr. S. Herbert Anderson disclosed the results of some extremely valuable experiments on fog penetration, in which he used a large chamber filled with artificially created fog.

Fog particles are minute particles of water of from one to ten microns in diameter, a micron being about 1/25,000th of an inch. The fog droplets non-selectively reflect and refract the rays of light. A haze will let the red rays through somewhat better than other rays; that is why the sun appears to be so red through a haze. A fog, composed of larger particles than haze, acts non-selectively, nothing gets through, and impenetrability results.

When we consider how thoroughly fog will blanket the sun or a powerful beacon, it is surprising how little actual moisture there is in a fog. Were all the water from a stratum of fog a mile thick to be collected into a layer it would only be 1/25th of an inch thick, yet this finely distributed fog can prove to be a great hazard to flying.

A short while ago it was thought that red or orange rays would penetrate fog better than other components of the spectrum. The experiments of Dr. Anderson and other scientists have shown conclusively, however, that the shorter wavelengths of the spectrum (violet), the medium wavelengths (blue, green, and yellow), and the longer waves (red) all fare about alike. Moreover the red rays have to be more intense to produce sight perception. Therefore the use of red or orange beacons is based on a fallacy.

Dr. Anderson also made this striking discovery: The very short ultra-violet rays, and the very long infra-red rays, both invisible to the eye, both penetrated the fog better than the visible components of the spectrum. More of the infra-red rays than of the visible rays are produced by an ordinary light source.

Why not therefore devise an instrument which will be sensitive to the infra-red rays and thus extend the utility of the airway beacon many times?

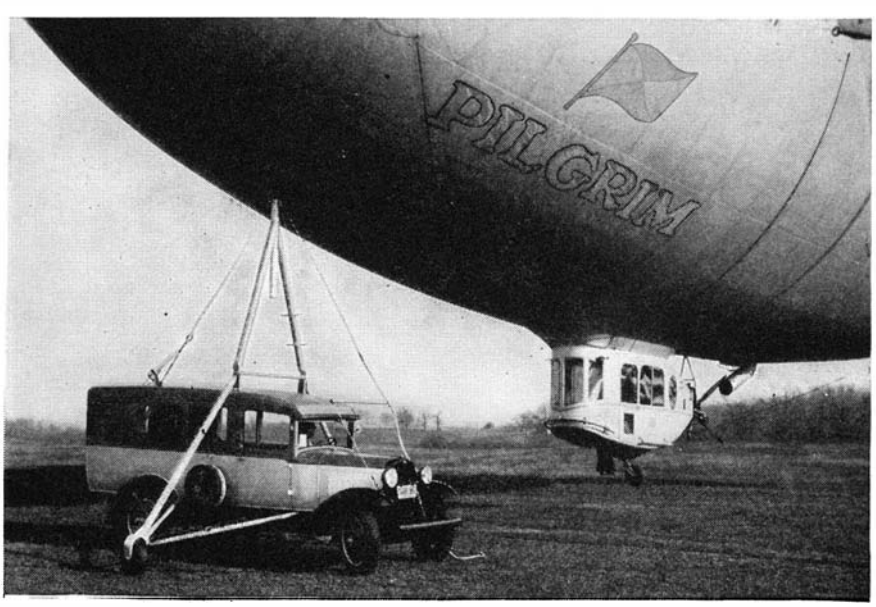
An infra-red beacon has certain definite advantages for localizing purposes. The same methods of projection can be used as for light beacons and flood-lights. Infra-red beams are not affected by local electrical disturbances. The power source for infra-red beams consists of standard electrical equipment.

At present only very sensitive laboratory methods of picking up infra-red radiation are available, far too delicate for aircraft use.

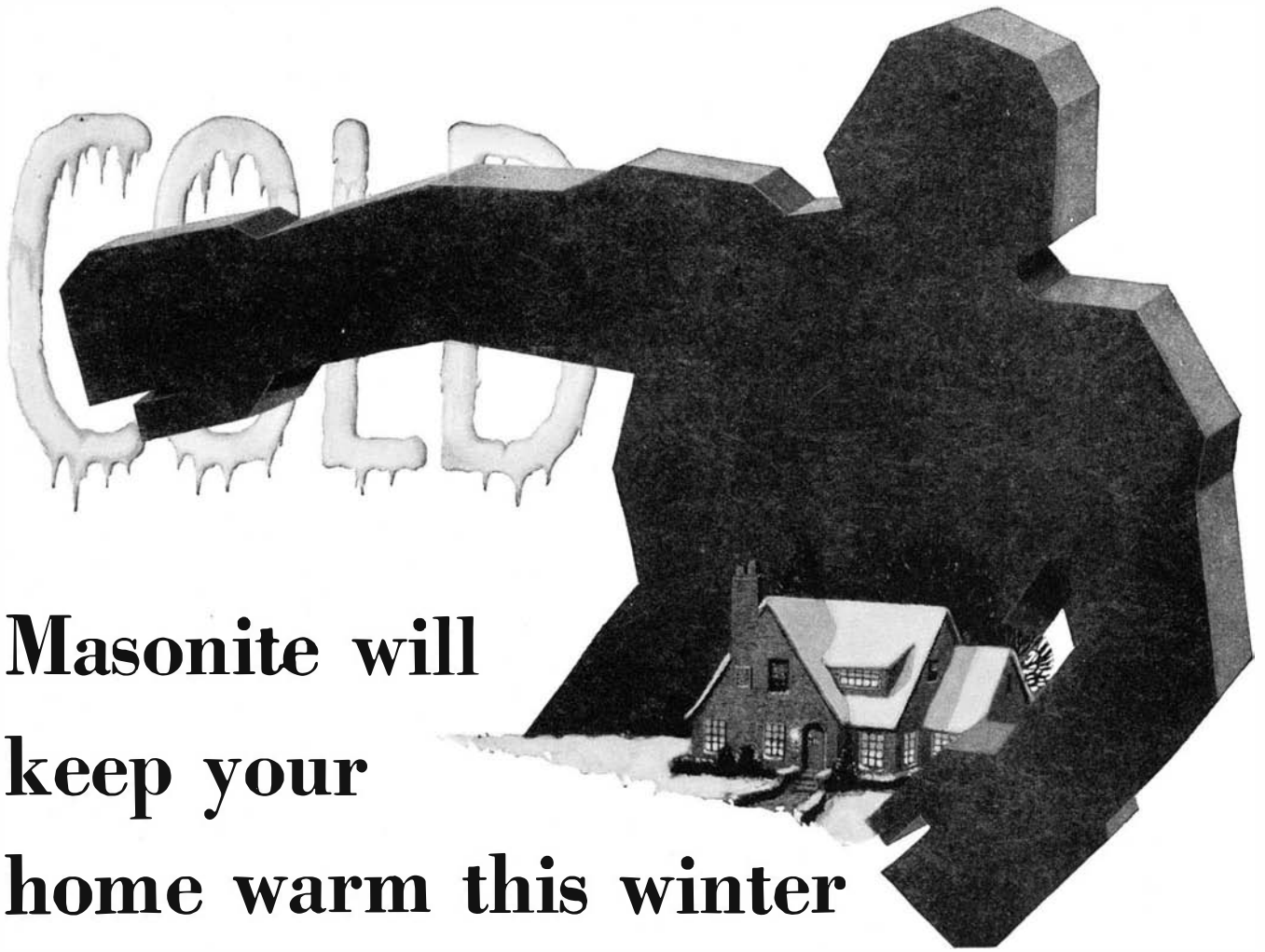
Here is a splendid opportunity for some one to devise practical instruments for flying use!—*A. K.*

A New Non-Corrodible Alloy

BATTERIUM metal, a new copper-aluminum-nickel alloy, introduced by Batterium Metal and Vislock, Ltd., of Market Harborough, England, is claimed to be an ideal acid-resisting metal for the construction of stills, fractionating columns, solvent extraction and solvent recovery plants, and also for chemical plant use generally. It is suitable for use in contact with organic acids, alkalies, superheated steam, and bleaching and dyeing liquids. Particulars of tests on the action of various



The "traveling harbor," or portable mooring mast for small dirigibles



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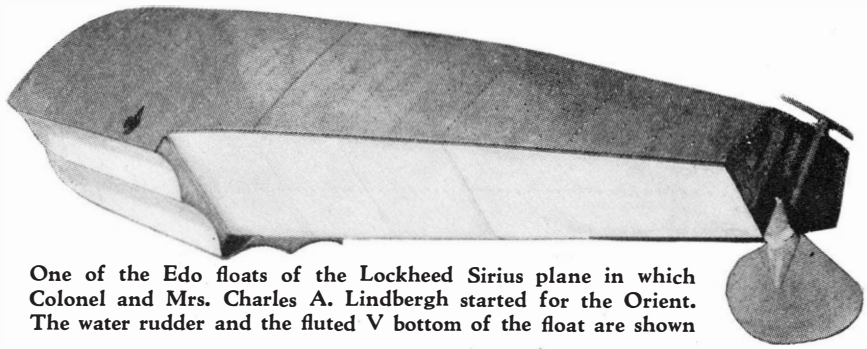
corrosive liquids on this metal are contained in a leaflet which has been issued by the makers. These tests were carried out at the Royal Technical College, Salford, together with Monel metal, Staybrite steel, and electrolytic copper as materials providing a standard of comparison.—*A. E. B.*

Lindbergh's Latest Equipment

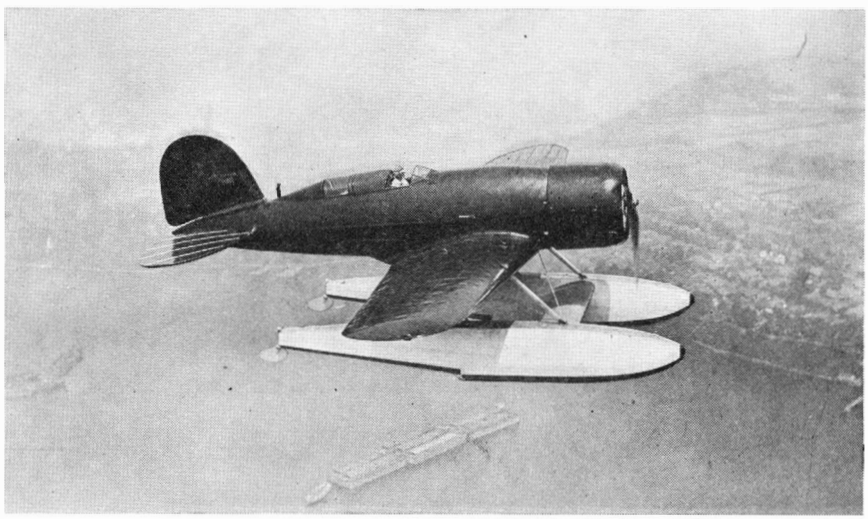
THE opinion is often expressed that Colonel Lindbergh is tempting fate by his many bold flights, sometimes in uncharted territory, and that an accident to him and Mrs. Lindbergh would be a disaster for American aviation in particular and for the country in general. It will be found, however, that Colonel Lindbergh, while bold, exercises the greatest care in all his plans.

At the time of writing, Colonel and Mrs. Lindbergh have left on their latest goodwill flight—this time to the Orient. As usual, the Colonel's preparations were excellent and the equipment used merits special study.

For his plane he has selected the speedy Lockheed Sirius, equipped with the latest type of floats. The Sirius is a low-wing monoplane, painted reddish orange and black, and powered with a Wright Cyclone engine, which, with a special supercharger, develops 680 horsepower at 2100 revolutions per minute. The wing span is 42 feet 10 inches; overall height from the bottom of the pontoon step to the top of the cowling is 11 feet 4 inches; and the overall length is 29 feet 11 inches. The design load with 400 gallons of gasoline is 6400 pounds. With a gross load of 6800 pounds—that is 400 pounds over the design load—Colonel Lindbergh took the plane off the water in only 41 seconds. The top speed of the plane is said to be about 170 miles per hour, though it is probable that the careful pilot will only cruise at 125 miles per hour, sparing his engine as far as possible for its long task. At this speed, the gasoline consumption will be 32 gallons an hour, so the flying range will be 1500 miles, long enough for every part of the trip with reserve gasoline to spare.



One of the Edo floats of the Lockheed Sirius plane in which Colonel and Mrs. Charles A. Lindbergh started for the Orient. The water rudder and the fluted V bottom of the float are shown

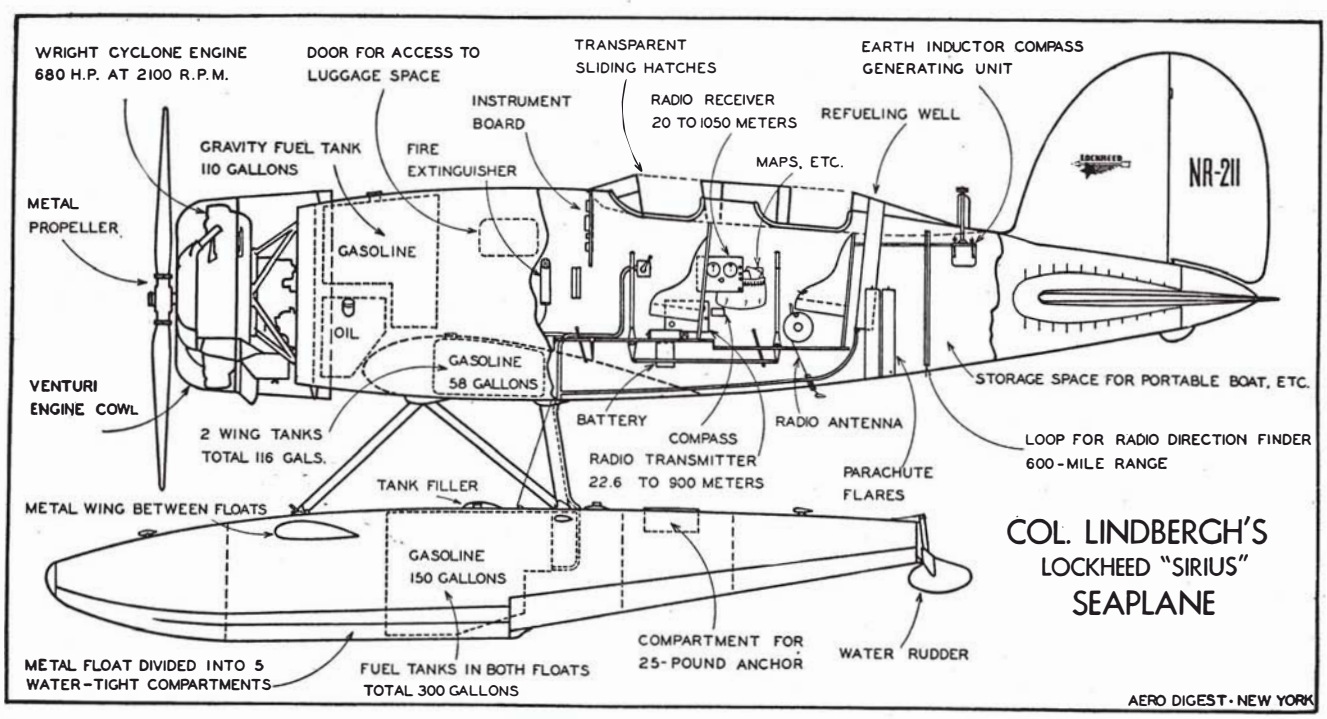


At the beginning of the flight: Colonel Lindbergh on his way to Maine to see his son before the flight across Canada. *Below:* Equipment of the fast plane

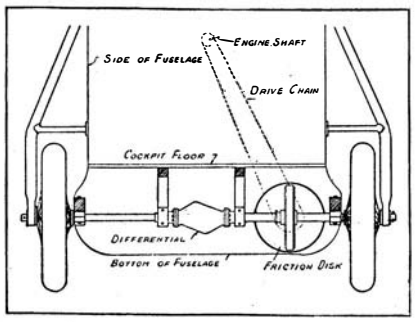
Five gasoline tanks are carried. The gravity feed tank behind the engine has a capacity of 110 gallons. Two wing tanks can carry 58 gallons each. In each of the two floats there is provision for 150 gallons. Behind the rear cockpit there is a special refueling well, placed high above the water, an obvious precaution for refueling under difficulties.

Colonel and Mrs. Lindbergh are both licensed radio operators, and their craft has been provided with both receiving and sending sets. The radio antenna can be unwound from a reel placed under the rear seat. The cockpits can be protected against weather by the use of sliding transparent covers over the cockpits. The equipment also includes a full set of instruments, an earth inductor compass, and parachute flares. At the rear of the fuselage there is carried a collapsible boat, with an emergency wireless set, and compressed rations.

Not the least interesting part of the seaplane is in the set of new Edo floats, claimed to have the least aerodynamic re-



sistance of any float for a given displacement. Their form approaches closely the ideal aerodynamic form, that of an airship. Another interesting feature of the Edo float is the sharp V bottom, the sides of which are at an angle of 30 degrees, whereas the usual commercial float has an angle of only 15 degrees. The sharp V naturally lessens the shock of a water landing, but when the



Possible mechanism of the plane of the future which will travel to the landing field under its own power

V gets too sharp, there is difficulty in planing on the step just before take-off, and the take-off period becomes both longer and more difficult. In the new Edo float the bottom is fluted, presenting four distinct surfaces. It is this fluting which allows the sharp V to be used without impairing the planing qualities.

The automatic water rudders are attached to the transom of the float with a horizontal as well as a vertical hinge and connected to the main air rudder controls through the use of springs. They lie well below the bottom of the floats when in the air or when taxying on the water at speeds low enough to require their use, but automatically rise out of the water when higher speeds are reached. This feature of automatic reefing provides a safeguard against over-control at landing or take-off speeds.

Another valuable feature of the flotation system is that the main cross-bracing member between the floats is itself of airfoil form, and therefore contributes to the lift —thus more than compensating for its air drag.—*A. K.*

Has the Airplane a Future?

WRITING in *Western Flying*, J. W. Miller states that aviation has a future provided that we remember the old pioneer spirit of the country and use courage and imagination. To make flying truly accessible to the public, he advocates certain very definite steps. Highway appropriations should be increased by 1 percent, and intermediate landing fields at 15-mile intervals should be built along all primary highways. These intermediate fields would need only five to eight acres and cost some 9000 dollars each.

The airplane should be designed to be really useful to the private owner. Lower landing speeds should be provided. It should be possible to fold the wings with a very simple mechanism. The tail skid should be replaced with a steerable tail wheel and means should be provided for disconnecting power from the propeller and applying it to the wheels. We would then have a vehicle that could reach the flying field from a garage under its own power.

Granted this question of emergency fields settled and a plane designed for popular use, Mr. Miller foresees a number of important sociological effects in the life of the nation.

Decentralization of our homes would follow very quickly. Delivery zones of department stores would be greatly extended. Location of factories and warehouses would be outside of cities.

Mr. Miller is imaginative but certainly plausible.—*A. K.*

Statistics of Flying Safety

THE Actuarial Society of America, a reliable authority on safety statistics, has recently published a comprehensive report on flying safety. The report states that for the year 1929 the flying fatality rate was approximately 1 death per 3,000,000 passenger miles. In 1930 there was a death rate among airway passengers of 1 death in 17,396 passengers carried, the average length of a trip being about 250 miles. This develops into a rate of 1 death for each 4,300,000 passenger miles, a decided improvement over 1929. The later half of 1930 showed still better figures, and for the year ending March 31, 1931 the rate was 1 death in 9,000,000 passenger miles.

Husky police dogs are vigilant guardians of a museum's treasures

It is interesting to compare this last rate with the death rate for other methods of transportation: For railways the rate is 1 death per 40,000,000 passenger miles; for street railways, 1 death in 455,000,000 passenger miles; and for automobiles, 1 death in 20,840,000 passenger miles.

It would appear that passenger flying on scheduled routes is now about half as safe as travel by automobiles. This is quite encouraging, particularly as airplane travel is constantly improving in safety.

The Department of Commerce analyzes the reasons for increased flying safety in the following terms:

"The close adherence by operators to the department's regulations prohibiting the flying of scheduled interstate air-transport planes carrying passengers for hire, below an altitude of 500 feet; the excellent quality of American designed and built aircraft and engines, coupled with their conservative and skilful operation and maintenance by pilots and mechanics with years of experience behind them; the assistance rendered by the Department through its 15,000 miles of lighted airways, 354 intermediate landing fields, radio-beacon service, radio weather broadcasts to planes in flight, and an extensive system of collecting and disseminating aeronautical weather information through automatic telegraph-typewriter circuits."

All this goes to explain the increasing popularity of airway travel by the American public.—*A. K.*

Museum Watch Dogs

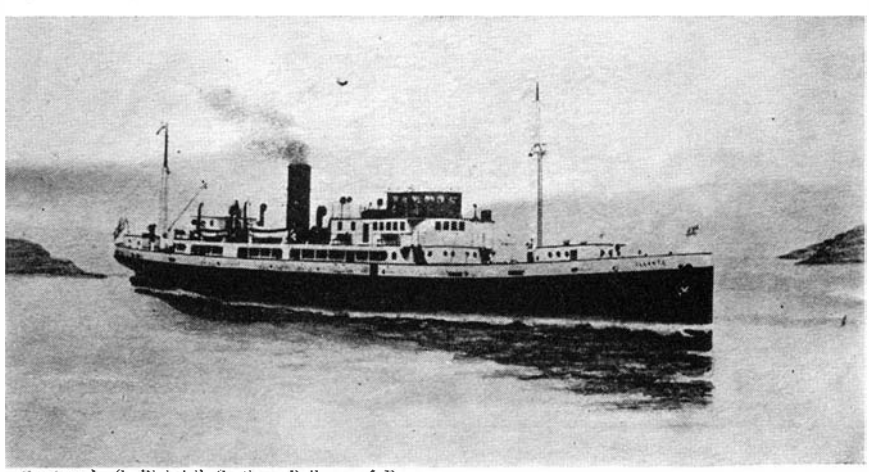
A NEW and successful method of protecting its treasures is employed by the Museum of Fine Arts in Boston. In addition to the regular watchmen, two German police dogs are now being used.

In this Museum there are two shifts of watchmen and a foreman. The first shift is on duty from 4 P.M. until midnight, the second being on from midnight until 8 in the morning. The foreman who makes the entire round of the Museum during each period, is accompanied by one of the police dogs which, because of his animal instincts, would be able to sense the presence of thieves much quicker than a human being.

One of the dogs serves with the first watch and the other dog with the second watch, but when the first dog is "off duty" he remains in the central office with the man on guard there. The tour of the Museum for each dog measures nine miles and in spite of the strenuous nature of their work they are on duty seven days a week throughout the year.

Steamer Hauled Up a Mountain

"IT took nine trains to pull the parts of the ship, *Ollanta*, up the Andes Mountains to Lake Titicaca," said L. S. Blaisdell, General Manager of the Southern Railways of Peru, to a representative of the Pan-American Union.



Courtesy L. S. Blaisdell, Southern Railways of Peru

The steamer built for service on Lake Titicaca, 12,500 feet above sea level

"Following our company's policy of endeavoring to give the utmost value in service, it was found desirable to augment our fleet of steamers on Lake Titicaca. The new vessel, the *Ollanta*, was constructed at Hull, England, and shipped aboard the S. S. *La Paz* to Mollendo on the coast of Peru. Discharge of cargo by lighter took place there and then the first of nine trains began hauling the *Ollanta's* parts up the steep grades of the Andes 300 miles to the shore of Lake Titicaca. The railroad crosses the crest of the mountains at an altitude of 14,688 feet and then the descent is made to the shore of the lake, which is 12,500 feet above sea level.

"The vessel is now in course of reconstruction on the company's slipway at Puno, which is the only modern type slipway in South America. The *Ollanta*—which means 'the great Inca general'—is 265 feet long and will have accommodations for 66 first-class passengers. There will also be much cargo space. She will be an oil-burner."

The first steamer to navigate Lake Titicaca, the *Yavari*, was transported piece by piece by mule-power from the Pacific coast in 1863, before the construction of the railroad. That was a stupendous task and required many months. Other small steamers were brought from England from time to time so that today passengers and freight are quickly transported over this great body of water.

With the completion of the *Ollanta* the last word in modern steamer service will be achieved. "In this connection," says Manager Blaisdell, "the vessel will satisfy the taste of the most fastidious travelers who are accustomed to the comforts and luxuries of big ocean liners."

Cheap Alloy Sought for Turpentine Cups

THE turpentine industry needs a durable and inexpensive cup for gathering turpentine gum, a cup which will neither rust nor discolor the gum. At the request of the Pine Institute of America, chemists of the United States Department Agriculture have been testing cups made from various substances and of several alloys. The Bureau of Chemistry and Soils reports that several months of investigation have not yet revealed a cup material which is both inexpensive and satisfactory, but that the search will continue. Some of the alloys tested resist the chemical action of water and turpentine gum, and do not discolor the gum objectionably, but these alloys are too expensive. Cups made of 26-gage plate, the investigators say, would cost about 25 cents each, or 2500 dollars for a "crop" of 10,000 cups, an expense which producers cannot undertake.—*A. E. B.*

Chemical Treatment Doubles Life of Fishing Tackle

ONE would hardly expect to find chemistry applied to fishing, yet that science is playing no inconsiderable part in the fishing industry today. In New England, for example, where fishing is a major industry, the nets, lines, and other fishing equipment have an exceedingly short life, so one of the major problems is the preservation of nets and lines. When the value of the cordage gear used by the

New England fishermen—4,000,000 dollars—is compared with the value of the annual catch of fish and shellfish, which is about 25,000,000 dollars, it is seen that the length of life of the gear is a very important factor in the cost of catching sea foods, especially when one considers that many nets wear out in one season, and most nets last less than two seasons. Clarence Birdseye points out this problem in a recent issue of *Chemical and Metallurgical Engineering.*

Until 1919 no scientific investigation of chemical preservatives for nets, twines, and ropes had been carried out in this country. In that year the United States Bureau of Fisheries began a comprehensive study of means of lengthening the period of usefulness of these important tools of the fisherman. These investigations, which are still being continued, have brought to light an important new preservative for nets and twines: copper oleate. This chemical, when used in combination with coal tar, has been demonstrated to be an excellent preservative of tensile strength of cordage gear. Treated with this combination of preservatives, netting often lasts twice as long as that treated with proprietary preservatives. —*A. E. B.*

Traction Booster Assists Braking

THE old adage that a man cannot lift himself by his own boot straps has lost some of its significance since a device was developed for street cars by the Westinghouse Air Brake Company called the "Traction Booster"—an auxiliary to the air-brake system.

This device, as its name suggests, "boosts" or increases the traction (adhesive friction) between the wheels of a car and the rails, without actually increasing the weight of the car, the purpose being to permit application of greater retarding force in order to shorten stopping distances.

While a man cannot decrease his weight on the ground by an upward pull on his boot straps (this merely increases the pressure between the soles of his boots and the soles of his feet) provision is now made so that a car can increase its own weight, that is, in effect, for the purpose in mind, by pulling itself down to the rails with greater force.

Ordinarily, a car is held to the rails by the pull of gravity alone—its own weight. By means of the "Traction Booster" it may be held to the rails with an additional *magnetic* pull. The advantage of this will be evident by a review of the following facts.

Consider first what stops a moving car. When the brakes are applied each wheel thrusts forward on the rails with a force equal to the brake shoe friction, which is opposed by an equal backward thrust of the rails against each wheel. This force acting in opposite direction to the motion of the car, causes retardation. The shortest possible stop is produced when the forward wheel thrust almost, but not quite, equals the maximum rail resistance, which is determined by the adhesion between wheels and rails. In other words, the total brake-shoe friction (pressure times coefficient of kinetic friction) must not exceed the rail adhesion (weight times coefficient of static friction), or wheel sliding will occur. (Automotive vehicles have a natural advantage over street cars in stopping ability, because of greater traction, since the coefficient of friction between rubber tire and roadway is higher than between wheel and rail.)

Since this rail friction is thus inherently restricted by the nature of the materials in rolling contact, and the braking force thereby limited, the only remaining way to increase traction and permit greater retardation is to increase the other factor involved, the weight, which is done by the "Booster."

This device utilizes magnetic attraction between the truck frame and rail for accomplishing its purpose. As may be seen from the illustrations, magnetic shoes are suspended between the wheels directly over the rail. When a predetermined air-brake cylinder pressure has been built up, a pneumatically-operated switch energizes the coils of these shoes, causing the latter to move toward, but not upon, the rail. This powerful magnetic attraction is equivalent to increasing the load on the rails without actually increasing car weight. Advantage is taken of the greater traction thus produced to increase the braking force of the air-brake system. Since length of stop is inversely proportional to the amount of retarding force, shorter stops naturally result.

It should be emphasized that no retardation is produced by this magnetic attraction. The shoes do not come in contact with the rail. Full control of braking pressure is retained by the air-brake system, thereby allowing its inherent flexibility to be exercised. These features differentiate the "Booster" from the magnetic brake which was in use a quarter century ago, but very largely abandoned as impractical due to high maintenance expense involved and the extreme variation of braking pressure due to voltage fluctuations. As the "Booster" shoes do not ride the rails, damage to them from cross-overs will not occur.

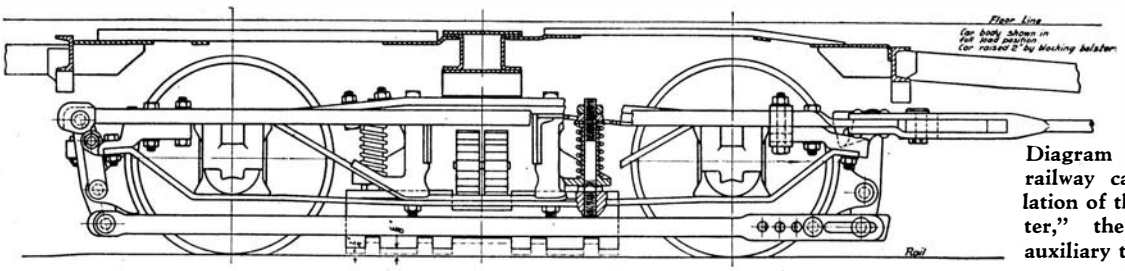


Diagram of a truck of a railway car showing installation of the "Traction Booster," the electro-magnetic auxiliary to the brake system

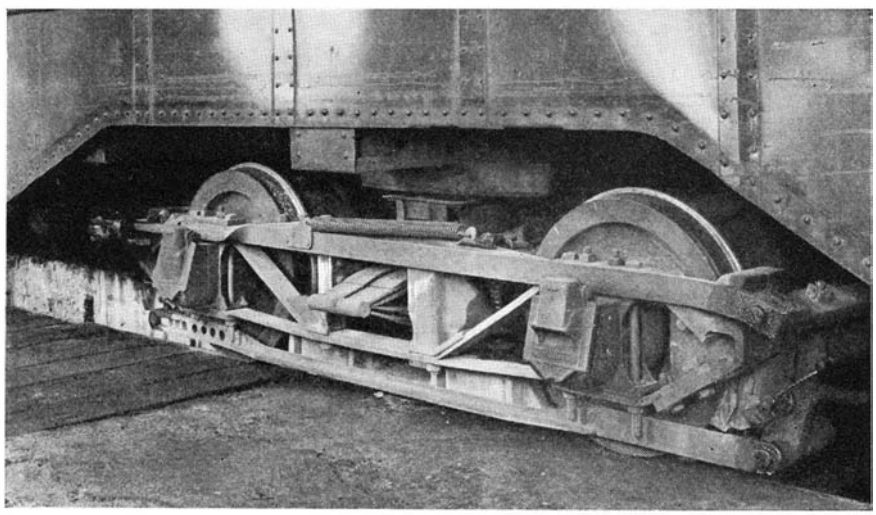
Normally, a retardation of but 3½ miles per hour, per second, is about the limit, whereas with this "Booster" a retardation of 7½ miles per hour, per second, has been attained without wheel sliding.

In addition to the advantages of the "Traction Booster" during deceleration, it can be used to advantage in acceleration and assist materially in the ascent of steep grades.

U. S. Consumes Half World's Tin, But Produces Negligible Quantity

TIN is the only metal of which the United States annually consumes more than 20,000,000 dollars worth and yet remains a negligible producer, points out the United States Bureau of Mines. In fact, the value of the tin annually imported for consumption ranges from 60,000,000 to over 100,000,000 dollars and accounts for almost half of the world production. Annual domestic production is valued at less than 50,000 dollars and amounts to less than one twentieth of 1 percent of the world's total output.

The principal tin-consuming industries are food packing, automobile manufacture, and building. The packing of food is relatively stable from year to year and may be counted upon to absorb a fairly constant quantity of tin plate and solder but



On this truck between the wheels is installed the "Traction Booster" which, by attracting a railway car to the rails, increases its effective traction

the automobile industry is subject to wide variation in the number of units produced, says Charles White Merrill, in a recently issued Bureau of Mines report.

If the recovery of secondary tin—that is, the production of tin from sources other than ore—were included with primary production, the United States would rank third among the tin-producing countries of the world. Tin-bearing alloys, tin-plate clippings, and melting-pot drosses are the most important materials from which tin is reclaimed. Most of the tin recovered from alloys does not pass through a refined-tin stage but is made into alloys which are brought to the required specifications by the addition of virgin metal.

Much study has been given to the problem of finding a substitute for tin plate in the canning industry, but no tin-free container has been developed as yet that can offer serious competition to the tin can. Glass containers have been used successfully where the advantage of display of contents has outweighed the higher initial cost and the difficulties of transportation. Experiments have been made with stainless steel cans, but the high cost and difficulties of opening have made their use uneconomical. Research to develop a practical aluminum can continues. Research in the substitution of lacquers for tin in the manufacture of tin cans has made little progress because of the difficulty in obtaining an appearance of cleanliness and beauty equal to that of the tin, as well as the difficulty in duplicating the purely utilitarian qualities of the tin coating.

Trolley cars which travel on rails encircling a building of the General Electric Company, carry hot and cold water for window washing. The cars may also be raised and lowered

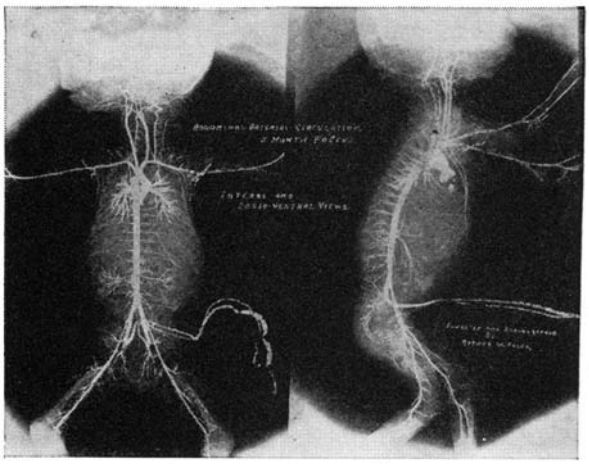
Aluminum is being used as a substitute for tin in the manufacture of foils and collapsible tubes. Moreover, tin foil is meeting severe competition as a food and cigar wrapper in cellophane, a transparent cellulose product, and in various waxed papers.—*A. E. B.*

Chemical Accident Record for 1930

ACCORDING to statistics compiled by the National Safety Council, the record of industrial accidents during 1930 shows that workers in the chemical industry are no more subject to injury than the em-

ployees of other industries. In a list of 28 major industries, the chemical industry ranked tenth on the basis of its frequency rate and fourteenth in severity. Accidents were most frequent in coal-tar distillation plants and most infrequent in plants manufacturing carbon products. The severity rate was lowest for industrial gases and highest for explosives.

As chemical plants increase in size, their injury rates decrease, a situation more or less common to plants in all industries. None of the groups employing less than 749 people had a frequency rate less than the average of 15.50 and none of the groups with less than 499 employees had better than average severity.—*A. E. B.*



Front and side views of a foetus into the arteries of which an opaque material has been injected. This radiograph illustrates the effectiveness of the new radiographic technique discussed in the column below at left

A New Radiographic Technique in Biology

WHAT is claimed to be a valuable biological procedure, the injection of opaque material into the arterial system of human and animal specimens, followed by the use of the X ray for making radiographs which then display the arterial system to better over-all advantage than is afforded by the usual method of dissection, has been developed by Arthur W. Fuchs of the Eastman Kodak Company.

For the average person and student, dissection is a difficult procedure demanding training, experience, and a certain degree of aptitude. A pair of Mr. Fuchs' radiographs is reproduced in these columns. These show the complete opaque injection of the arterial system of a five months' foetus, made through the umbilical cord. The arterial system is seen to be almost diagrammatic. By the combination of radiographs taken from various directions the complex system of arteries is made simple at once.

The procedure is that of injecting a suspension of lead oxide in olive oil and xylene into the blood vessels after death.

Doubtless this method of making the invisible clearly visible could be adapted to other uses than the one described—this, at least, has been the history of the majority of newly developed methods.

Car Driver's Posture Influences Fatigue

FATIGUE in driving an automobile is due to poor posture as well as to improper springs, shock-absorbers, and other defects in the car, according to medical and other authorities. Dr. Dudley B. Reed, professor of hygiene and director of the Health Service of the University of Chicago, declares that slumping down in the seat, and other mistakes in posture, when riding or driving, by restricting the natural functioning of the lungs and other organs, is a direct cause of unnecessary fatigue; pressure under the knee, due to too deep a seat or to other causes, subjects the nerves to pressure that may result in serious disorders.

Dr. Reed and other authorities agree that good posture is a health and safety measure as well as a means of greater enjoyment and they declare that properly designed and upholstered seats are essential to proper posture. In this connection, Dr. Reed declares, "I feel that one can maintain correct posture more easily under riding conditions if the upholstery is of such a material as mohair rather than of smoother and more slippery material."

Here are the chief essentials of correct riding or driving posture as presented by Dr. Reed and by Dr. Bennett, director of educational research of the American Seating Company: The person who would ride comfortably, safely, and with the least danger of unnecessary fatigue, should sit well back in the seat with the weight resting chiefly on the seat bones, on a point below the shoulder blades, at the top of the hips to help support the back, and on the feet. It is extremely important that there be no pressure under the knee. The correct posture, experts agree, is the one that gives the greatest relaxation and comfort, permits the greatest freedom of arms and legs, and keeps the body poised in a position where response in case of emergency is easiest and quickest.

Pellagra Due Wholly to Foods

IT has been definitely established that pellagra is strictly a dietary disease, which may be uniformly produced or prevented at will by simply varying the quantity of the foods which carry the antipellagric vitamin, the United States Public Health Service declared in a statement recently.

The United States Public Health Service states that although pellagra has been known to be more or less prevalent in certain sections of Europe for nearly 200 years, and in this country for almost a quarter of a century, it is only recently that the nature of its cause has been made clear and practical and effective measures for its treatment and prevention have been established.

Pellagra is unlike most preventable diseases with which we have to contend, as infection appears to play no part whatever in its causation, and the sanitary and hygienic measures commonly employed against transmissible diseases offer no aid in its control.

It has been abundantly demonstrated that pellagra may be uniformly produced or prevented at will by simply varying the quantity of the foods which carry the antipellagric vitamin—vitamin G. This occurs without regard to the quantity of other foods consumed which, except for the shortage of this particular vitamin, may be in perfect physiological balance. It is therefore seen that pellagra, like the other vitamin deficiency diseases, is brought about by the absence of a specific and essential dietary factor and is in no way dependent

With spines erect, their bodies supported at the shoulders, a point above the hips, on the seat bones, and on the feet, these girls will not easily tire

upon starvation in the ordinary sense as is frequently assumed.

The various foods and foodstuffs have been found to differ widely in the quantity of the antipellagric vitamin which they supply, and this makes variety in diet of the utmost importance in the treatment and prevention of pellagra.

Some foods, such as fresh lean meats, liver, milk, canned salmon, and commercial wheat germ, have been found to be so rich in this vitamin that the addition of a reasonable quantity of any one of them will effectively supplement an otherwise pellagra-producing diet.

Other foods, including eggs, canned haddock, dried peas, soy beans, dried milk, and tomatoes, have been found to possess considerable protective value, but must be consumed in relatively large and often excessive quantities when depended upon as the only or principal source of vitamin G, while still others, including corn products, wheat flour, rye flour, oatmeal, salt pork, lard and the commercial lard substitutes, butter, carrots, rutabaga turnips, mature onions, sweet potatoes, molasses, and white rice are such poor sources of this vitamin that they cannot be depended upon, regardless of the quantities or combinations consumed.

Fortunately, in most sections of the country the diet is composed of a sufficiently large variety of foods to insure a fairly adequate supply of the pellagra-preventive vitamin at all seasons. Under such conditions pellagra appears only sporadically, if at all, and usually results from dietary idiosyncrasies and eccentricities, or other factors peculiar to the individual.

Substance of Digestive Juice Prepared Pure

THE stomach's digestive ferment that dissolves the starch in foodstuffs and makes it available for the energy needs of the body has been prepared in the pure state for a first time in the chemical laboratories of Columbia University. This marks an important step toward finding out what these complicated ferments really are, a problem that has hitherto remained unsolved because they could not be obtained pure.

Professor H. C. Sherman, who is well known as an authority on the vitamins, and two associates, Professor M. L. Caldwell and L. E. Booher, announce their accomplishment in a report to the journal *Science*.

Starch, under the action of this ferment, is converted into malt, this being also the first step in the preparation of fermented liquors from grain. The crystals of diastase or amylase, as the starch ferment is called by chemists, were obtained from solutions of the pancreatic extract in a mixture of alcohol and water. The crystals show resemblances to proteins, those nitrogen-containing compounds which form so large a part of the stuff of the body.

This is the third digestive substance to be isolated. Protease, also found in digestive juice, which digests proteins like gelatin or the casein of milk, was recently crystallized by Dr. John H. Northrop and Dr. M. Kunitz at the Rockefeller Institute for Medical Research at Princeton, New Jersey. Urease, the enzyme that transforms urea into ammonium carbonate for plant

(*Please turn to page* 277)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

THIS year there have been two conventions of amateur telescope makers—one held in July at "Stellafane" near Springfield, Vermont, as in the previous five years, and a new one held in August in Pittsburgh by the Astronomical Section of the Academy of Science and Art. We hope that next year there will be several others, covering the whole nation. The hobby of amateur telescope making continues to thrive and spread like a lusty culture of disease germs on an agar-agar plate. Our own fell, deep-dyed hope is to infect the entire planet.

About the usual number—some 125 amateur telescope builders—attended the annual powwow at "Stellafane," in spite of hard times.

This year the Porter turret telescope was ready for use and a number of the more enthusiastic, wakeful amateurs spent the night keeping it busy. This is the telescope which was mentioned in advance of completion, in the SCIENTIFIC AMERICAN book "Amateur Telescope Making," at the top of page 51 (second edition), except that the Cassegrainian part has not yet been added. Light from a star reaches the diagonal flat mirror closely attached to the revolving turret, is reflected outward to a 16-inch paraboloid at the end of the framework structure of tubing, and this paraboloid returns it as a cone which passes through a hole in the flat. The eyepiece is within the turret. This turret is made of concrete cast on to steel plates and revolves in right ascension on heavy rolls, being turned by means of a hand crank. The arrangement of the turret proper resembles that used on the well-known Hartness turret telescope. The slender object projecting at the right is a length of four-inch shafting which serves as a counterweight. The observer remains within the turret and is protected from the icy blasts of the cruel Vermont winters and from the persistent attentions of the Vermont mosquito. In the picture the square part of the structure is of wood, and the entire part at the left is of concrete, the two being anchored together by means of heavy bolts.

The second big feature of the "Stellafane" gathering was a six-inch telescope made by a lady. This received so much attention, and its maker, Mrs. Thomas Jenkins of Albany, so much praise, that there is no record of anything like it. As soon as the convention was over, the newspapers of Albany got wind of this unusual accomplishment and obtained an interview with Mrs. Jenkins, at which the photograph reproduced in these columns was also taken.

Courtesy Albany Times-Union

Mrs. Jenkins and "it"

Incidentally, this same photograph was passed by the Albany papers into the hands of the press photograph agencies and thus came to be published in newspapers all over the nation. It is only fair to state that Mrs. Jenkins should not be credited with the misinformation in the legend published by most newspapers with the picture, as this appears to have arisen phoenixlike from the imagination of the press photographer, which surpasseth understanding.

Mrs. Jenkins is the wife of Thomas A. Jenkins, a representative of the General Electric Company, and has studied mathematics and physics at the New York State College for Teachers. She, with some help from Mr. Jenkins, devoted 130 hours to the mirror part of the job. This is the third woman who has successfully completed a mirror as an amateur, the others being Mrs. Skinner, a draftswoman who was one of the members of the original "Telescope Makers of Springfield" and Mrs. Margaret Weisenberg of New York (SCIENTIFIC AMERICAN, October, 1929, page 354). Women seem to possess a real instinctive flair for any kind of rouge and mirror work and it is hoped that others will essay it.

Russell W. Porter, the father of the amateur art in America, told the assembly about progress and some of the plans at Pasadena, especially with regard to the 200-inch telescope. In the site investigation the choice has now been narrowed down to three candidates. The investigation will be continued while the work on the great telescope progresses, as it is only by integrating the findings of several years at a given site that a safe criterion of seeing can be obtained. One site, for example, which had performed splendidly for more than a year suddenly "blew up" and gave such bad seeing during a subsequent period that it was entirely thrown out of the running. One site is at Palomar about 100 miles south of Mount Wilson. A second candidate is about 100 miles east of Pasadena at an elevation of about 7000 feet, while a third is in the Mint Canyon near the Mojave Desert. Work on the 200-inch mirror is progressing, perhaps more slowly than the eager public wishes, but the intention is to avoid any haste that might later prove prejudicial to the main consideration, the telescope. The job will require a number of years at best, some of the newspapers and ill-informed writers to the contrary notwithstanding.

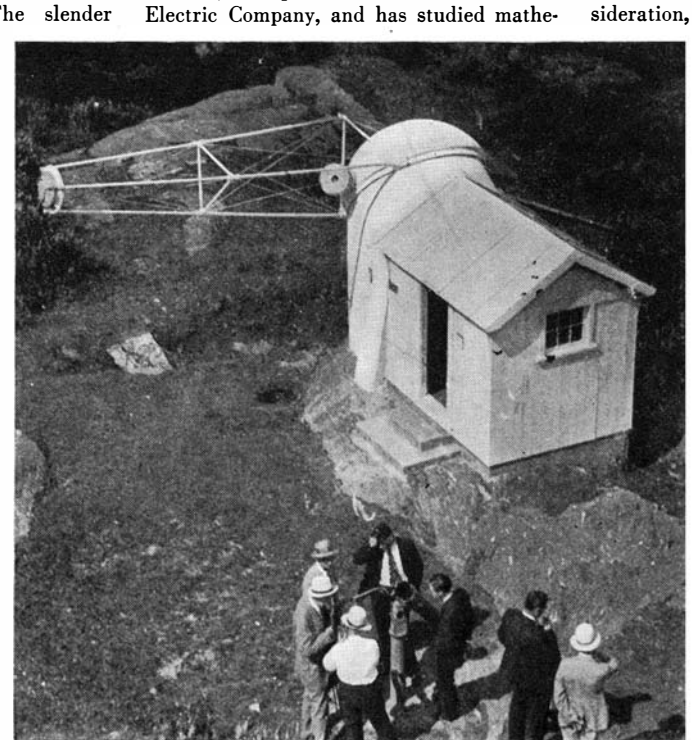


Photo by James Stokley

Porter's turret telescope at "Stellafane"

THE other assembly of amateur telescope makers was held at Pittsburgh, Saturday and Sunday, August 8 and 9 and, being well advertised in advance, brought more than 100 amateurs to that city, the visitors coming from eight states. Several professional astronomers attended the meeting. The interesting J. W. Fecker plant was visited. At the Allegheny Observatory a number of speeches were listened to, including those by C. B. Roe, President of the Pittsburgh club of amateurs; R. W. Porter and John M. Pierce of Springfield, Vermont; M. D. Blish, secretary of the newly organized club, "Amateur Telescope Makers of Chicago"; J. W. Fecker who has just completed the 69-inch mirror for the Perkins Obser-

vatory at Ohio Weslyan University; and Dr. James Stokley, Director of the Fels Planetarium in Philadelphia. A wreath was placed on the tomb of "Uncle John" Brashear, the great mirror maker.

On Sunday a visit was made to the Valley View Observatory, which was described in the July 1931 SCIENTIFIC AMERICAN, pages 30-32. This is the headquarters of the Pittsburgh group. A ten-inch mirror was silvered as a demonstration. There were other activities and everybody had a good time. An informal account of this gathering, from a private communication by R. W. P., reads in more lively style. "Just back from Pittsburgh. Fine time. Those fellows did well. Headquarters in big hotel, badges, cars with big signs announcing convention. Fecker gave them the run of his shop. Supper, much speechifying. Evening at Allegheny Observatory, clear night. Hottest night ever. Sunday, spent morning with Fecker. Had a look at the 69-inch over a knife-edge. Wow! Everything at this meeting was done fine."

So there you are; amateur telescope making still lives.

HERE is something else, this time from Chicago, a letter from Gerald E. McCord, President of the "Amateur Telescope Makers of Chicago."

"The readers of this magazine may recall former statements that an organization for amateurs in telescopy and astronomy was being formed in Chicago. We are pleased to present the following report of our progress to date.

"In March of this year the first meeting of this group was held at the Hotel Sherman in Chicago for the purposes of organizing and planning a program. A constitution was drawn up and the name 'Amateur Telescope Makers of Chicago' was selected. The constitution reads in part: 'The purpose of this organization is to promote interest in astronomy among the amateurs of Chicago and to assist all members in the art of telescope making.'

"There are now 45 names on our rolls. Meetings are held the first Sunday evening of each month. They are a combination of business meeting and small group discussions of some question that is giving some member trouble at that time.

"Completed mirrors of the society number six and range in size from 3½-inch to 24-inch. The 24-inch telescope was built by Mr. F. W. Nack and is now in use. Five other mirrors are in process of construction, the largest of which is being ground from an especially made disk of Pyrex. Its diameter is 12 inches.

"We will welcome contact either in person or by correspondence, with other amateurs anywhere. Address all mail to the secretary, Mr. M. D. Blish, 7548 West 62nd Street, Argo, Illinois or phone Kildare 8971 and ask for Mr. W. L. Dennis, if you are in town. Our technical adviser and an honorary member of the society is Mr. J. E. Mellish."

THAT Jap, Nagata, has earned the right to carve his initials on the comet he recently discovered, the comet having been named for him as is the custom. Nagata is not a telescope maker but is an amateur astronomer nevertheless. Here is a star for the telescope maker to hitch his wagon to: let him discover a new comet—and fame.

CURRENT BULLETIN BRIEFS

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

THE JENNINGS CENTRIFUGAL PUMP gives some valuable data for those interested in hydraulics. Particular attention is paid to position of suction and discharge connections. *Nash Engineering Company, South Norwalk, Conn.—Gratis.*

WHERE TO BUY SUPPLIES FOR EDUCATIONAL INSTITUTIONS is a pamphlet which is invaluable to educational authorities and purchasing agents of schools, colleges, and summer camps. *Porter Sargent, 11 Beacon St., Boston, Mass.—Gratis.*

AN ANEMOMETER FOR A STUDY OF WIND GUSTS (Engineering Research Bulletin No. 20 University of Michigan) by R. H. Sherlock and M. B. Stout describes a new type of pressure plate anemometer for research on the loading and strength of overhead power lines. The apparatus is fully illustrated and described. *Department of Engineering Research, University of Michigan, Ann Arbor, Michigan.—$1.00.*

OUTDOOR SPORTS LIGHTING illustrates some recent installations which allow longer playing hours. Every outdoor sport can now be played under artificial light. This pamphlet contains a remarkable series of diagrams showing how various courts and fields should be lighted. *Nela Park Engineering Dept., General Electric Company, Cleveland, Ohio.—Gratis.*

PARACHUTE SUPPLEMENT OF AIR COMMERCE REGULATIONS (Aeronautics Bulletin No. 7-D, Aeronautics Branch, U. S. Department of Commerce) deals with parachute approval and maintenance and parachute riggers. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

REPORT ON THE VEGETABLE OIL INDUSTRY OF HYDERABAD STATE (Bulletin No. 1, New Series, Commerce and Industries Department, the Nizam's Government) by A. F. Yuill gives information on the oil-seeds and oil-crushing industry in this part of India, but the information will prove of value to all interested in vegetable oils. *Nizam Jubilee Press, Hyderabad (Deccan), India, 3 rupees.—$1.10. Remit by International Money Order.*

CURRENT DEVELOPMENTS IN AMERICAN COLLEGE SPORT (Bulletin No. 26, The Carnegie Foundation for the Advancement of Teaching) by Howard J. Savage, John T. McGovern, and Harold W. Bentley deals with the relation of college and school athletics to the educational process and insists that the final responsibility rests with the university or college officers. *Carnegie Foundation for the Advancement of Teaching, 522 Fifth Ave., New York City.—Gratis.*

WATER FILTRATION FOR ALL PURPOSES (Bulletin No. 194) describes in great detail the filtration of water for water supply and swimming pools. The pamphlet is well illustrated. *Wm. B. Scaife & Sons Co., Oakmont, Pa.—Gratis.*

MOSS PEAT, ITS USES AND DISTRIBUTION IN THE UNITED STATES (Circular No. 167 U. S. Department of Agriculture) by A. P. Dachnowski-Stokes describes the imports, uses, requirements for a successful moss-peat industry and the distribution of moss-peat in the United States. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

WOOD-LIQUID RELATIONS (Technical Bulletin No. 248, U. S. Department of Agriculture) by L. F. Hawley gives the relations between wood and liquids. Substantially every important property of wood is affected by the presence of some liquid, in one form or another, so there are many important problems involved. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE MERRIMACK ARCHEOLOGICAL SURVEY by W. K. Moorhead is a 79-page illustrated account of the Indian archeology of the Merrimack River valley and is the work of a noted archeologist. *Andover Press, Andover, Mass.—$1.25.*

SANITARY DRINKING FACILITIES WITH SPECIAL REFERENCE TO DRINKING FOUNTAINS (Bulletin of the Women's Bureau, No. 87, U. S. Department of Labor) was prepared by Marie Correll of the Division of Research of the Women's Bureau. The pamphlet deals with the source of water, bubbling fountains, individual paper cups, and the location of drinking water facilities. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE RUINS AT KIATUTHLANNA, EASTERN ARIZONA (Bulletin of American Ethnology 100, Smithsonian Institution) by Frank H. H. Roberts, Jr., describes the effort to obtain additional data on certain phases of the earlier archeological horizons. The pamphlet has 195 pages and is profusely illustrated. *Superintendent of Documents, Washington, D. C.—65 cents (money order).*

THE DESIGN OF CAPACITOR MOTORS FOR BEST STARTING PERFORMANCE (Engineering Research Bulletin No. 19, Department of Engineering Research) by Benj. F. Bailey is a treatise in which the writer has endeavored to simplify the fundamental theory and the methods of making the necessary computations for the design of capacitor motors. *Director, Department of Engineering Research, University of Michigan, Ann Arbor, Mich.—50 cents.*

ANNUAL MEETING OF THE AMERICAN INSTITUTE OF CHEMISTS (*The Chemist*, Volume VIII., No. 9) describes the presentation of its medals to Messrs. Andrew W. and Richard B. Mellon for their notable achievements, particularly the founding of the Mellon Institute, which will soon occupy its magnificent new building. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

RESEARCH ON FUEL ECONOMY AT MELLON INSTITUTE (Reprint from *Combustion*, Oct. 1930) by William A. Hamor tells of the work the Mellon Institute is doing in the fields of fuel economy. *Mellon Institute, Pittsburgh, Pa.—Gratis.*

X-RAY PROTECTION (Handbook, Bureau of Standards No. 15) gives a unified set of safety recommendations and was prepared under the direction of an eminent committee. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

MEDICAL EXAMINERS OF THE AERONAUTICS BRANCH (Aeronautics Bulletin No. 23) gives a list of medical examiners in all parts of the United States, numbering 800 in all. The result of their examinations is reported to the central office in Washington where qualification or disqualification is made. The scale of fees is given and varies from 5 dollars to 15 dollars. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

STUDY OF INLAND WATER SITUATION by Samuel S. Weyer presents in very graphic form man's dependence on water. The facts are admirably presented. Those who wish the salient facts in relation to the Mississippi River drainage flood problem will get them here. *Fuel-Power Transportation, Educational Foundation, 1116 Beggs Bldg., Columbus, Ohio.—Gratis.*

SIXTEENTH ANNUAL REPORT OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS, 1930 (including Technical Reports Nos. 337 to 364) is a large quarto volume of 787 pages, fully illustrated and bound in buckram. It is one of the most valuable contributions ever made to aeronautical literature. It is, of course, published at cost as it is not the policy of the Government to make a profit on its technical literature. *Superintendent of Documents, Washington, D. C.—$1.50 (money order).*

YEAR BOOK OF THE DEPARTMENT OF AGRICULTURE 1931 (House Document No. 777, 71st Congress, 3rd Session) is the usual handsome volume dealing with the year in agriculture—what is new in agriculture, department publications, crop and livestock production trends, and 507 pages of statistics. The first half of this cloth-bound book is well illustrated. *Superintendent of Documents, Washington, D. C.—$1.50 (money order).*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 273)

use, was first made crystalline in 1926 by Dr. James B. Sumner at the Cornell Medical College.

The enzymes or ferments play a very important part in the life processes of plants or animals. They accelerate chemical reactions without themselves being used up in the process. Chemists call such substances in general catalysts, but enzymes are very special kinds of catalysts which are extremely unstable and therefore difficult to handle in the laboratory.—*Science Service.*

Soap vs. Germs

SOAP, and common soap at that, has been found to have remarkable germ killing powers, by John E. Walker, M.D., of Opelika, Alabama, who has reported his findings to the American Medical Association in the *Journal* of that organization of physicians.

While it is unsafe to generalize too freely about the germ killing power of soap since some germs are affected in a way quite different from others, Dr. Walker finds that soapsuds "compare favorably with many of the recently synthesized chemicals that have been heralded, at least in advertisements, as crowning achievements of modern chemistry." He says that the recognition of the germicidal properties of soap is comparatively recent, and the standard textbooks on surgery and bacteriology make practically no mention of these properties.

There are, however, two germs against which the thorough washing of hands with soap is not effective: those of typhoid fever and the staphylococcus organism. On the other hand, the thorough washing of the hands with soap suffices for the destruction of streptococci, pneumococci, meningococci, gonococci, and diphtheria bacilli; also influenza bacilli.

Where it came to kinds of soap, Dr. Walker found no very wide differences between them. There actually was a difference of a few fold in germ-killing power, though this difference varied with the kind of germs. In any case, such differences would make little difference, so to speak, because it was found that the ordinary lather one makes in washing the hands is many times as concentrated as the concentration of soap found necessary to kill germs even with the weakest soaps. White floating soaps, perfumed toilet soaps, laundry soaps, cocoanut-oil and olive-oil soaps—all came out of the test in good standing though, of course, none was as germicidal as carbolic-acid soap.—*A. G. I.*

Chemistry to Establish Value of Farm Crops

DECLARING that farm products are worth only as much as the chemical value of their components, William J. Hale, in a recent address to the Manufacturing Chemists' Association attributed the world-wide economic depression to the organic chemical revolution. [Although Mr. Hale's

ideas do not coincide with those of the editor, we present them for what general interest they contain.

"Those industrialists and politicians who cry aloud for higher prices on agricultural staples in order that the money paid to the farmers will find outlet in greater purchasing power for industrial products are only crying for their own destruction," he said. "Chemistry decrees that these organic chemical mixtures—staples, if you wish—never again can sell for more than the sum of the chemical values of their several components, and simply because these components are obtainable elsewhere with less expenditure of labor. Thus, cotton, of 99 percent alpha cellulose content, is of little more value than the alpha cellulose of 98 percent purity, obtainable now from wood at a price of six to seven cents per pound. Cotton, therefore, must compete with this alpha cellulose, and unless it can be sold for approximately 10 cents per pound or less, it will sooner or later pass entirely out of domestic consumption. Corn, wheat, and other staples must follow in line. Corn at 40 cents per bushel and wheat at 60 cents per bushel carry a value about the equivalent of the sum of the values of the chemical components contained in these grains, and never again should sell at higher prices.

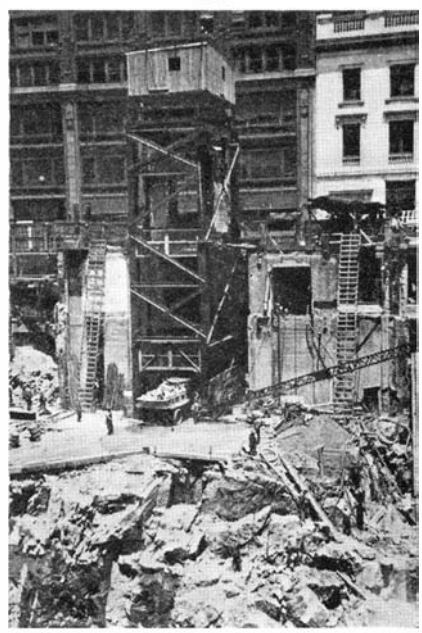
"It is reported that we are in a period of depression, but how can we consider prices depressed when they approach the actual values of the products concerned. Thus, crude oil at the wells is not worth over 50 cents a barrel, nor is coal at the mines worth more than two dollars a ton, and yet there are those who would have us believe that petroleum must be conserved, that it is a great asset to the country, and that its passing might mean our undoing.

"To all this, the chemists's reply is: 'Tommyrot!' We don't need this oil; use it as best we can at as low a price as possible. When it is gone, we shall use up the coal, also at as low a price as possible. When the coal is gone, we shall manufacture hydrocarbons at lowest prices, and our children will relate stories of how their fathers wasted their time digging holes in the ground to get out a lot of dirty fossil remains at a tremendous cost of time and labor. There is nothing so childish as this cry of conservation when the chemist already knows how to provide the requirements in heat, power, and light for the human race without any coal or oil in the picture.

"Many claim that corn, wheat, cotton, and other staples are now selling below the cost of their production. Undoubtedly this is correct for certain sections of the country, but for other sections it is most decidedly not. Whenever a high cost of production prevails, the agriculturists must cease this particular pursuit. What we want are low-priced basic commodities, and these we will have."—*A. E. B.*

Artificial Sponges from Cellulose

An artificial sponge is being manufactured in Germany under the name "Agfa-Viscose-Sponge." It consists of regenerated cellulose, and is similar to the artificial silk manufactured from viscose. It combines the advantages of the natural sponge without its disadvantages, and can be boiled with soap or soda without losing its shape or stability. It can be made in every desired size with large or small pores. In contrast with the sea sponge, the new sponge has smooth, plain surfaces of outstanding absorptivity. It is suitable, not only for body care, but also for all types of cleansing, especially for washing automobiles, wagons, boats, and the like. —*A. E. B.*



Instead of using the usual ramps for trucks hauling debris from an excavation job, one New York contracting concern has installed elevators to speed up transportation

Spontaneous Combustion of Hay

"From the time it is cut until it is used, fully one tenth of the harvested hay crop of the United States is lost as a result of spontaneous heating; it is as surely lost and consumed as if American farmers had consigned every tenth load of their harvest to the flames," said Dr. C. A. Browne, of the Department of Agriculture, recently in making public the results of the latest investigations of the spontaneous combustion of hay.

Doctor Browne said that although the annual loss resulting from the burning of barns and other farm property in the United States as a result of spontaneous combustion has been estimated to exceed 20 million dollars a year, the actual loss in the decrease in the weight of nutritive value of hay during spontaneous heating will annually amount to many times that sum.

"The spontaneous heating of hay," says Doctor Browne, "takes place in three stages. The first stage is due to the vital activity of the living cells of the grass which continues for some time after it is cut. As a result of these cellular processes, the sugars and other carbohydrates of the grass begin to break down and heat is evolved. If the freshly cut grass is placed in a pile, the escape of heat is retarded. The heat can be felt by inserting the hand into the pile.

"When the mass of heating hay reaches a temperature of 110 degrees, Fahrenheit, the life of the grass cells is destroyed, and then commences the second period of spontaneous heating caused by the molds and

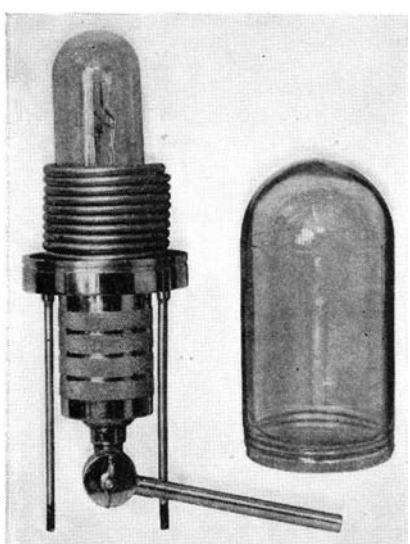
bacteria that occur naturally in hay. The numbers of the micro-organisms, because of the favoring warmth and moisture produced in the first stage of heating, increase greatly and additional heat is produced, the temperature rising as high as 180 or 185 degrees, Fahrenheit.

"When hay is properly cured by the ordinary process, its moisture content is reduced from about 75 percent to less than 20 percent, at which point the vital processes of the cells stop and bacteria and molds can not live, so there is then very little danger of the hay overheating in the stack or mow. The vital processes of the grass cells in improperly cured hay have not been completely arrested and heating begins in the interior of the mow; moisture is driven from the warmer to the cooler parts; and the hay begins to 'sweat.'"

To prevent fire resulting from the heating hay, Doctor Browne advises that if a burnt odor becomes perceptible measures should be taken to locate the fire pocket which has formed somewhere within the mow. This can be done, he says, by boring into the hay in different places with a steel tube provided with a sharp cutting edge. If a section of the tube is very hot when it is removed and the core of hay in it appears burned, this indicates a fire pocket. In case of a fire pocket, the hay must be removed at once, but first provide fire extinguishing appliances or water for extinguishing any outbreak of flames, for there is always danger that the sudden admission of air to the fire pocket may cause the outbreak of flames.

Light with Less Heat

ELIMINATION of three fourths of the heat, with negligible loss of light, has been accomplished in a new type of high-intensity incandescent lamp equipment developed in the Research Laboratory of the General Electric Company.



Little heat escapes from the powerful light surrounded by a liquid

There are numerous applications where intense illumination with a minimum amount of heat is required, such as over operating tables in hospitals, in lighting wax models and other objects in store window displays, and in opaque projection.

Heat is a necessary evil with all man-produced light; the scientist cannot produce the cold light of the firefly, and such light is not the type generally wanted, anyway. Approximately 85 percent of the electric energy consumed in the most efficient tungsten incandescent lamp is radiated as heat, although in the household-size units this heat is not objectionable. When larger lamps are used, however, the heat quickly becomes apparent.

The elimination of the heat is accomplished by absorbing the heat rays in a liquid surrounding the bulb. Distilled water, a solution of copper chloride, and some other solutions will absorb heat while transmitting most of the light. The heat is conveyed away from this solution by means of a cooling coil through which water is circulated.

The new unit consists of a lamp immersed directly in the absorbing liquid, which is confined by an outer glass jacket. The cooling coil through which tap-water is circulated is also immersed in this liquid. Convection currents set up within the jacket liquid are sufficient to maintain a circulation, and no mechanical stirring is required.

In cases where a tap-water supply is not available, a radiator, such as is used with automobiles, may be used with a closed water system. A pump is then used to circulate the water, and a fan to cool the water in the radiator, which may be placed at a distance.

The absorbing layer of liquid practically surrounds the light source, so that almost no radiation reaches the atmosphere of the room except through the absorbing medium. The cooling water is circulated in and confined by the coil, so that either distilled water or some heat-absorbing solution may be kept permanently in the jacket. The jacket and lamp surfaces are thus kept clean and free from the deposits of ordinary tap-water, even though this is the cooling agent.

Maternity

THE United States has a higher death rate from childbirth than any of the 20 other countries from which statistics are available, according to Dr. Howard W. Haggard, associate professor of physiology at Yale University. Dr. Haggard's comments were broadcast as part of a series of talks entitled "Devils, Drugs, and Doctors."

Available childbirth mortality figures, he pointed out, range from 2.6 per thousand to 6.6. Denmark and Italy lead the world with the lowest figure. The United States stands at the bottom of the list. "These figures for our country, translated into actual deaths, mean that each year in the United States 16,000 mothers die leaving behind them their new-born babies," Dr. Haggard said. "As compared with Denmark and Italy, 10,000 of these mothers die unnecessarily. The means exist to prevent these deaths, but the fact that the deaths continue year in and year out signifies that the means are not made available to the mothers who need them."

The Maternity Center Association supplies complete education and medical care to mothers requesting it in one area of New York City. The maternity death rate among women receiving this free service is 2.2 per thousand, the lowest recorded in the world, compared with 6.2 mothers in the same district who do not come

under the care of the association. Dr. Haggard cited these statistics to bear out his point that the high national mortality rate is unnecessary.

"In our country," he said, "we have physicians specializing in obstetrics who are as skilled as any to be found elsewhere in the world. Our nurses are as well trained as those of any other country. We have many excellent maternity hospitals. But these means of saving lives and insuring health are not available to most of the mothers of this country."

"Battledeck" Floor in Garage

AN automatic arc welding machine, crawling along by its own power, has demonstrated its value in the construction of a new type of steel floor for buildings. The Wendell Garage, owned by the Berkshire Auto Company in Pittsfield, Massachusetts, is the first to use this machine on what is known as the "battledeck type of floor construction". It was used at a considerable saving in cost in the erection of a two-story addition to the garage.

The American Institute of Steel Construction is the sponsor for the new kind of flooring. It was first announced at a convention of that body in Biloxi, Mississippi, November 14, 1929, and described in SCIENTIFIC AMERICAN. Proponents of the method showed the new flooring involves much less weight than other types and is able to stand every kind of service.

Justification for these claims was found in the Pittsfield application. Unusual construction problems confronted the owners, and these were entirely solved through the use of the welded floor, and its advantages over the conventional concrete slab floor were demonstrated. The architect, George E. Haynes, found it necessary to erect a two-story addition in the angle of a one-story building with a ramp leading from the ground floor of the existing building to the second floor of the new structure. The space available for the ramp was of limited length and, as it was essential that the practical rise should not be exceeded, these facts determined the height of the second floor. It was required that the first floor be without columns. As the depth of the second floor construction determined the ceiling height of the first floor, it was obvious that the ordinary concrete slab method of floor construction would have made the height in the clear less than that required by the owner. The span had to be cleared across the 60 foot width and the girders not less than 20 feet on centers.

Computations showed requirements of a 6-inch concrete slab and a 36-inch girder, making a total of 42 inches from the top of the second floor to the under side of the girder. This was more than could be used. The weight of the concrete was 75 pounds per square foot and the girder was 300 pounds to the foot, in addition to the other steel.

The battledeck floor was investigated and it was immediately apparent that the height of the girder plus the thickness of the plate would be the total thickness of the floor. This showed a 33-inch, 200-pound girder representing a saving of 80 pounds per square foot on girders and of 9 inches in the depth of the floor.

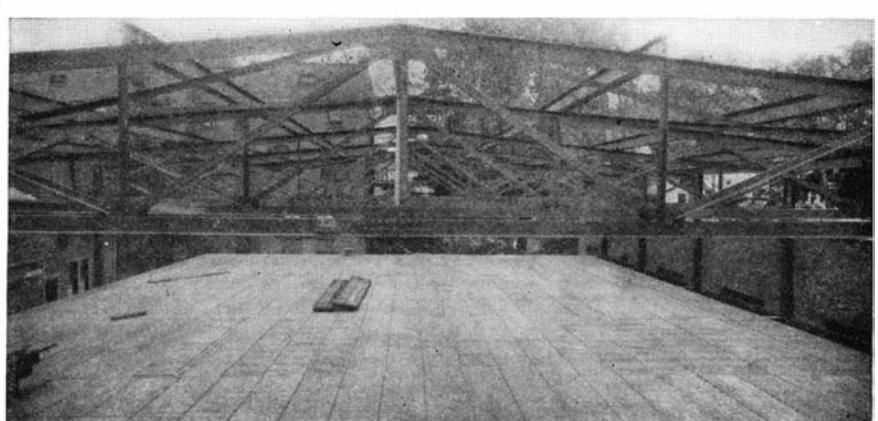
The battledeck floor consists of 5-inch, 10-pound I-beams, spaced 24 inches on centers with ¼-inch steel plates placed from the center line of one I-beam to the center line of the adjoining I-beam and from center to center of girders. An allowance of ¼ inch between plates was made. The battledeck construction weighs 15 pounds per square foot as contrasted with 75 pounds per square foot of concrete slab construction. This startling decrease in dead load was surprising to construction men. It resulted in reduced column requirements and footings. The footings were very important as, in order to avoid cantilever, the footings extended under the existing walls at the column point.

There was used a total of 193 separate ¼-inch steel plates each 2 feet wide, making a total area of 40 by 160 feet, or 6400 square feet.

Ship Stresses

EVERY ship is, on the whole, a thin-skinned, supported beam which is subjected to various stresses by the sea's movement and by the weight applied when being loaded. Designers' calculations of the extent of these stresses can not, by present formulas and knowledge at least, be calculated with the exactitude of those on a stationary land structure such as, for example, a bridge.

In order to throw new light on this problem in ship-building, Dr. W. Dahlmann of the Technical College and Engineer Paul Maack of the Government School for Ship Engineers, both in Hamburg, Germany, some time ago made a series of stress measurements on the S.S. *Hamburg* of the Hamburg-American Line. These measurements were made by fixing extremely sensitive and exact instruments on the ship's walls and on its interior sup-

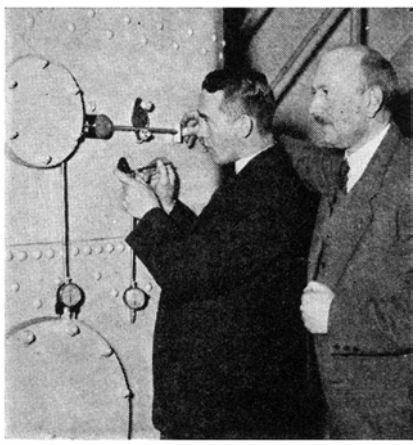


Courtesy General Electric Company

An electric-arc welded "battledeck" floor in place

ports to measure even the smallest stresses and strains of the structure.

While a report of the results obtained has not been given out, it is expected that they will supply data on the "creeping" of various parts of the ship under the influence of twisting and turning movements of the sea and under the influence of loading operations. From these data may then be concluded the strength of materials necessary to neutralize or eliminate the "creeping" movement which, no doubt, will cause changes to be made in shipbuilding design.



Making a strain measurement in determining the stresses on a ship

Honey High in Food Value

HONEY is one of the best of the high energy-producing foods, says the United States Department of Agriculture. Because it is composed almost entirely of simple sugars it can be assimilated with ease. Most sugars require action by the gastric and intestinal secretions to break them down into simple sugars similar to those occurring naturally in honey.

Because it is easily assimilated, honey is of importance where normal digestive activities have been impaired by disease or old age. Honey can be utilized by the body without placing much of a burden on an enfeebled digestive tract and is also recognized as a valuable food for babies and young children.

Honey is especially good in the diet of athletes. The rapid absorption of the simple sugars of honey replaces the sugars in the blood and muscles that have been burned by strenuous exercise.

Odors Add to Sales Appeal

PLEASANT odors, many of them artificially compounded in the chemical laboratory, are being used to make various articles of merchandise more appealing to the customer. A silk hosiery manufacturer, for instance, uses scented lubricating oils in spinning its thread, and the stockings have a nice odor, says James H. Collins of Arthur R. Maas Chemical Laboratories.

A soap manufacturer makes laundry soap that leaves clothes with a clean fragrance—lavender, we believe.

This is no limited feminine appeal. An overall manufacturer kills the smell of new cloth and dyestuffs by giving his work-clothes a distinct perfume of masculine type. Just as there are heavy scents preferred by brunettes, and light perfumes suitable for blondes, so there are men's scents, among which are lemon and mignonette.

How does peat smoke strike you for a man's perfume? Scotch tweed cloth has long been known to buyers by the peat odor of the weavers' cottages. There is no reason why peat, or piney woods, or similar scents should not be imparted to goods for men.—*A. E. B.*

Pi

A MNEMONIC is a simple device for aiding one to remember something easily forgotten. For example, we meet a Mr. Fish and, wanting to remember his name, we couple his mental image with that of a fish. (And the chances are that the next time we see him we call him "Mr. Perch." Mnemonics are convenient—if we can manage to remember the mnemonic itself.)

A fine mnemonic for remembering the series of capital letters, OBAFGKMRN, which designates the well-known Draper sequence of star types, is "O, be a fine girl; kiss me right now." This mnemonic is regularly taught by serious professors of astronomy, who find it a sure way to make their students remember the letters and their proper sequence.

Sir James Jeans has worked out a neat mnemonic for remembering *pi* (π) to 10 decimal places, pi being 3.1416 to most of us and 3.14159265356+ to those of us who like to remember such things. He gives "How I want a drink, alcoholic of course, after the heavy chapters involving quantum mechanics." If we write down in a series the numbers of letters in the respective words of this sentence we get *pi* as given above.

One of our readers, Alan S. Hawksworth of Washington, D. C., has devised a mnemonic for remembering the value of $\text{Log}_{10}\pi$ to 15 decimal places. The sentence runs: "This logarithm employs a zero character, mantissa follows, in digits precisely what I now give."

The Draper classification mnemonic and *pi* mnemonic given above might be characterized as "motivated." We get—or at least we ask for—respectively, a kiss and a drink. What seems most needed now is a suitable motivation for the mnemonic for $\text{Log}_{10}\pi$. Perhaps some of the readers can improve on it.—*A. G. I.*

Bran

THE perennial controversy about bran runs on and on, some condemning it, others praising it. (See page 188, September 1931, SCIENTIFIC AMERICAN.) In the *Journal of the American Medical Association* Dr. Murray B. Davis of Nashville cites a case in which a patient who had suffered for years from constipation and been an addict to the "pill" habit switched to bran. A week later sudden illness enforced an operation and a mass of bran the size of a hen's egg was found completely obstructing the bowel.

Dr. Davis comments that the public has come to believe that bran is harmless, but that Dr. Alvarez, the famous stomach specialist, regards it as one of the most indigestible foods to be found in nature. In fact bran, the covering of the wheat kernel, has been especially adapted by nature to

protect the seed in its passage through the intestinal tract of herbivorous animals. It is his belief that those who have perfect digestions may be helped by roughage, but those who have irritable bowels may get into trouble. The bran may ball up in the small intestine, especially in the case of persons with sluggish intestinal tracts—those whose bowels move normally only once or twice a week.—*A. G. I.*

Pre-cast Sewer Pipe Joints

SEWER joints of asphaltic rings precast in the bell and on the spigot of the pipe recently were used with marked success in Seattle for an intercepting sewer where extreme groundwater conditions in clay and quicksand formation on a pumping line made effective joints of extreme importance. Previous trouble experienced by the city with root growths, combined with numerous sewer failures caused by leaky joints, with subsequent washout and collapse, prompted the test of the asphaltic joint in place of the cement-mortar type. The new joint is similar in some respects to the Stanford coal-tar joint used in Europe, but it has been improved as to jointing material, the method of application to the pipe and the resulting characteristics of the joint.

Manufacture of these joints under plant conditions by skilled workmen is in decided contrast to the problem of producing good joints under field conditions. The process consists of casting asphaltic rings to form the joint on the bell and spigot of each pipe section. The material is about 60 percent inert matter that is ground from pipe fragments and 40 percent asphalt. The resulting compound is flexible at freezing temperature, softens at 212 degrees, Fahrenheit, and flows at 300 degrees; the penetration is from six to eight at 77 degrees. These characteristics are for a standard mix and may be modified to provide for different requirements.

The scarified bell and spigot of the pipe length are painted with a solvent about one hour before applying the hot asphalt, assuring proper adhesion to the pipe, which is essential to the success of the joint. Machine-made molds for both halves of the joint are provided with a slight taper. Molds for the spigot end are placed on a leveled pouring platform, and the ends of the pipe are centered in them by eye. The molds for the bell end are placed and the rings poured with the asphalt at a 400-degree temperature, as shown in the accompanying illustration. Prior to pouring, the molds are whitewashed to prevent sticking and provide a coating on the joints to make handling easier. Following pouring, the molds are allowed to remain in place until the compound has cooled and shrinkage completed.

Simplified laying procedure under adverse conditions is a particular advantage in the use of this joint. Just before they are lowered into the trench, the collars on both ends are swabbed with a solvent that livens the surface of the asphalt. The pipe lengths are lowered into the trench by ordinary methods, placed in position and "shoved home" to complete the simple laying procedure. For sizes under 21 inches a properly anchored bar provides sufficient leverage to close the tapered joint. An ordinary hand-jack with a trench brace is used for 21-inch pipes or larger. Within an hour after the joint is laid, tests have proved that it becomes a homogeneous mass even when laid under water.

This property of consolidation is of particular importance as it permits construction practices which materially reduce costs and assure a tight joint under extremely adverse conditions. Before placing a length, the workman merely removes by hand any pebbles or large material from the bell of the previous pipe, and any sand or silt that remains is consolidated in the joint itself. Tests have indicated a successful joint after the pipes have been subjected to a freezing temperature for 48 hours prior to jointing. Other tests have shown no sign of leakage at the joint with pressures of 70 pounds per square inch, although this test did not indicate its ultimate strength.

Hot asphalt being poured in making efficient pre-cast sewer pipe joints

Development of this joint was made under the direction of J. C. Johnston, northern division sales manager of Gladding, McBean and Company, manufacturers of the pipe for the project. He was assisted by H. E. Faulknes, engineer of tests, Seattle, together with W. E. Lemley and Howard Manser of his own company.

Process To Use Domestic Manganese Ores

THE Bureau of Mines has developed a practical method of solving the emergency manganese problem, which is of exceptional importance to the steel industry should a war or some other cause cut off foreign supplies of high-grade manganese ore, according to information made available at the Department of Commerce.

Manganese, it was explained, comprises 80 per cent of the alloy, ferromanganese, as used in making steel, and there is a scarcity of ore in this country of sufficiently high grade for ferromanganese production. Intensive work by the Bureau on the deoxidation of steel with manganese-silicon alloys, which can be made from domestic manganese ores, has shown their use would decrease ferromanganese requirements of

our steel 60 to 80 and even 100 percent. Excellent quality steel has been made with these alloys, it was stated.

The following additional information was furnished at the Department:

Manganese is used in the steel industry to improve blast-furnace operation and to make the steel workable by offsetting the harmful effects of oxygen and sulfur. Another reason for the use of manganese is that high-manganese steels have been developed with great success recently. The manganese gives to the steel many desirable physical properties.

Processes have been developed for utilizing domestic manganese ores which should easily fill our reduced ferromanganese requirements brought about by the use of manganese-silicon alloys. There are no technical difficulties in the application of the practice of using these alloys, and any difficulties involved would be only those arising from habituated ideas of the necessity for ferromanganese.

General acceptance of this practice and development of the available sources of domestic material suitable for making ferromanganese should make this country independent of foreign ores.

When our country was shut off from outside sources of manganese ore during the World War, the price of ferromanganese ranged from 100 dollars to 400 dollars per ton, and there was grave concern as to the availability of manganese at any price. The lack of domestic ores of ferromanganese grade was keenly felt during that period.

During the last decade there has been a continuous effort to develop a domestic manganese industry in this country, and some advance has been made. This gain, however, has not been striking enough to give the steel manufacturer any great amount of confidence that he can rely on domestic ferromanganese of the regular 80 percent grade during an emergency.

Imports of manganese ore depend not only on the relations between our nation and others but also on social and economic conditions within those countries which supply us. Ores of a composition permitting the manufacture of ferromanganese at a reasonable price are plentiful in Russia, India, Brazil, and the African gold coast.

The most important finding of the Bureau in investigating the use of manganese-silicon alloys for the deoxidation of steel was that a ferro-alloy containing manganese and silicon in the ratio of 5 to 1 was the most efficient in making clean steel at a decided saving in cost to the steel manufacturer. The reduction in ferromanganese requirements is striking. Further tests have shown that in the grades of steel which constitute our largest tonnage, ferromanganese can be dispensed with by the substitution of ordinary spiegel and a product of excellent quality obtained.

Spiegel ordinarily contains 20 percent manganese, 5 percent carbon, 1 percent silicon, and 74 percent iron. There is a huge tonnage of low-grade manganese ore in the United States suitable for the production of spiegel. In addition to these ores, there is a large tonnage of slag from open-hearth steel furnaces which should be considered a potential source of manganese.

A SOLAR OBSERVATORY FOR THE AMATEUR

(*Continued from page* 247)

in the piston, which can be varied in size to vary the rate of flow. This rough contrivance served to give the photograph reproduced in Figure 8. A more perfectly made arrangement of the same kind would give smoother motion.

With the apparatus described above a great variety of experiments can be made. When clamped in a fixed position it serves very well as a spectroscope, with which much of the visible, ultraviolet, and infrared spectrum can be photographed on plates sensitive to these regions. Many of the experiments described in books on spectroscopy can be easily performed, as it is a simple matter to make the auxiliary apparatus required for producing the spectra of flames, arcs, and sparks, while vacuum tubes containing hydrogen, helium, and other gases are not expensive. The solar spectrum, as already stated, can be photographed, and the presence in the sun of sodium, magnesium, calcium, iron, and many other elements proved by photographing their spectra on the same plate beside it. By holding the sun's image exactly tangent to the slit during an exposure, the bright lines of calcium, hydrogen, and helium can be photographed in the chromosphere, which surrounds the sun as a sea of glowing gas. These lines reach to higher levels in the prominences, the forms of which may be registered by using the instrument as a spectroheliograph and giving an exposure, with the *K* line set on the second slit, longer than that required for the sun's disk. In work of this kind the clock must keep the sun perfectly stationary, and the direct light of the brilliant disk should be excluded by a circular metallic screen, slightly larger than the solar image, fixed in position before the first slit.

It is easier to record the bright *H* and *K* lines in the spectra of the flocculi, which are scattered irregularly over the sun, as shown by Figure 8. For this purpose the instrument is fixed in position while the spectra of various parts of the disk (especially near sun-spots) are photographed with exposures shorter than those needed for the prominences. Narrow bright lines will be seen on the photographs with a magnifier at the center of the broad dark *H* and *K* lines, at points where the first slit happens to cross calcium flocculi. The occasional eruptions on the sun's disk described in the articles referred to on page 244 are represented by exceptionally bright calcium flocculi, which appear suddenly, change rapidly in form and area, and last from a few minutes to two or three hours.

The advantage of using calcium light is most easily recognized by taking a photograph of the sun with the same instrument, after moving the first slit a short distance so as to bring a part of the spectrum outside of the *K* line upon the second slit. In this case the calcium flocculi will not be recorded and only the sun-spots, perhaps with some faculae near the edges of the disk, will appear.[10]

[10] Readers who wish to know more about the calcium flocculi may consult such books as Abbot's "The Sun" or Russell, Dugan and Stewart's "Astronomy."

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

Patent Law in U.S.S.R.

A NEW statute on inventions and technical improvements, ratified by the government, came into force in the Soviet Union on May 25, 1931, states the *Economic Review of the Soviet Union.* All matters concerning the issue of patents and certificates of authorship are under the control of the Committee on Inventions of the Council of Labor and Defense of the U.S.S.R.

Two fundamental conditions which should be noted and which may be of interest to foreign applicants are as follows: (1) Foreigners have the same rights as citizens of the U.S.S.R.; and (2) as was provided under the previous patent law, persons living abroad must authorize a permanent resident in the U.S.S.R. to represent them in conducting their patent affairs.

Patents are issued only for new inventions which may have a practical use in industry. They are also issued for new methods of preparing medical, food, and flavoring substances, and other substances obtained by chemical means, but not for the substances themselves.

The procedure for dealing with an application for a patent is as follows: each application is subject to examination, in order to determine whether the invention is a new one. An invention is not considered to be new if prior to the filing of the application it was in use within the U.S.S.R. or abroad, or was described in a publication or made public in any other way so that the invention has become available to persons interested.

In granting a patent the following regulations apply: (1) Patents granted are valid for a period of 15 years. This period dates from final decision on the granting of the patent, but the rights of the owner are protected from the day on which the priority of his application was recognized. (2) Without the consent of the owner of the patent no one may make use of the invention. The owner of the patent himself may work his invention if he observes the laws regarding activity in private undertakings; particularly foreigners and foreign juridical persons may work their inventions if they observe the law regarding the arrangements for allowing foreign capital to engage in business within the U.S.S.R. (3) The owner of the patent may issue to another person permission to work his patent wholly or in part.

As regards the obligations of the owner of the patent, they include: The annual payment of the fees fixed by law. Further, he must work his invention on an industrial scale within the U.S.S.R. within three years from the day when the patent was granted, personally or through a licensee. If within the stipulated period the invention has not been worked, interested persons and organizations may petition the Committee to issue a compulsory license for use of the invention. In such a case the owner of the patent gets a remuneration, the amount of which is set by the Committee.

The law provides for another case in which the question of the compulsory issuance of a license may arise. This is when the invention is of essential importance to the government and no agreement with the owner of the patent has been reached. Then the owner receives a remuneration fixed by the Committee.

(*The verbatim text of the new patent law will appear in English in No. 6 of the scientific magazine on inventions, "Erfindungswesen," published in Moscow in the German language. This periodical may be procured from the Amkniga Corporation, 19 West 27th Street, New York City.*)

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.

Correction

DUE to an unfortunate typographical error, the name of Edwin J. Prindle, well known attorney and author of the proposal for a single court of patent appeals, published in our September issue, was mis-spelled. We offer our apologies.

Color Not a Trademark

IN *ex parte* Boston Wire Stitcher Company, First Assistant Commissioner Kinnan held that the company, of East Greenwich, Rhode Island, is not entitled to register, under the Act of 1905, a trademark for staples for tacking, stitching, and binding in stick form, a mark described as "a yellow or gold colored lining on the inside of the staple stick or refill."

The ground of the decision is that the alleged mark constitutes merely a color unassociated with any design or symbol and not functioning as a trademark.

In his decision, after referring to applicant's argument as to the difficulty of applying an identifying mark to the goods themselves, and applicant's explanation of the manner in which its goods and the machines in which they are used are sold and the fact that other parties sell staples which do not fit applicant's machines causing them to operate unsatisfactorily and it was applicant's desire to have some identifying mark upon the staples, the First Assistant Commissioner said:

"It must be deemed settled law that an applicant cannot monopolize a color for its goods unless the color is in some design, symbol, or configuration as indicated by the Supreme Court in the case relied upon by the examiner. (Citing decisions.)

"It is not thought there is any case which supports the view that coloring the entire inside surface of a stick or refill in the manner disclosed by the applicant can be deemed as a trademark. It would seem this coloring of the entire inner surface cannot by any logical interpretation be regarded as a design or symbol."

Yarn-Dyeing Machine Maker Signs Stipulation

UNFAIR competition in the leasing of machinery will be discontinued by a corporation manufacturer of machines used for the random dyeing of yarns, according to a stipulation agreement between the company and the Federal Trade Commission.

Leasing its machines to manufacturers and sellers of woollen, cotton, and rayon underwear, in competition with other corporations and firms, the respondent agreed to stop attempting to enforce leases of its machinery on the conditions that the lessee shall not use or deal in the goods or machinery of competitors of the lessor. The conditions of this agreement apply in all cases where the effect of such lease may be substantially to lessen competition or tend to create a monopoly in commerce.

The corporation further agreed to cancel all restrictive clauses which may at this time be contained in leases now in effect, and to notify the lessees that such clauses are without effect.

"Electric" Radio Set Patent Upheld

THE invention covered by the Lowell and Dunmore "plug in" radio receiving set patent used on all alternating current operated sets has been held by the Board of Appeals of the Patent Office to be entitled to priority over competitive claims of four other individuals.

The Board sustained the findings, in 1929, of the Examiner of Interferences of the Patent Office, who held the Lowell and Dunmore invention was prior to the other inventions. The two engineers, at the time the patent was issued in 1923, were employed at the United States Bureau of Standards, and devised the patent during their studies in connection with aeronautical radio.

The following additional information was made available in connection with the case:

In 1929 the Federal District Court at Wilmington, Del., held that the Lowell and Dunmore patent was valid and infringed by the Radio Corporation of America. An appeal from that decision, however, now is pending before the Circuit Court of Appeals at Philadelphia.

The Department of Justice in 1929 instituted a suit against the inventors, claiming that the patent was properly the property of the United States, on the ground that it was devised and developed while the engineers were employes of the Bureau of Standards, with the aid of Government

materials and during Government time. The inventors, however, again were sustained in their contention that the patent was properly their property.

In the patent interference case before the Board of Appeals the four other participants were Prof. Michael I. Pupin, of the Westinghouse Electric and Manufacturing Co.; Albert S. Blatterman, of the Murad Radio Laboratory, Asbury Park, N. J.; Robert L. Duncan, of Wired Radio, Inc., of New Jersey; and Marius Latour, of Paris.

Use of Word "Mahogany"

THE Federal Trade Commission recently announced its dismissal of a complaint charging Gillespie Furniture Company, Los Angeles, with unfair methods of competition involving use of the words "mahogany," "Philippine mahogany" and other terms of which the word mahogany is a part, to describe furniture said to be made of woods other than mahogany.

Chairman Hunt dissented to the action of the Commission in dismissing the complaint. Commissioner McCulloch also dissented and filed a memorandum of dissent, which follows:

"Respondent, Gillespie Furniture Company, deals in furniture made of wood grown in the Philippine Islands, and in selling respondent represents it as made of 'Philippine Mahogany.' This is charged to be a false and misleading representation —that the wood is not mahogany.

"True mahogany is a wood of the botanical species Swietenia, of the tree family Meliaceæ. Furniture made out of it has, for time out of mind, been held in high esteem.

"The wood now under consideration has never been known in the Philippine Islands as mahogany—it is called 'lauan' and 'tanguile,' and is not of the tree family 'Meliaceæ.' It belongs to a family entirely different from mahogany, and it is first called mahogany after it has been received here and put on the market by lumber dealers. In other words, it is not, botanically speaking, mahogany, though it has some of the same characteristics. This much is shown by uncontradicted testimony. According to what the writer considers the preponderance of the evidence, this wood is quite inferior to true mahogany for use in making furniture and other things, and does not come up to the commercial test of mahogany. When highly finished it has the appearance of mahogany, and its designation as mahogany is deceptive to the purchasing public.

"Several years ago the Commission issued complaints against six separate respondents upon the charge of falsely representing the Philippine wood 'lauan' or 'tanguile' to be mahogany, and on trial of the cases orders were issued requiring each of the respondents to desist. The cases were reviewed by a Circuit Court of Appeals, on application of a respondent, and the orders of the Commission were affirmed. The Supreme Court denied the respondent's application for review on certiorari.

"The court decided that the botanical test was controlling, and in disposing of that question said:

" 'It becomes unnecessary for us to discuss here the difference of expert opinion as to whether the trade designation mahogany should be confined to one or more species of the genus Swietenia, for wood from trees which in no way belong to either the genus or mahogany tree family, is neither true mahogany nor any kind of mahogany. And the experts justified the findings of the Commission that the woods imported from the Philippine Islands and sold by respondent as "Philippine Mahogany" are not from any tree of the Meliaceæ family.'

"The court also approved the Commission's finding that the Philippine wood was not mahogany from a commercial or usable standpoint.

"Subsequently numerous other concerns entered into stipulations with the Commission to desist from calling the wood mahogany.

"The anomalous situation is now presented that whilst six business and manufacturing concerns are restrained by final judgments of the Federal Courts of Appeal from representing the Philippine wood as mahogany, by the decision now rendered in this case, the remainder of the furniture trade is left free to represent it to be mahogany.

"Another lamentable result of the present decision of the Commission is that the deceptive calling of the Philippine wood mahogany is, according to substantial testimony in the record, causing the public to lose confidence in or desire for mahogany and to turn to other kinds of material."

"Mural" Not Registrable

THE United States Radiator Corporation, of Detroit, Michigan, is not entitled to register, under the Act of 1905, the word "Mural" as a trademark for heating radiators since the word is merely descriptive of the goods or of the character thereof, according to a recent decision by First Assistant Commissioner Kinnan.

In his decision, after noting that there are radiators, as shown by the record, which are susceptible of being mounted or installed in an enclosure within a wall and others which are supported by brackets fastened to the wall, the First Assistant Commissioner said: "From the foregoing it is apparent there is among these various types of radiators a class or a type which is known and readily distinguished as wall radiators, and the word sought to be registered is used upon this type as well as upon other types."

And then, after referring to dictionary definitions of the word "mural," he said: "It is evident that when used alone in connection with goods of the character to which applicant applies it, the word has no other known meaning than that noted in these dictionaries. To those familiar with the different types of radiators, this word appearing on a wall radiator would, it is deemed, mean only that the radiator is of that type; that is, the word would be merely descriptive of such a radiator."

Must Not Sell Below Cost

THE Federal Trade Commission has ordered Noma Electric Corporation, New York, manufacturers of decorative electrical goods such as Christmas tree lighting outfits, to refrain from selling extension or non-extension Christmas tree lighting outfits equipped with any kind of lamps at prices which are less than the cost to the company of manufacturing such outfits, when this is done with the intent to suppress competition in the manufacture and sale of such goods.

The Commission's order followed the company's waiver of hearing and its election not to contest the Commission's complaint.

Inventive Genius Active

INVENTIVE genius appears to be more active now than under normal business conditions, according to R. Potter Campbell, chairman of Campbell, Peterson & Co., Inc. The company acts as agent for new products and processes.

"An analysis begun a year ago has been a revelation to us," said Mr. Campbell. "We have been impressed by the steady flow of new products, devices, compounds, and processes from Germany, Austria, France, Czechoslovakia, Poland, South America, Australia, and other countries. Inventive genius appears to be far more active at this time than in normal periods because of the desire of the scientist and inventor to increase emoluments."

Suit to Compel Patent Grants is Permitted

THE statutory provisions, section 4915 of the Revised Statutes, giving, in certain cases, to an applicant for a patent whose application has been refused by the Commissioner of Patents a remedy by a suit in equity in a district court of the United States, has just been held constitutional by Judge Simons of the District Court for the Eastern District of Michigan, reports *The United States Daily*.

Although originally enacted in 1836, the validity of the statute was challenged for the first time, according to Judge Simons' opinion, in the case in which he has just rendered a memorandum opinion.

The jurisdiction of the district court to entertain a suit under the law by which a judgement was sought that the applicant was entitled to a patent was challenged on the ground that Congress lacked power under the judicial article of the Constitution to grant such power to the district courts.

Two of the defendants supported their contention that the statute was invalid, according to the opinion, by the two following propositions:

"1. This suit is not a case or controversy, because not in such form that the judicial power is capable of acting upon it, since the contentions of all adverse parties are not submitted to the court for adjudication.

"2. This suit calls for mere administrative or advisory or declaratory action."

After reviewing decisions of the Supreme Court relative to remedies given in courts from decisions of other administrative tribunals, Judge Simons concluded that section 4915 was constitutional and that Congress had power under the Constitution to enact it.

The decision was handed down in the case of Cleveland Trust Co. v. Nelson et al. It arose out of interference proceedings in the Patent Office. The Commissioner of Patents had not been joined as a party defendant in the suit at the time Judge Simons' opinion was handed down.

Books SELECTED BY THE EDITORS

A HISTORY OF CHEMISTRY

By F. J. Moore, late Prof. Organic Chem., and revised by William T. Hall, Asso. Prof. Analytical Chem. Both of Mass. Inst. Tech.

A TREATMENT of the historical development of the important theories of chemistry and the personalities of the great men whose efforts have contributed to that development. In this revision much new material has been added. Brief biographical sketches of a number of brilliant chemists who died during the last twelve years are given. An additional chapter is devoted to Americans who did much to develop chemistry in this country.—$3.20 postpaid.

THE WAVE MECHANICS OF FREE ELECTRONS

By G. P. Thompson, Prof. Nat. Philos., Univ. Aberdeen

"AN attempt to state the principles and applications of the new wave mechanics, in so far as these concern electrons not forming part of an atom, using the minimum of mathematics." So says the preface. The "minimum of mathematics" mentioned is the calculus. Of course it is impossible to make this subject simple and at the same time get very far into its real substance. The author—who by the way is the same Thompson (son of the famous J. Arthur Thompson) whose experiments on gold films had much to do with demonstrating the truthfulness of the wave atom concept—is to be congratulated on this book.—$2.65 postpaid.—*A. G. I.*

RADIATIONS FROM RADIOACTIVE SUBSTANCES

By Sir Ernest Rutherford, Dr. James Chadwick and Dr. C. D. Ellis

SIR ERNEST RUTHERFORD'S name always will be associated in a leading way with radioactivity, and thus this book might be said to proceed from the fountainhead of information on that subject. It is authoritative and brings the whole field up to date. It is not an elementary work, neither is it a veritable nightmare of higher mathematics. The reader should, however, have some knowledge of mathematics and modern physics. As a reference book this outstanding work will be invaluable. 575 text pages, illustrated.—$6.75 postpaid.—*A. G. I.*

INTERNAL-COMBUSTION ENGINES

By H. E. Degler, Prof. Mech. Engr., Texas Univ.

AN elementary treatise considering only the things which form an important part in the development of this subject and describing engines and auxiliaries which are commonly used. Principles of operation, construction, performance—both stationary and portable—are treated thoroughly, yet concisely. A certain knowledge of the principles of the flow of heat and the operation of steam engines is assumed. —$2.15 postpaid.

EXPERIMENTAL MECHANICS

By A. Frederick Collins

ANOTHER of this uniform experimental series from which you can gather the fundamentals of engineering without any background of previous study. A series of simple and useful experiments with mechanical movements and directions of how to make them out of pasteboard. All devices described are illustrated by simple line drawings.—$2.15 postpaid.

ECONOMICS FOR ENGINEERS

By Edison L. Bowers, Asst. Prof. Economics, and Henry Rowntree, Instr. in Economics. Both of Ohio State Univ.

THIS is practical presentation of economic principles and problems for engineers and engineering students. The treatment is as concise as possible and emphasizes the engineering aspects of economic theory and business activity. The discussion of costs and pricing is especially thorough. Some aspects of business activity, such as marketing, investments, and insurance, not ordinarily included in texts on economics, are treated here for the convenience of the engineering audience to whom the book is addressed.—$4.20 postpaid.

SPEED

By Frank Hawks

UNDOUBTEDLY one of the most interesting books on aviation that has appeared. It recounts events in a most colorful career, gives sane reasons for his continuing marvelous flights and is written in unusually easy and convincing style. An adventure story entirely without technical instruction, but the facts one gleans add considerably to the history of flight and point a convincing finger to future development. Altogether a most delightful and instructing story.—$2.65 postpaid.

THE CONQUEST OF THE ATLANTIC BY AIR

By Charles Dixon.

WE all have read items in the news concerning the transatlantic flights but nowhere before have all the known details of all the flights, both successful and unsuccessful, been collected. Here one will find many important points which have been missed in the day-to-day accounts and it all makes most interesting reading. Historically this book is significant for it places on permanent record the true stories when they can be written with greatest fidelity to authenticated reports.—$2.65 postpaid.

GLIDING AND SOARING

By Percival and Mat White

THERE have been several books on gliding issued comparatively recently, but none in our opinion quite as concise, clear, and conclusive as this one is. A profusion of diagrams, photographs, and drawings explain many confusing points for the beginner, while aerodynamics and construction data form a valuable reference for the more expert pilot. Many executives of commercially operated airlines believe the future development of gliding will do more to assist aviation than anything else.—$2.65 postpaid.

TELEVISION, ITS METHODS AND USES

By Edgar H. Felix, M. I. R. E.

THE authors of books on television which have so far appeared, have, in general, been content to deal solely with the electrical and mechanical phases of the art and to pass over with little or no mention the questions which hold the greatest interest to the average person. The present work turns the revealing light of conservative judgment, backed by technical knowledge, on the television scene and reveals it in its true perspective. Television is imperfect and

the realization of television in the average home is still around the corner —but the corner may be far, far away. In order that the reader may grasp the entire situation, a goodly part of this book has been devoted to a straightforward description of various television systems as they exist today. Then are answered such questions as: When will television arrive? How will it be commercialized? What kind of television entertainment may we expect? The logic is unassailable as it is based on cold facts, and a reading of this book will tell the interested person all he needs to know of television systems, their drawbacks and advantages.—$2.65 postpaid.—*A. P. P.*

UP FROM THE APE

Earnest A. Hooton, Prof. Anth., Harvard.

"I HAVE simply sat down and typed out the stuff which I deliver each year, more or less extemporaneously, to a class of Harvard students most of whom have had no previous instruction in the subject."—from the author's preface. If the reader wishes to take a course in general anthropology "at Harvard" via "Up from the Ape," here is his chance. This book of 605 pages covers anthropology from several angles and gives an all around survey of the subject of human evolution.—$5.20 postpaid.—*A. G. I.*

TWO THOUSAND YEARS OF SCIENCE

By R. J. Harvey-Gibson, Prof. Univ. Liverpool

THROUGH a typographical error the price of this book as given in our July issue is incorrect. The correct price is $3.65 postpaid.

THE SCIENTIFIC DETECTIVE AND THE EXPERT WITNESS

By C. Ainsworth Mitchell

AS the title indicates this is a popular description of the methods by which those with specialized training have been able to assist in solving problems of the kind which constantly arise in criminal investigation. It includes the giving of evidence but covers scientific detection more particularly. A majority of the references are English though celebrated American cases are included. 5 x 7½—243 pages freely illustrated. —$2.15 postpaid.

THE ART OF LEARNING

By Walter B. Pitkin, Prof. Journalism, Columbia

HERE is a book that describes in detail the technique or art of learning. Regardless of the extent of the reader's formal education it aims to explain practical and direct methods for applying himself most effectively in making new knowledge his own. In short, it makes clear just how to use one's mind with greatest economy of time and effort for maximum results.

Concentration, controlling attention, memorizing, analyzing and digesting facts, selecting salient features, training and developing one's mental powers are discussed in an informal and unorthodox manner. Written expressly to give practical aid to those whose positions or ambitions compel them to learn some new science, profession, trade, or business.—$2.65 postpaid.

THE AMERICAN BLACK CHAMBER

By Herbert O. Yardley

ETHICS vary with situations, at least one is led to believe that from this most astounding story of an important under-cover activity of our Military Intelligence Bureau during the war. That it is possible to accomplish the seemingly impossible seems to be the fact of many operations of the Cryptographic Bureau with regard to foreign diplomatic messages in code. Were it not authenticated by internal evidence that seems conclusive one would believe the story was a production of some renowned detective story writer. A book that will give you much absorbing reading, and if you care to delve deeper, plenty of sharp mental effort.—$3.65 postpaid.

100 PATHS TO A LIVING

By Edward Mott Woolley

TRUE experiences of men and women who discovered new ways of getting a job, who got into vocations more congenial, who built up new abilities in lines they had never known before and stories of those who found means of obtaining financial and personal independence. Narratives of brains, ingenuity, strategy; brief biographies that suggest occupations and how to get into them. Knowing what others have done gives aid to those who would better their status in life, from the less important up to the very important—in each instance there is a key to success, if we can but find it.—$1.10 postpaid.

PERSONALITY AND WILL

By Francis Aveling, Reader in Psychology, London University

YOU will like this book. It goes straight to the point in a clear cut, lucid manner, and is most readable. No farflung sentences to test continuity of thought. No jumbles of expressions to baffle the layman reader. Paragraphs are set out with headings which focus at once the subject to be analyzed and the trend of development moves with ease to the conclusion. Some of the chapters are Instinct and Its Immediate Derivatives, Sentiments and Values, Character and Temperament, The Self or Person, Freedom and Determinism, and The Nature of Personality.—$2.15 postpaid.

NUT GROWING

By Robert T. Morris

THIS is a well conceived plea to all who have a bit of ground, to plant nut trees both because of the food and lumber value which they develop and for esthetic reasons. The New York *Times* says "There is no other person in this country with Dr. Morris's breadth of scientific and practical knowledge of nut culture wherewith to demonstrate its possibilities for profit and pleasure." —$2.65 postpaid.

STEPS IN THE DARK

By Milton Mayer and John Moore

THIS book contains 28 short essays on topical subjects, mainly scientific, and makes interesting reading of the lighter kind. The authors are inclined to dramatize science, both where there is drama and where there is not, the style being rather strenuous and a bit "newspapery." However the sketches are interesting and the reader would get his money's worth even if the publisher had not padded the book so heavily with thick paper and by other methods.—$2.65 postpaid.—*A. G. I.*

THE WAY TO RECOVERY

By Sir George Paish

THE present crisis is the most serious the world has ever experienced and the most difficult to adjust. Only by a calm analysis of the underlying conditions and a frank facing of the truth, whereby national aspirations and jealousies can be restrained in the interest of fair and equitable apportionments to all, will a way be found out. Unlimited credits for a time is the author's solution and in quite a convincing way he develops this theme. Broadmindedness and an attitude of brotherhood toward all, mark the clear thinking which this book contains. It may well be thoughtfully read by all of us.—$2.15 postpaid.

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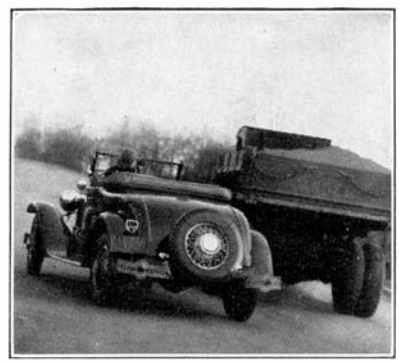

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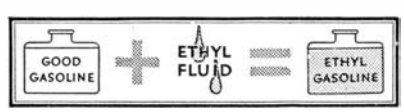

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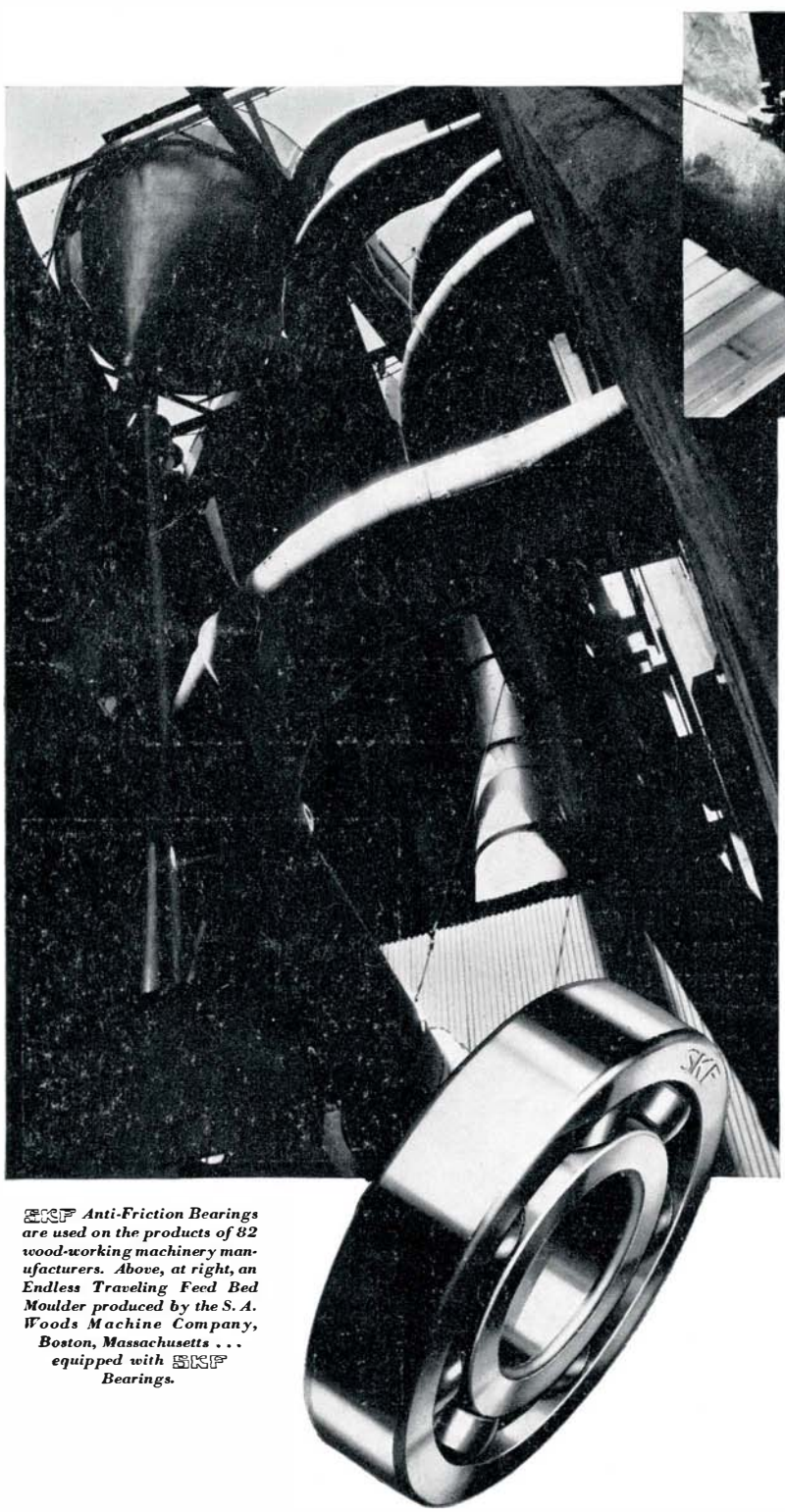

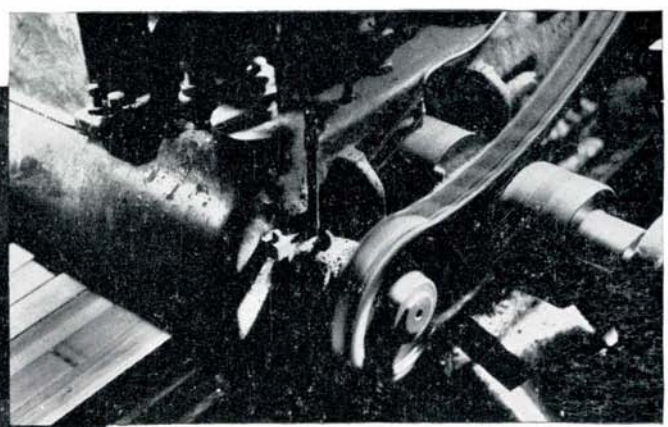

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