

SCIENTIFIC AMERICAN

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By Henry Norris Russell

SCIENCE VERSUS THE CRIMINAL

By Albert A. Hopkins

HOW SHALL WE LIVE IN THE FUTURE? . . .

By Mary Jacobs

DOLLARS IN TRIBUTE TO 'WHITE ANTS' . . .

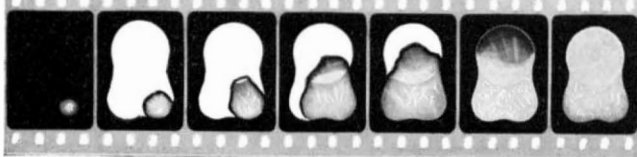
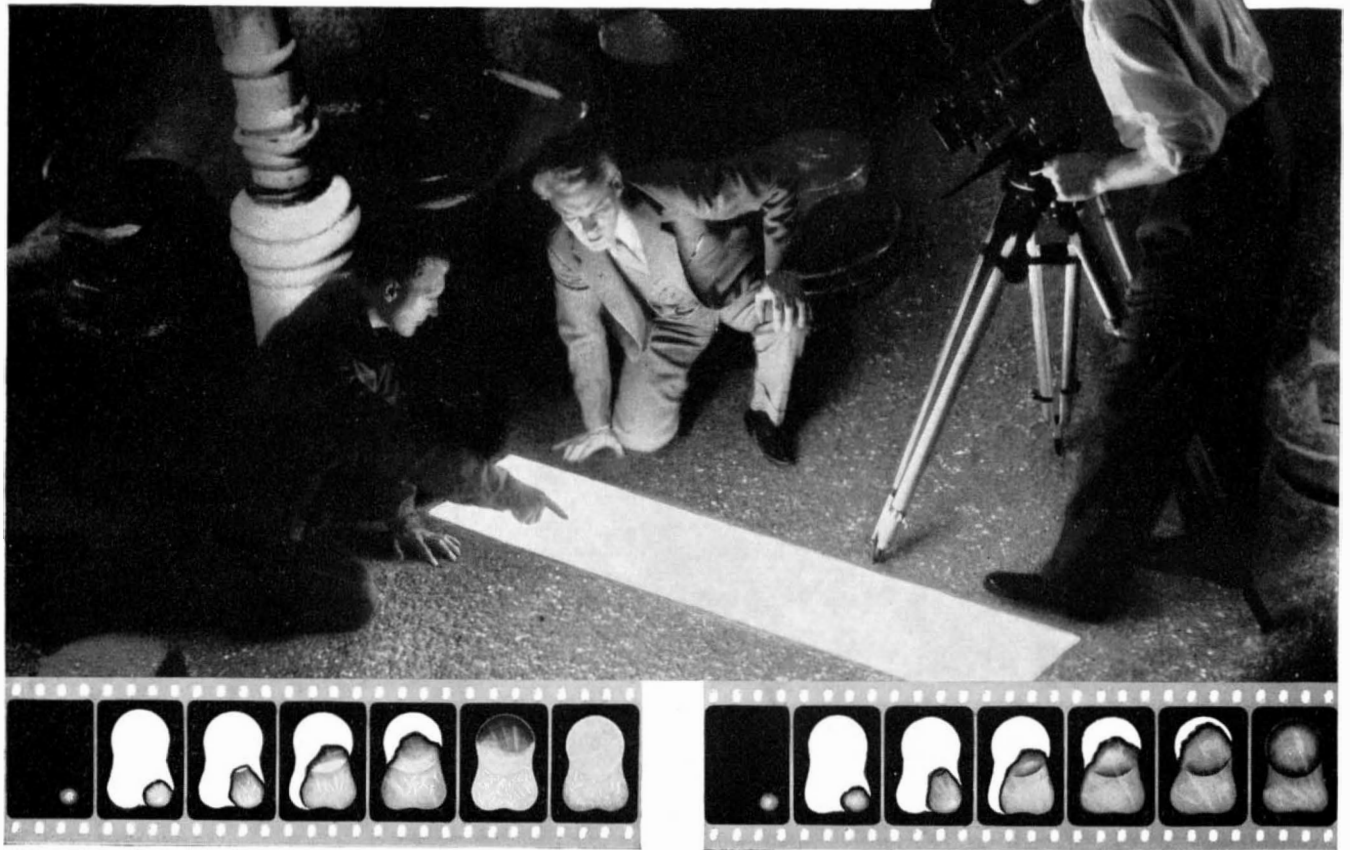
By S. W. Long

AMATEUR ASTRONOMY IN THE WEST

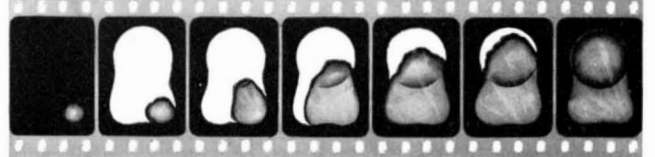


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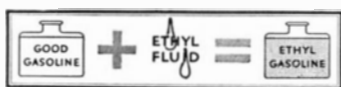
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EIGHTY-EIGHTH YEAR

ORSON D. MUNN, Editor

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ANNOUNCING
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THE BELL SYSTEM offers to the public a new Teletypewriter Service. Any subscriber to this service may be connected, through the teletypewriter "central," to any other subscriber, whether he be around the corner or across the continent. Subscribers can type back and forth by wire, for short or long periods, just as they now hold conversations by telephone.

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ACROSS THE EDITOR'S DESK

ROCKET propulsion of man-carrying vehicles, especially those which leave the ground and travel through space, is probably one of the most intriguing subjects to the present-day follower of scientific developments. But there is so much misinformation available from various sources that those who are earnestly in search of the truth are often misled. Rocket propulsion is as yet in the experimental stage, and many writers have prematurely burst into print concerning it with predictions for which they have no sound foundation. Those who are doing the real experimental work with rockets are the ones about whose work the least is heard, and this is particularly true of Professor Robert H. Goddard. Quietly working in New Mexico, under the sponsorship of the Smithsonian Institution and the Guggenheim Foundation, Professor Goddard has been carefully feeling his way along a path which may some day lead to great changes in transportation methods. We have secured some of the details of a new rocket-plane upon which he has been working, and which embodies unusual principles, and will present them in our next issue.

In order that students of military science and history may grasp the situations which arise in the development of affairs of international importance, it is essential that they know something of the personalities that have been responsible for guiding the governments concerned through troublous times. Recognising this, we have already presented surveys of the lives of several men of international note, and now have in hand for our March issue a summary of the careers of Viscount Grey and Lord Haldane. This has been prepared by Captain W. D. Puleston (who wrote the other articles referred to) and we feel that it will be received with the same acclaim that has been accorded to Captain Puleston's work in the past.

An electric power company goes into the business of tree-planting and the question immediately arises as to why they should do so. Surely, trees cannot be used to produce power, and just as surely, the planting is not being done merely for purposes of beautification. But—hold a minute—while the trees do not produce power directly, they have a great effect on the capacity of certain water-power plants. This is true because . . . but that is the crux of an interesting conservation article which is scheduled for next month, and it would hardly be fair to the author to reveal the answer in this column. Those who are interested in our natural resources will find

much of importance in this article; casual readers will learn of the connecting link between trees and water wheels.

Another scientific hobby looms on the horizon. Whether or not it will assume the proportions of our amateur telescope making hobby is a question which only time will answer, but at least it is one that will tempt most of our mechanically inclined readers. It is that of gem-stone cutting. Does it sound difficult and expensive? Quite the reverse is the case, as shown in an article by J. H. Howard, which is scheduled for March. Mr. Howard has taken up this hobby and, delving into the scanty literature available, has turned out some work that would do credit to the professional. As to cost—the equipment and materials need not total more than 50 dollars. From not more than 25 dollars' worth of raw material, Mr. Howard has cut several hundred stones and has enough material left for several hundred more. Agate, carnelian, jasper, and dozens of other stones are readily available and lend themselves admirably to the work.

"From Angora Goat to Mohair Fabric" is the title of another March article; it leads through the intricate steps by means of which that versatile fabric, mohair, is produced. Mohair is a familiar textile for upholstery, and now a development in the industry has introduced a "man-made fur" that is making its bid for a high position in the clothing world. A special series of photographs will illustrate an article that explains in understandable language the complicated steps in the manufacture of mohair.

Power from the sun is a subject that has intrigued scientific workers for centuries. As with rocket flight, premature announcements by those without a basis in fact have rendered the public skeptical of the entire subject. Now, however, there has been designed by Dr. John A. Anderson, of the Carnegie Institution of Washington, and Russell W. Porter, of the California Institute of Technology, a solar furnace that will make possible experiments with sustained temperatures in the neighborhood of 10,000 degrees, Fahrenheit. With it the physicists hope to be able to subject various substances to a temperature as high as that found in some parts of the sun's surface, and study their reactions. We shall publish soon a description of this furnace, and tell something of its possibilities.



THE BOOK OF THE MICROSCOPE

By GERALD BEAVIS

This new and popular book of 246 pages (illustrated) provides a pleasant approach to the world of microscopic marvels. Without any of the earmarks of a treatise or textbook it tells how to observe and what to observe in the animal, vegetable, and mineral kingdoms. This vast world contains an endless variety of subjects. Microscopy, once tasted, usually becomes a lifetime hobby and incidentally it is an inexpensive one.

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PHOTOCELLS

AND THEIR APPLICATION

By ZWORYKIN AND WILSON

The "electric eye" is increasing in importance for laboratory experiment and for the actuating of relays where infinitely delicate impulses only can be obtained. This is the first comprehensive text that has appeared and the authors' association with some of the most decisive experimentation guarantees authority and conclusive treatment.

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THE FINGERPRINT INSTRUCTOR

By FREDERICK KUHNE

Schools of identification are increasing in number. Foreign nations are sending representatives to study our systems. Hospitals are adopting this method to prevent substitutions. There is great opportunity in this line if one will but study it attentively. This book is the recognized authority.

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100 PATHS TO A LIVING

By EDWARD MOTT WOOLLEY

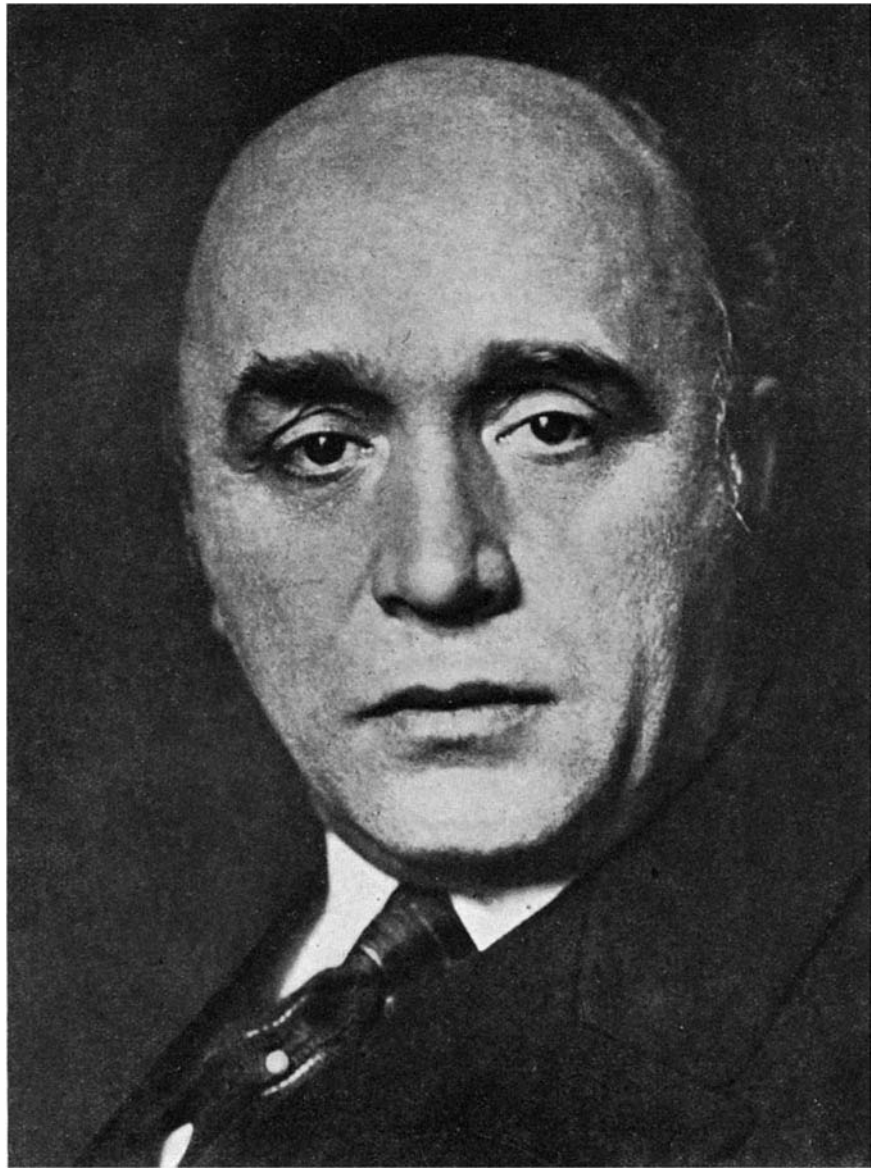
True experiences of men and women who discovered new ways of getting a job, who got into vocations more congenial, who built up new abilities in lines they had never known before and stories of those who found means of obtaining financial and personal independence. Narratives of brains, ingenuity, strategy; brief biographies that suggest occupations and how to get into them.

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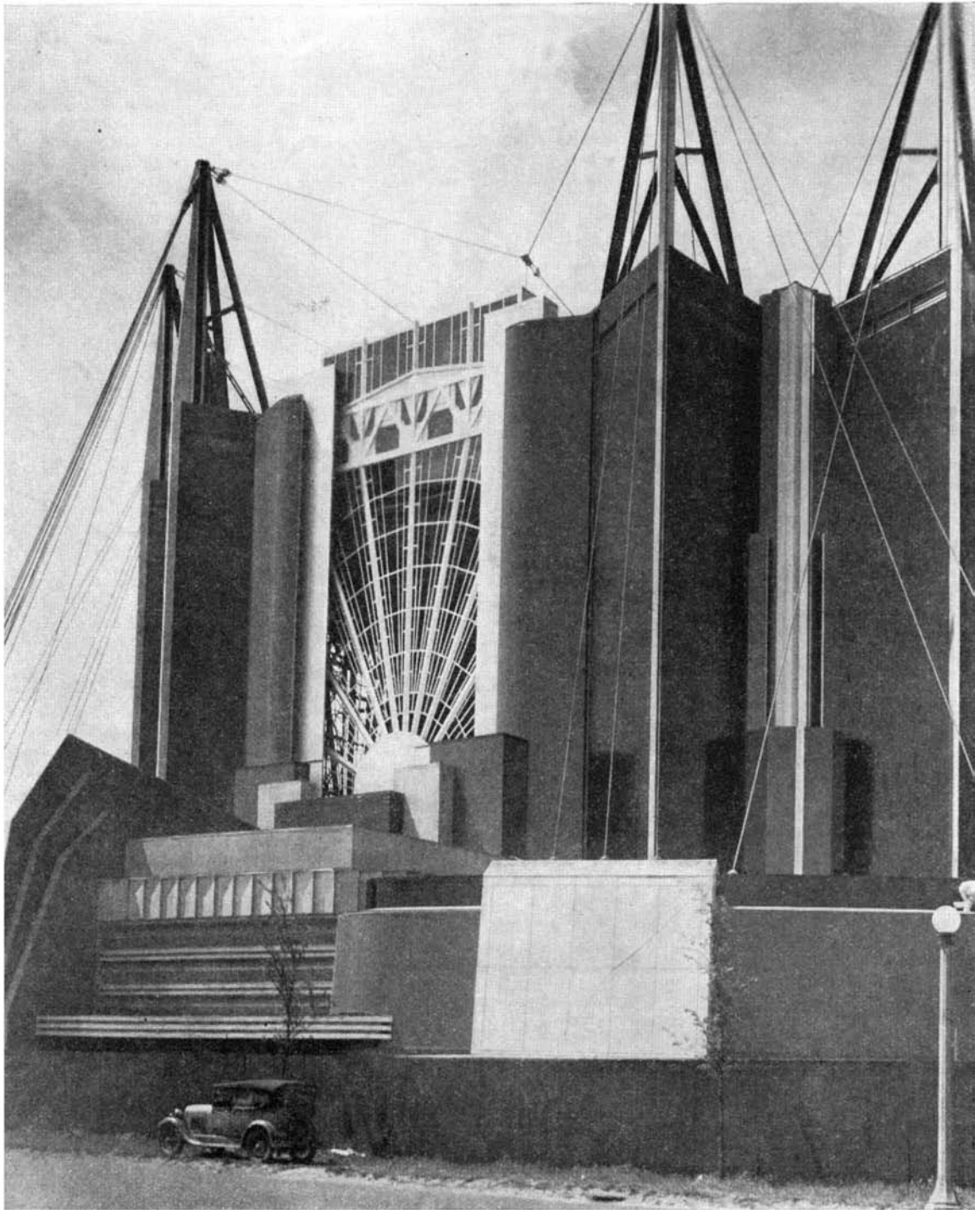
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DR. FRIEDRICH BERGIUS

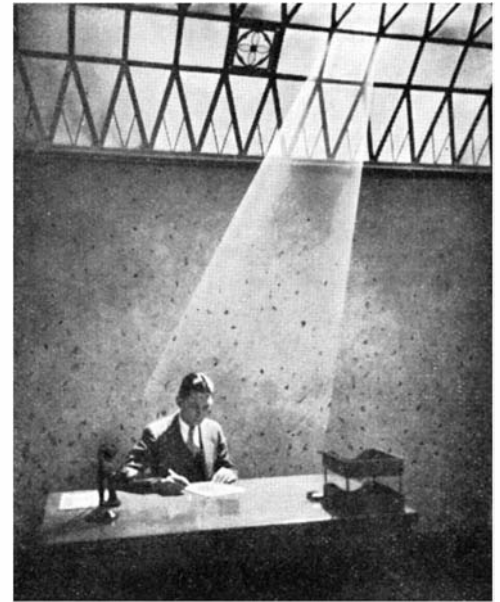
THE Nobel Prize for Chemistry has been awarded to Dr. Friedrich Bergius of Heidelberg, Germany, who shares it with another German chemist of fame, Dr. C. Bosch. For 15 years—before, during, and after the World War—Dr. Bergius labored on this process which is now known as “berginization.” It converts coal into gasoline or oils. This is the process now controlled in America by the Standard Oil Company of New Jersey (see “A Gallon of Gas from a Gallon of Oil,” in *SCIENTIFIC AMERICAN*, November 1930, pages 352-354) and at present under actual though relatively small production at that company’s Bayway, New Jersey, plant. Owing to the existing world over-production of petroleum this plant is not at

present converting coal into gasoline but into lubricating oils. The Bergius process will be at its best when oil is above two dollars a barrel, not the present fifty cents. It will be of great value in time of war for nations which lack petroleum (Germany, for example—in fact that is very largely how the process came to be worked out in the first place), and in general for the future when oil becomes less plentiful. The difference between coal and oil is essentially a matter of their hydrogen content. The Bergius process consists of adding hydrogen to coal—though it is not nearly as simple as this sounds and is partly secret. Dr. Bergius has also discovered a way of converting wood into sugar, but this has not been put into production.



**CABLE-SUSPENDED DOME AT THE
1933 CHICAGO EXPOSITION**

HERE is an important application to architecture of the principle of support used in the suspension bridge. This is the east entrance to the cable-suspended dome of the Travel and Transport Building at "A Century of Progress"—Chicago's 1933 World's Fair. The roof is supported by cables from the six steel towers. The dome is 125 feet high and 200 feet across. The space enclosed is said to be one of the largest unobstructed roofed areas ever erected by man. Great latitude is allowed for expansion and contraction as weather conditions change. The structure is extraordinary to look upon but the brilliant color scheme tones down some of the harsh lines. The capacity for exhibits will be enormous. For further description see the feature article on page 76.



Left: The windowless office is a coming reality. We will work in an air-conditioned room flooded with artificial light from unobtrusive sources. In the center of the ceiling is an ultra-violet unit, while the window is false, being lighted by a blue daylight lamp. Right: Auxiliary illumination projected from built-in system with a daylight lamp back of a prismatic glass plate

HOW SHALL WE LIVE IN THE FUTURE?

By MARY JACOBS

ULTRA-VIOLET rays will have a marked influence upon our mode of living within the next generation," says Dr. H. C. Rentschler, Director of the Research Laboratories of the Westinghouse Lamp Company, who has been doing intensive research in this field for many years. The air we breathe, the food we eat, our lighting, our furniture and decorations, our very homes and conditions of living will be metamorphosed by this modern development.

"Of course," he continued, "these changes have already begun to manifest themselves, as in the case of artificially conditioned air in the theaters. There will be no sudden transformation, but a gradual extension of our facilities for enjoying life, as we become acquainted with the properties and powers of the ultra-violet rays.

"Bear in mind," the Doctor added, "that these changes, radical though they be, are no more far-reaching in effect than those which have occurred in our homes within the past 30 years and most of which we are all familiar with. Many of us recall the homes of our childhood—the wood or coal-burning stoves used for cooking and heating purposes, the kerosene lamps, the tin bath-tubs, and generally inadequate sanitary facilities. Within a brief space of time the gas-lamp made its appearance, then the electric bulb illuminated the world . . . the modern bathtubs

and sinks, the gas and electric stoves . . . and greatest wonder of all, the steam heating system. Now we accept these as a matter of course, but when they were first introduced, each of these and the myriad other improvements



Dr. Harvey C. Rentschler, who was interviewed by the present author

which have made life more pleasant, were heralded with amazement and often with great skepticism."

"Let us consider the home of 1950. It will be entirely different, both externally and internally, from our pres-

ent-day home, just as the house of 1931 was a vast improvement over that of the preceding generation. Other materials will be used: in place of wood, the framework will be of steel, which will do away with the architect's present problem of constructing substantial walls to support the floors and roof. Now the number and size of the windows must be carefully taken into consideration, for the window casings must be adequately reinforced. The future home will have no such problem: the architect will be able to give his imagination free rein in deciding just how much glass he wishes to use, both for decorative and utilitarian purposes."

ALTHOUGH glass will be used freely, there will be no windows as we know them. There will be no need for open apertures for light or ventilation—the application of the ultra-violet rays will cover these requirements. The materials used for finishing the structure will be made of specially prepared concrete or absorbent plaster, which will facilitate the heating and cooling of the interior of the house, without regard to the outdoor temperature. Double walls will be erected with a dead space between them, containing a good insulating material to conserve heat and deaden noises. Thus, what has been termed the "curse of city life," disturbing sounds, will be almost entirely

done away with, giving nerve relief.

The elimination of windows, Dr. Rentschler feels, will be a very important factor in lowering our heat bills and in aiding our general health. Our present window panes have three times as much heat conduction as wall space of the same size, so that a great part of our heat goes through the pane itself. The glass used for our future homes will be specially treated to prevent this enormous waste.

Air will, of course, be artificially purified. It will not come from windows that open into the germ-laden, dust-bearing city atmosphere; it will be forced through pipes and chemically treated to remove dust and germs; it will be filtered and subjected to ultra-violet rays, and automatic ventilators will admit this purified air to our living rooms and offices. The ultra-violet will destroy any germs which may remain, and provide it with health-giving properties.

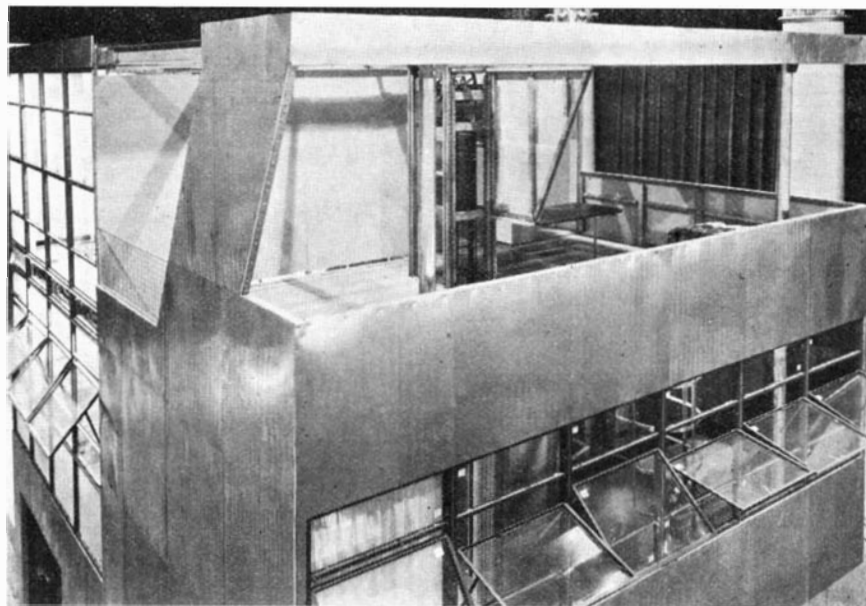
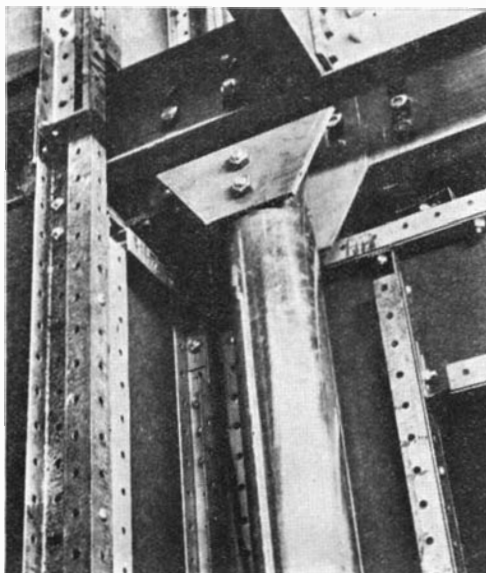
Every room will be supplied with the proper amount of ultra-violet essential for good health. Colds and other infectious and contagious diseases will be reduced to a minimum. Our rooms will not be too hot and humid in the summer; too cold and dry in the winter. We will be able to adjust the temperature and humidity at will. Do you wish to transport yourself, in your imagination, from the wintry North to the balmy South? The turn of a switch regulating the wall ventilators will provide the desired temperature. You may, at will, experience the sunny climate of California or the cold chill of the snowcapped mountains of the arctic regions . . . while you sit comfortably at your ease in your living room.

"BUT," I asked Dr. Rentschler, "won't many of us, creatures of habit that we are, object to doing without windows, despite the improvement to our health and the added comforts? Won't that arrangement give us a pent-up, imprisoned feeling?"

"The change, of course, cannot be too abrupt," was the answer. "At first we shall allow just enough window space to make us feel at ease. In reality, however, the windows will either be hermetically sealed or they may open into a wall. As we become accustomed to the idea of windowless dwellings, even these make-believe apertures will be discontinued."

Whatever glass will be used in constructing a house will function for lighting purposes only. Perhaps the upper part of the wall surface and the lower part of the ceiling may consist of glass panels, permeable to ultra-violet rays.

These panels, which will admit light during the day, will serve as inbuilt lighting panels from which light will be reflected at night. We will use not only the type of lights employed at present, but ultra-violet lights of different kinds. These will enable us to change the appearance of our rooms to suit our moods. The mere turn of a switch will bring us orange light for a gay, brilliant mood; or soothing violet light when we want to sleep.



Top: Method of putting together an aluminum structure. Above: An aluminum house attracted wide attention at a recent New York architectural exhibition

"In fact," Dr. Rentschler continued, "our entire lighting system may be changed. Instead of imprisoning stars in electric bulbs, we may have large luminous masses to diffuse our light. We may have globes outside wall openings to reflect light indoors and color our outdoor atmosphere; we may have wall panels upon which we shall play color symphonies, just as we play musical symphonies on instruments now. In-

stead of hanging pictures on our walls, we shall illuminate landscapes and portraits painted on these panels. There will be no danger of tiring of a picture then—at the press of a button its coloring, and even motif, will appear to change.

"We have all seen the effect of stage lights upon the appearance of actors' costumes. A yellow frock may appear orange, or blue, or purple, depending upon the color of the light played upon it. Moving-picture producers take this matter of changing color into consideration in the preparation of films; for example, the actors must make up their faces in weird colors in order to appear natural on the screen.

"Imagine this change intensified to a remarkable degree; so that not only color combinations but the entire appearance of paintings, draperies, and furniture will be radically changed. By the use of a newly discovered kind of fluorescent paint, we can at will change the character of a room by flashing ultra-violet lights upon furnishings which have been treated with this compound."

By way of demonstration Dr. Rentschler showed me a room which has been built in the Westinghouse building. It contains but a single window, and that opens into a wall. Ventilators

in the wall supply purified air; light comes from lamps behind the glass panels which have been set into the walls and ceiling; ultra-violet light shines down upon you day or night, the quality being adjusted to your desire. There are no radiators; an invisible heating system hidden in the walls furnishes heat in the winter. A refrigerating system, similar to that utilized in our electric refrigerators, is installed to

cool the room during the warm months.

Upon the wall hung what appeared to be an ordinary painting. It represented a typical New York apartment house, many-storied and uninteresting. Ultra-violet light was flashed upon it. There hung the same painting; but how different it looked! In the background were huge, snowcapped mountains; in the foreground, the outlines of a pretentious estate, surrounded by high walls.

In considering lighting, photo-electric cells will play an important part. They will be utilized to perform innumerable functions automatically. Already they are being used to open doors in restaurants. Waitresses at the Stevens Hotel in Chicago need have no fear of bumping into each other and upsetting their trays as they pass through the doorway. An invisible light ray constantly plays upon the door; as the shadow of a human figure intercepts this, the photo-electric cell receives the message, the circuits react accordingly, and the door swings open.

THE photo-electric cell is an extremely sensitive mechanism which responds to the slightest change in the intensity of light. It will not be necessary for us to switch the lights on at night—the shadows of approaching nightfall will cause the cell to motivate the switching mechanism, so that lights will go on automatically!

These devices will turn on electric heaters and stoves for us; start and stop machinery in our factories; displace the doorkey. Flashing a light on the keyhole in a certain code will do the trick.

“Just how will ultra-violet rays improve our health?” I asked.

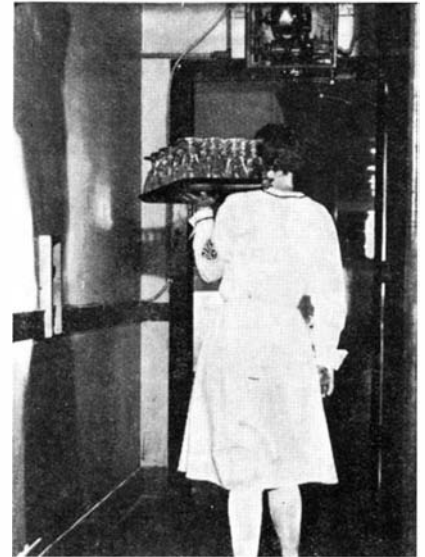
“The universal application of ultra-violet should improve our health enormously. Should we desire it, this synthetic sunlight will play upon us both out-of-doors and indoors, night and day, while at work or at play. It has shown itself to be highly efficacious in the treatment of various disorders and diseases, especially with reference to rickets and skin irritations, such as boils, scurvy, and eczema.

“Why, even our tempers will be improved by the use of this synthetic sunshine. We all know how much better we feel while in the fresh air and sunlight—petty disturbances seem to disappear. On a raw, dreary, drizzly day, every minor irritation is magnified!”

“What about the food of the future,” I queried. “Will not the ultra-violet ray affect that?”

“Assuredly; it has already,” was the reply. “Ten years ago most of our foods were calculated by calories; today they are accepted or discarded largely according to their vitamin content. Vitamin D, which makes possible the assimilation of calcium and phosphorus contained in our foods, is particularly important as a basis for sound health. The irradiation of foods (exposing them to ultra-violet rays) generates this vitamin for the needs of the body. Otherwise it might remain inert; our foods would lack the properties so essential for strong limbs, sound teeth, stimulating growth and nutrition. Disease germs are killed or weakened.

“It is impossible to foretell the far-reaching effects of its application to food; extensive experiments are being conducted which will probably result in a whole series of new health-building foods, through the use of ultra-violet rays.



A photo-electric cell actuates door opening device in a Chicago hotel

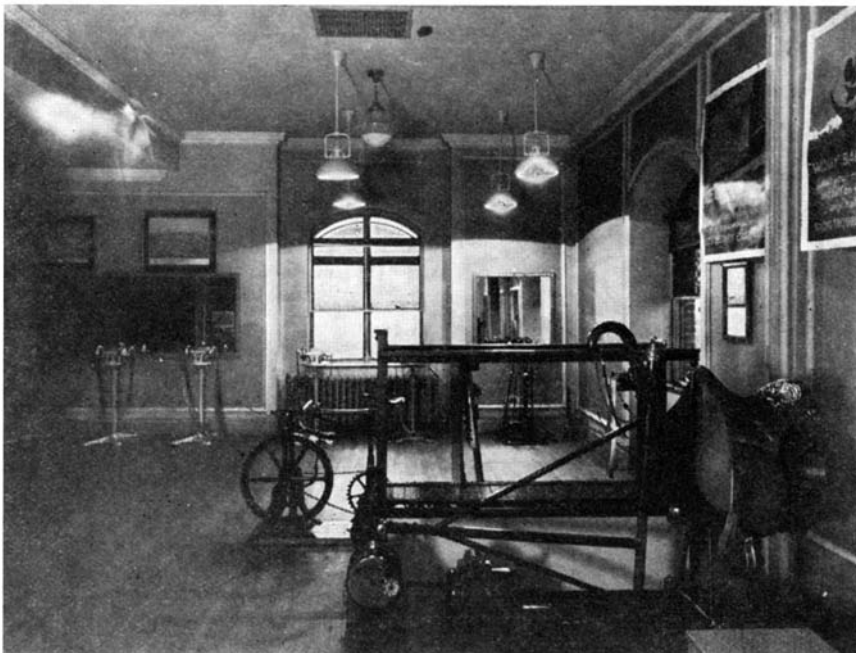
“Small wonder, then, that the house of the future will contain plenty of ultra-violet appliances. In the kitchen apparatus will be provided for subjecting foods, such as vegetables and raw meats, to artificial irradiation, prior to serving them at the table. Housewives will do this as naturally as they now wash foods.”

The cooking of foods, too, will be greatly simplified. All cooking units will be electrically operated; attachments will automatically adjust and turn off the heat while the food is cooking.

“I think that electricity will be the main fuel for home and factory use a quarter of a century from now,” continued Dr. Rentschler. “Coal, gas, and other fuels occasion an enormous waste, for private consumption particularly. Within a few years these fuels will be sent to central stations to provide power for generating electricity. Naturally, the price of electrical current will be cut down considerably.

THEN our methods of manufacturing power will be improved, resulting in a still further reduction in cost to the layman. We may discover a practical way to obtain electricity for commercial use from the sun, through harnessing ocean temperatures, or from the tides, or by breaking up the atom. As the supply increases, the price will again be lowered.”

The houseworker of 1950 will most likely find it unnecessary to cook at home if, despite the mechanical aids at her command, she does not care to. Just as we now have restaurants available everywhere, Dr. Rentschler believes that there will be community cooking quarters, connected with individual homes by means of pneumatic tubes. There will be one of these centers in each apartment house of the future, and all that will be necessary to obtain our



Gymnasium in Providence Biltmore Hotel, Providence, R. I., has artificial sunlight installed by using ultra-violet lamps. It is attractive to guests in the winter

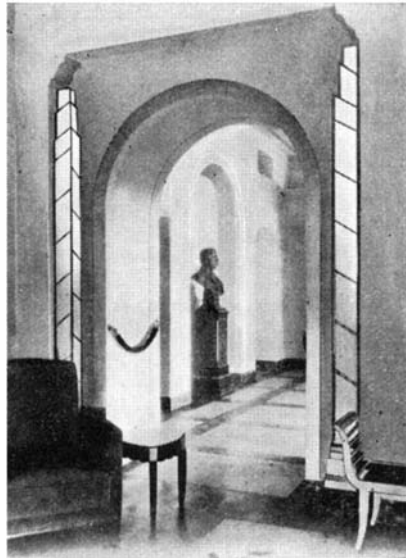
breakfast, lunch, or an eight-course dinner, will be a telephone call to this center, giving the attendant instructions as to what you want and when you want it.

Of course, our kitchens will be odorless and soundproof. No clatter of pots and pans, no noise of running water and smell of frying foods, will be wafted through the house, to the discomfort of the occupants.

CLEANING the home will be greatly facilitated. The rooms will be built with round corners, like some of the modern hospitals, so that dust will not accumulate, and we shall have improved electric devices that will make our work child's play. The wiring system of a house will be greatly improved. The complete wiring will be laid in conduits of noncorrosive metal; a blank space inside each wall, leading to a central spot, will be left free, so that it will be comparatively simple to install any new developments.

"Do you think our houses will be built underground, since the problems of lighting and ventilation will have been solved?" I asked. "Space is at a premium in the cities at present, and most likely congestion will not diminish within the next generation."

"We will have no underground dwellings," was the prompt reply. "People never feel comfortable underground. In the case of subways, this may be necessary, and we therefore acclimate ourselves to traveling by this rapid transit



Luminous pilasters assist modernistic decoration. Clear and colored lamps are installed behind panels

system. But for living purposes, never.

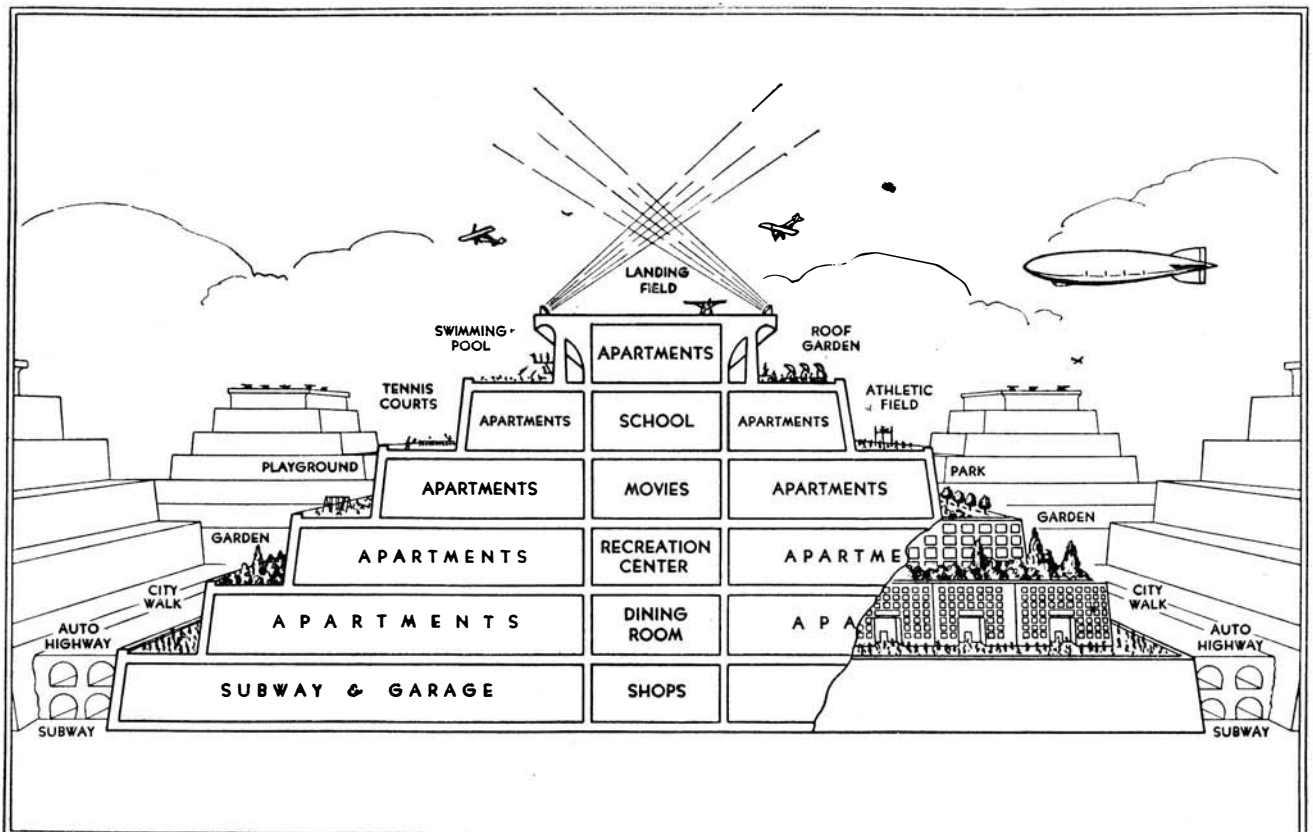
"Large apartment houses will differ materially from our present day ones. They will be small communities, quite sufficient to themselves. An idea of their structure can be gained from the accompanying sketch. The ground floor will be devoted to garages, subway stations, and shopping centers. Clothing stores, food stores, and the like will be situated here. Children will rarely have occasion to visit this floor.

"The many floors above will represent living quarters. Each apartment

will receive its heat, light (there will be no windows), air, refrigeration, fuel for cooking, and ultra-violet rays from central plants that will serve the entire building. Surrounding the apartments on one floor may be a city street, a garden on the next, a swimming pool on the next, and so on. Automatic elevators will connect the floors, and make communication between the first floor and the 30th, for example, very simple and quick. The center of this huge edifice will be devoted to recreation centers, to a moving picture house, a school, a dance floor, a community dining room, a community laundry. Perhaps there will be a radio broadcasting station and a television studio for each apartment house, too.

"**T**ELEVISION, you know," continued Dr. Rentschler, "will occupy quite a prominent place in our lives 25 years hence. While it will not supersede the newspaper and periodical, as has been predicted, I believe that it will supplement them to a great extent. Radio did not do away with the phonograph and the theater; why should television eliminate the newspaper?"

"It is quite possible that we will be able to watch pictorial representations of the daily news, with talkie accompaniment, flash on television panels in our homes. It is quite possible that we will get good reproduction of plays, concerts, and operas, as we sit in any easy chair at home. But we will still regard these presentations as second bests."



A forecast of the future in city planning where the structures are windowless

OUR POINT OF VIEW

All Honor to Marconi

ALTHOUGH Marconi had been experimenting with wireless for several years prior to 1901, his greatest triumph came about on December 12 of that year. On that memorable day the first transatlantic signal was sent out from Poldhu, on the Cornish coast of England, and received 1700 miles away at the entrance to the harbor at St. John's, Newfoundland. Just 30 years after the historic three dots—"S" in the Morse code—opened a new era in communication, Marconi stood before a microphone in England and his voice was heard throughout the world.

From coherer to crystal detector to vacuum tube to oscillating circuit to the multi-tube receiver with which we are all familiar has been the rapid development of receiving equipment. From huge induction coil or transformer to alternator to arc to vacuum-tube oscillator has been the course of transmitting equipment. Through the development of radio has flashed the genius of many searching minds, but above them all, keeping pace with advancement and constantly adding to the total knowledge has been Marconi. Great and inspiring as was the demonstration of world-wide radio telephony on December 12, 1931, it was no more marvelous than the reception of the three faint dots that blazed a transatlantic trail.

All honor to Marconi, to whose foresight and enthusiasm the world owes a greater debt than it can ever hope to pay.

Metallic Thrift

IT has often been said that mankind is using extravagantly his mineral wealth. This may or may not be generally true, but specifically, in the case of the United States, we believe that it is. Whether or not it is due in our case to unsound taxes and forced over-production, both of which conduce to waste, is still a moot question.

The United States produces about 70 percent of the world's supply of oil, 80 percent of its sulfur, 80 percent of its lead, 50 percent of its steel, 40 percent of its coal, 40 percent of its iron, and 55 percent of its copper. High production of some of these is imperative and will make no difference in the long run. Continued high production of others, however, is unnecessary and may some day have disastrous results. Oil, for example, is being used so rapidly that an

end of it in less than a hundred years is freely predicted. It has been said that coal may become a museum exhibit "in a few centuries" but we think this hardly likely for at least 25 or 30 centuries—unless this fuel is simply superseded by some other source of power and heat. Lead and copper are reclaimed to an astonishingly large extent, but a fortune is wasted each year in the tin cans that Americans indifferently throw into the garbage cans. Tin is not too plentiful. Iron supplies, however, are sufficient to last for many, many years; aluminum is everywhere but is not so easy to extract except from a few of its ores; and magnesium, not yet well broken to the industrial yoke, is found in abundance.

In three quarters of a century we have seen a great decline in the production of American gold. Now the Rand, in Africa, whence a large percentage of the world's supply of the precious metal has come for many years, is said to be petering out. What will be done when there is no more of it to be had? What will be done when there is no more oil and tin and copper? Perhaps science will answer that question. As to that, we can not say; we simply hope for the best. While we await the answer, however, it behooves us to exercise what thrift we can in the use of our mineral wealth by producing only so much that wastefulness will be unprofitable, reclaiming more used metals than ever before, and substituting, wherever possible, other materials or the more plentiful metals for the scarcer ones.

Future Leaders

UNEMPLOYMENT conditions have had one important effect which has been stressed but little, and that is, they have upset the normal home life of boys and have given a great deal of leisure to those boys who would ordinarily be working in their spare time. In such a trying period, the boy must have a strong character indeed if he is not to fall upon evil ways. Americans may point with pride, therefore, to a character-building movement that numbers close to 900,000 boys and their leaders: the Boy Scouts of America who are to celebrate their 22nd anniversary during the week of February 7.

In the interests of the highest ideals of character and citizenship, we can not commend too highly this splendid movement among the boys of the country. Es-

entially of the outdoors where nature, with all her works, is clean, the Boy Scout who lives up to his oath thinks and lives and acts cleanly. He learns the joy of living and the responsibilities of life. Learning early all that good citizenship means, he becomes a citizen to be honored and trusted, and is thenceforth a good influence to direct others along the path to good citizenship. He stands courageously forth for the preservation of American ideals and traditions; his organization, as a whole, is a powerful bulwark against the growth of the various "isms" that would threaten the structure of our institutions.

We felicitate the Boy Scouts on the occasion of their anniversary and wish them continued growth and success.

Science and Art

AS we view the buildings of the Chicago World's Fair which are described elsewhere in this issue, we pause to wonder whether their design is truly a reflection of the "culture" of the age, as some people contend. We wonder whether it is really the expression of a nascent art of the machine age or a symbol of the decay of art. In either case, the new modernism has been thrust at us with shocking abruptness and it will take us much time to put away old, long-cherished ideals and get the "feel" of the new.

The directors of the World's Fair employed a number of the country's best known architects to design the Fair buildings. Their combined efforts have produced the outre effects which will greet visitors to the Fair in 1933. We venture to say that most of those visitors, holding traditional opinions of the traditional in art, will not admire the new designs although they may be properly impressed, entranced, or enthralled with the effects obtained—especially at night when myriads of colored lights play upon the buildings. These same people would give but scant notice to Fair buildings in the grandiose style of the nineties, so the architects attempted to interpret the spirit of the age. Few will be convinced that they have succeeded in doing so, however, for it is difficult to find inclusion in the designs of more than a little human philosophy. On our part, we should not like to see such designs applied to the residences of human beings, but we believe they will attract as many visitors to the Fair as the exhibits themselves; and we hope they do.



An artist's conception of the 1933 World's Fair grounds

COMMEMORATING A CENTURY OF PROGRESS

CHICAGO always does things in a big way. A hundred years ago it was only a frontier village, hardly worthy of a thought; now it is the third city of the world in respect to population. It is to celebrate this "Century of Progress" that the great international exposition is to be opened in June, 1933. The "World's Fair" in 1893, gave Chicago an excellent place in the sun, and it took 22 years before anything comparable to it took place, on this side of the water at least. Since 1893 we have broadened out considerably. Many of those who found a new thrill in the Japanese village have now seen the original in a proper setting. Travel, moving pictures, and the radio have had a great influence on our lives, and it is doubtful if an exposition of the 1893 model would be successful today.

These facts were probably taken into consideration by the board of trustees, for "A Century of Progress" follows no pattern of former fairs. It is an attempt to adjust an international exposition to modern conditions. The competitive idea of former fairs is not in the modern spirit. Today, members of the same industry co-operate as to standards and the elimination of waste. Research laboratories afford some of the best minds an opportunity to try out ideas under scientific conditions. Patents are pooled to do away with expensive litigation. Science is aiding as never before to make this a better and more pleasing world. An exposition based on such a broad platform can hardly fail.

The writer, who was stationed at Chicago for several weeks in 1893, recently

re-visited Chicago to see the progress which is being made. The total expenditure, including exhibits and private halls, will be over 50,000,000 dollars. Five structures are already completed, or nearly so, and 10,000,000 dollars in bonds have been sold. No world's fair in history has been so far along in preparation 19 months before the opening. Evidently the dour lesson of unpreparedness in 1893 has not been wasted.

THE site of the exposition is along the lake front, largely on reclaimed land, and extends from 12th Place to 39th Street, all east of the Illinois Central's trackage. The area covers approximately 634 acres of mainland, island, and enclosed waters. This is one of the largest tracts ever used for exposition purposes. At its doorway are the great Field Museum of Natural History, the new Shedd Aquarium, and the Adler Planetarium. This really gives the keynote to the whole plan, which is educational.

It is safe to say that never before has science, both pure and applied, been given such an opportunity for being explained to, or even "sold," if you like, to the public. The location is ideal, for one can walk from the Stevens Hotel, the largest in the world, to the Administration Building, in less than 20 minutes. The location has every requirement desirable in a world's fair—natural beauty, a combination of land and water, proximity to the heart of the city; as for railway accommodations, 28 railways go to Chicago and stop there; as for hotels, it is probably the best pro-

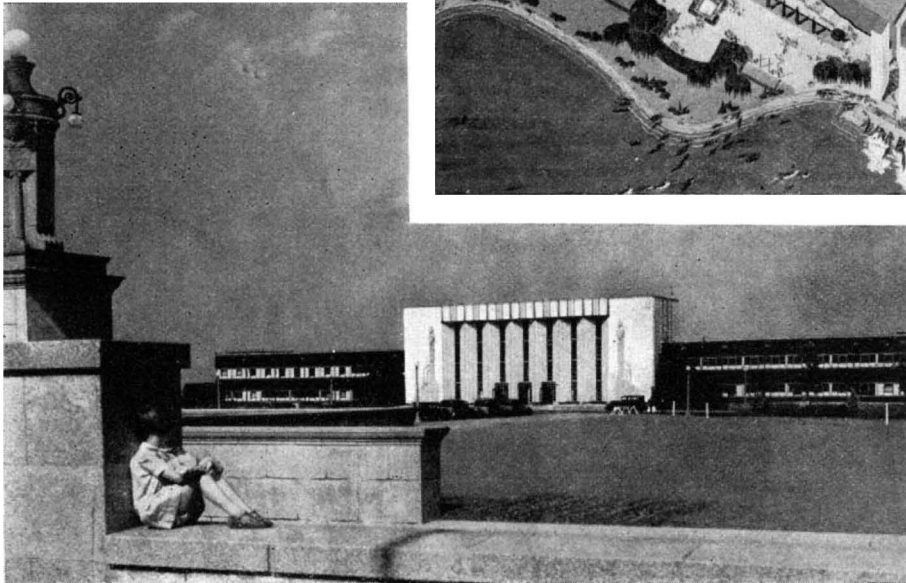
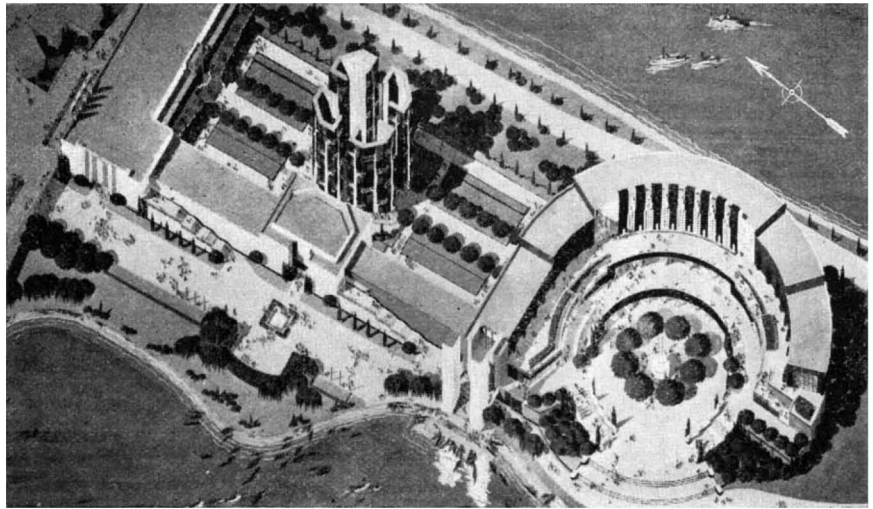
vided city in the world; by 1933 over 400,000 guests can be accommodated.

One odd thing about the fair buildings is the extraordinary pigmented architecture, but let us not criticize these creations too hastily. Some of the best architects in the country have designed the structures, and we must remember that their odd shapes and garish colors are intended to be elaborately lighted by new systems, and the lagoons and landscaping will aid materially to produce a harmonious whole. The cost of making the new land is about 50,000 dollars an acre.

Foreign governments have been quick to see the benefits of participation, as there has been no real international exposition since the one held at San Francisco in 1915. While there will be old-world villages, foreign cafés and orchestras, and plenty of amusements, there will be an absence of the rather raw sights of the "midway" of 1893, for the 20th Century is somewhat more somber than the "golden nineties."

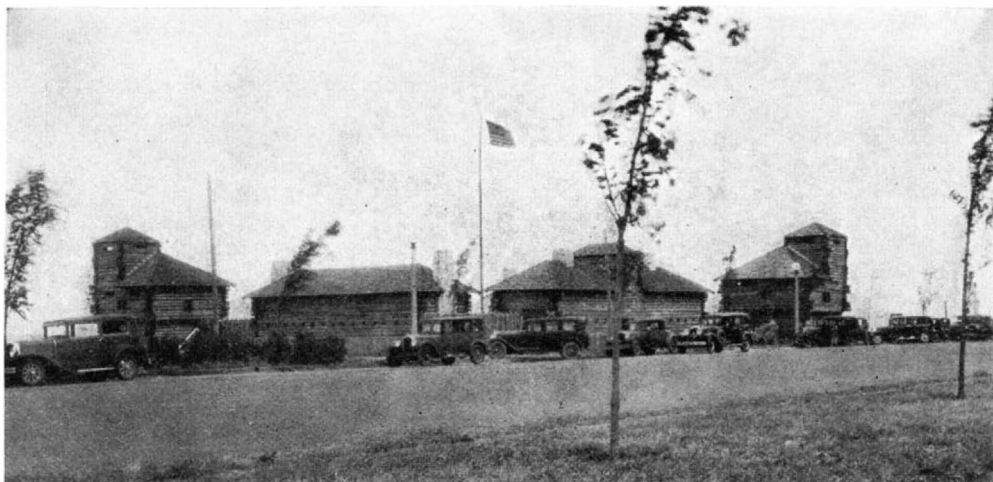
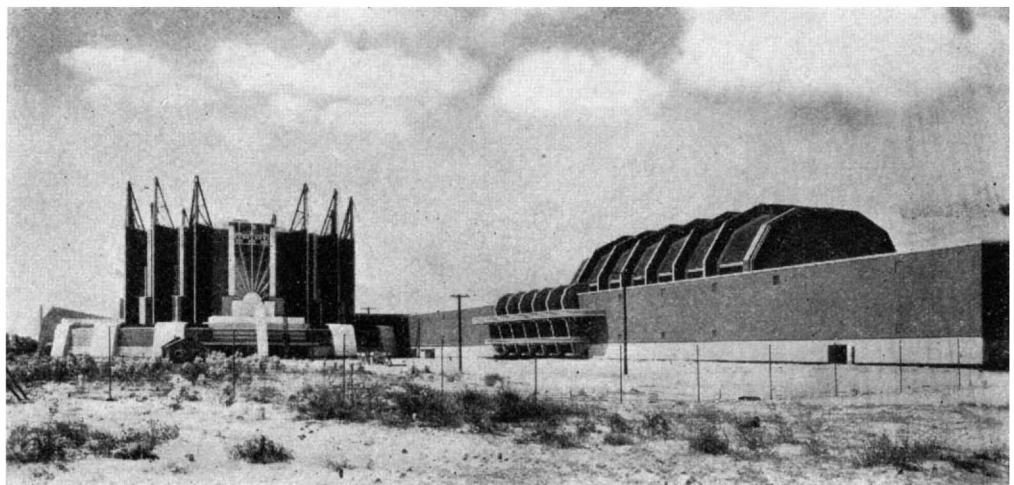
The Administration Building is ultra-modern. The main façade is dominated by the central white unit which contrasts with the "midnight blue" of the wings. The Hall of Science is well along toward completion. In this huge building will be unfolded the story of the discoveries of science and invention. The General Exhibits Group of buildings will be 1700 feet long and will be divided into seven pavilions. An elevated runway will permit intra-exposition vehicles to circulate. The Travel and Transport Building is illustrated on page 70 and opposite.

Right: Electrical group now being erected on Northerly Island. The group is 1200 feet long, the treatment modernistic



Left: Main façade of the Administration Building now in use for offices. The central part is white and the long, low wings are dark blue

Right: Travel and Transport Building. The horizontal section to the right is for marine transportation where a full-size section of a large ocean liner will be placed on display



Left: Among the educational and entertainment features now open is the reproduction of the blockhouse and barracks of Fort Dearborn, commemorating the great massacre of 1812

WEIGHING THE SATELLITES

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

THERE are sometimes many ways of solving the same problem—for example the distance of a star or a group of stars can be found by several radically different methods. But as often, there is only one path to the goal. We can “weigh” stars and planets—in more accurate phrasing we can find their masses—and sometimes with great precision. But the only method we have we owe to Sir Isaac Newton.

Mass, on the astronomical scale, can be measured only by its power of gravitational attraction. Gravitation, despite its controlling importance in the large-scale operations of nature, is in a very real sense the weakest of known forces. On the engineering scale the mutual gravitation of even the largest and heaviest objects is utterly negligible. The entire force of attraction between two 10,000-ton ships lying side by side and a hundred yards apart amounts to just more than two ounces of weight!

IN the laboratory, gravitation can be detected and measured with precision, but such precautions have to be taken that it is hardly practicable even today to exhibit its action in a lecture experiment. Only for huge masses such as the earth itself does gravitational force become big enough to be conspicuous.

Such bodies are the special study of the astronomer but, though astronomical masses are great, so are astronomical distances.

At the separation of even the nearest stars their mutual attraction produces excessively small effects. If the sun and its nearest neighbor, Alpha Centauri, should be brought perfectly to rest at their present distance and freed from the attraction of all other stars and then left to fall freely toward one another, their distance would diminish by only 388 feet at the end of a year. At that time they would be approaching

one another at the rate of one inch per hour. Yet so massive are the stars that to produce this ridiculously slow motion would require the continuous action upon each star throughout the year of a force equal to a weight of 34,000

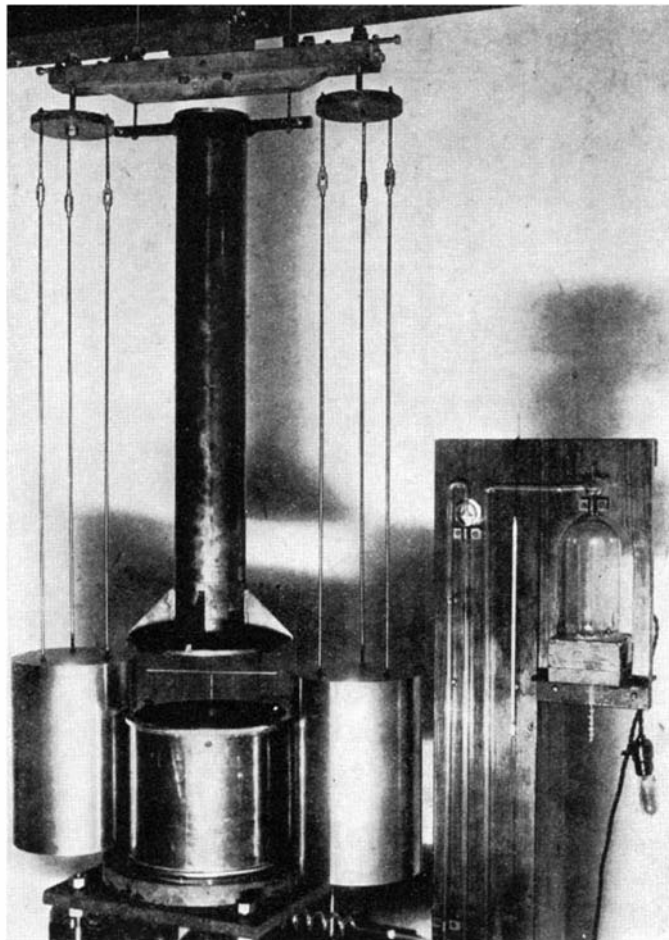
attraction and the mass of the star even though it may be isolated in space.

For a planet the determination is very easy if it has satellites, since their motion is controlled almost entirely by the planet's attraction. If there are no

satellites we must have recourse to the attractions or “perturbations” of the motions of the other planets which are produced by its attraction. Here we run into calculations which are very complicated and laborious but perfectly definite. If the planet is massive enough to produce measurable changes in the motion of the other we can find its mass. Even if the maximum perturbations which it produces are only as great as the inevitable small and random errors which affect the best observations we may still get a tolerable idea of the mass by a sort of averaging of the results from a great number of observations of the disturbed planet. But if the perturbations are but a small fraction of the observational errors the amount cannot of course be detected.

THE same process can often be applied to the satellites of a planet, provided it has several. The larger satellites of Jupiter and Saturn perturb the motions of their neighbors sufficiently to permit good determinations of mass. For some of Saturn's small-

er moons a favorable combination of circumstances causes the perturbative action to run in the same direction for several years, and then in the opposite direction, so that even a very minute force can be detected by its cumulative effects. The innermost of the satellites, Mimas, has thus been found to possess a mass which is only $1/2100$ of that of our moon. This is by far the smallest quantity of matter which has ever been measured astronomically by its gravitation, yet by ordinary standards it is enormous—no less than 38 millions of billions of tons (38×10^{15}), or enough



“In the laboratory, gravitation can be measured with precision.” Delicate torsion balance used by the physicist Heyl in accurately determining the earth's constant of gravitation

billion tons—a force inconceivably large.

We can hope to observe the attraction of astronomical bodies only when there is something near them to be attracted; that is, not much farther away than the planets are from the sun or from one another. Among the stars this limited us until recently to double stars, whose mutual attraction controls their orbital motions. The attraction of a star upon its own atmosphere, however, determines the pressure in the latter and there is hope that by studying the spectral lines we may in time be able to determine the pressure and hence the

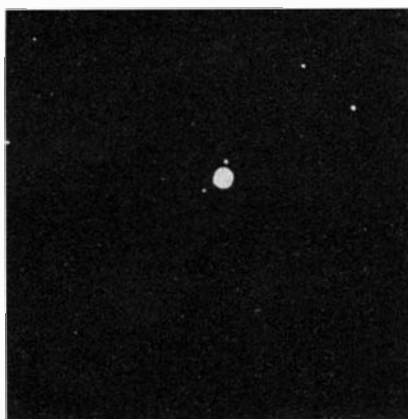
to make a ball of rock 180 miles in diameter. Smaller bodies cannot be expected to attract one another enough to produce observable effects. It is startling to find out that, for the gravitational astronomer, a quadrillion tons is a mere dust speck too small to weigh.

This being so, it occasions no further surprise that the satellites of Uranus, which are relatively faint, do not disturb one another's motions enough to make it possible to find their masses. The two moons of Mars are tiny bodies and we can only guess from their brightness that they are about five and ten miles in diameter and then guess again at their densities.

THE earth has only one moon and so has Neptune, and the only possible chance for finding the masses of these satellites is from their attraction on the planets themselves. How this is done for our moon is an old story. Its attraction actually displaces the earth, causing its center to move every month in a little orbit about the common center of gravity of the two bodies, shaped just like the moon's orbit but much smaller. It is the center of gravity and not the earth itself which moves in the regular orbit about the sun. Consequently, whenever the moon is ahead of the earth, which happens at her last quarter, the earth itself lags behind and the positions of the sun and all the planets as we see them are shifted a little from what they would be if the moon was not there. After first quarter they all seem to be shifted in the opposite direction. By careful observation, especially of the nearer asteroids, it has been found that the earth's center is 2880 miles from the center of gravity of itself and the moon. The moon is 81.5 times as far off on the other side. It follows therefore that the earth is 81.5 times as massive as the moon.

Neptune's satellite must be a pretty large affair. It looks faint on account

of its great distance and the feebleness of the sunlight which falls upon it, but if it could be brought to the same distance from the sun it would look as bright as the brightest satellites of Jupiter, or as Titan, the largest satellite of Saturn. For that matter, at the same distance it would be nearly equal in brightness to Pluto, and not much fainter than Mars. Now Jupiter's satellites range from 2000 to 3200 miles in diameter and Titan's diameter is 2600 miles. The masses vary from two thirds to twice the moon's mass, while Mars is 4200 miles in diameter and has nine times the moon's mass. It is therefore reasonable to suppose that Neptune's satellite is something like 2500 miles in diameter and more massive than the moon. If it has a low reflecting power like Mars it may be more than 3000

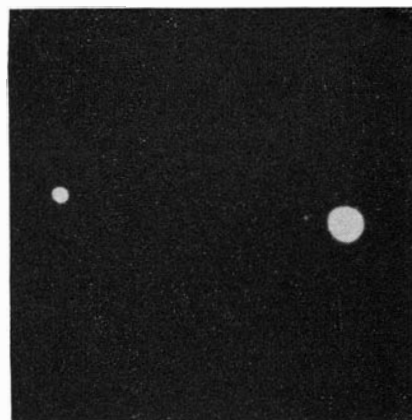


Courtesy Yerkes Observatory

Uranus and two of its four satellites, probably Oberon and Titania, which can be seen only with a telescope of at least 10 inches aperture and even then only very rarely

miles in diameter and correspondingly massive.

Neptune itself is 1400 times as massive as the moon. As its satellite circles around it (with the short period of five days 21 hours) it should therefore shift



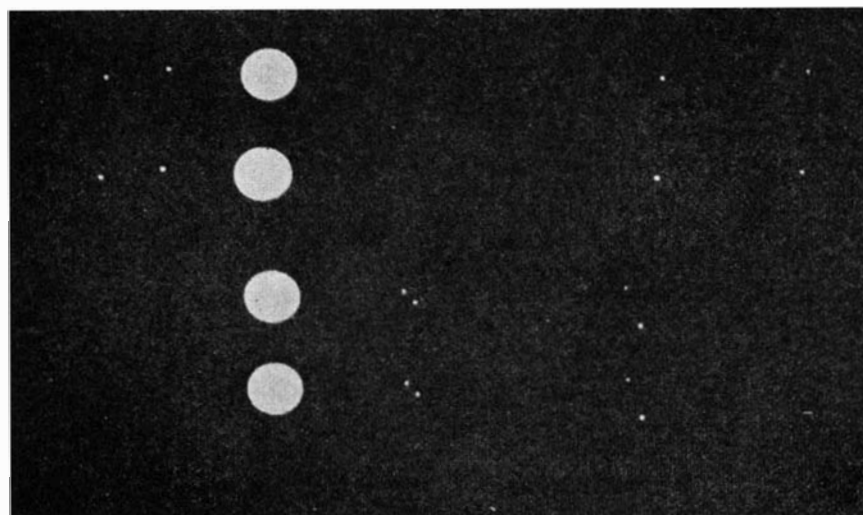
Courtesy Yerkes Observatory

Neptune and its nameless satellite. It is not the star on the left but the tiny dot in line with Neptune and that star, nearer the planet

back and forth by about 1/1000 of the diameter of the satellite's orbit, or perhaps more. This amounts to 0".03 in the heavens—a small quantity but well above the limits of modern photographic measurement. Calculations of this sort encouraged Dr. Nicholson—the discoverer of the ninth satellite of Jupiter—to observe the planet in the hope of detecting this minute shift. With the collaboration of Dr. van Maanen and Dr. Willis, 13 plates were obtained last May and carefully measured. A good deal of calculation was necessary. Allowance had to be made not only for the orbital motions of Neptune and the earth, but for the oscillation in the earth's motion caused by the attraction of the moon, and for the parallax arising from the fact that the observer is carried around by the earth's rotation. Both of these last effects are greater than the one for which the observers were seeking, but they can be and were completely eliminated by calculation. The corrected results showed a small but definite tendency for Neptune to run ahead of its calculated position or behind it when the satellite's attraction would produce these effects. The final solution indicated that the satellite's mass is 0.06 ± 0.024 times the earth's, or 5 ± 2 times the mass of the moon.

ACCORDING to this result this remote and often forgotten body is the heaviest and very likely the largest satellite in the whole solar system—more massive than Mercury and half as massive as Mars. Turned loose "on its own" it would make a very respectable planet.

It appears to be strictly true, then, that as regards the size of the bodies composing them the planetary and satellite systems overlap, one beginning before the other leaves off—which emphasizes the difficulties in forming a really satisfactory theory of the origin of the whole.—*Mount Wilson Observatory, December 3, 1931.*



From Russell, Dugan and Stewart's Astronomy, courtesy Ginn and Co.

Two pairs of photographs of four of Jupiter's satellites, Io, Europa, Ganymede, and Callisto, made with the 24-inch refractor at Lowell Observatory

SCIENCE AND THE PERMANENT WAVE

By J. G. CROWTHER

Scientific Correspondent of the *Manchester Guardian*

FASHIONABLE ladies have "permanent" waves made in their hair by stretching and steaming. Wool fibers, or sheep hairs, are "set" by stretching and steaming in processes used by textile manufacturers. Natural silk will not stretch but will shrink under suitable treatment. These and many other properties of animal fibers have been brilliantly investigated by means of the X-ray analysis by W. T. Astbury, Director of the Department of Textile Physics at Leeds University, England, and these basic investigations have large industrial importance.

Until 1928 Mr. Astbury was one of Sir William Bragg's assistants at the Royal Institution, where he learned and helped to advance the technique of the analysis of crystals by X rays. Since then he has commenced to apply X-ray crystal analysis to the structure of wool, human hair, llama hair, hedgehog spines, porcupine quills, natural and artificial silk, finger-nails, and other external animal growths. These fibers all have substantially the same chemical constitution. There are comparatively slight constitution differences which confer very important practical differences in properties, but to a large extent a human hair, a wool fiber, and a ram's horn are made out of the same substance, a protein called keratin.

HAIRS and nails are well known for their tough and elastic character and their power of resistance to decay and disintegration. As they are made up of keratin this substance must be both elastic and chemically stable. The elasticity of wool fibers, for example, is remarkable. They can be stretched 70 per cent of their length when dry, and 100 per cent in water, and in water they can also be shrunk 30 per cent of their length. They will recover their original length when released, and this can be done an indefinite number of times. Thus they are almost perfectly elastic.

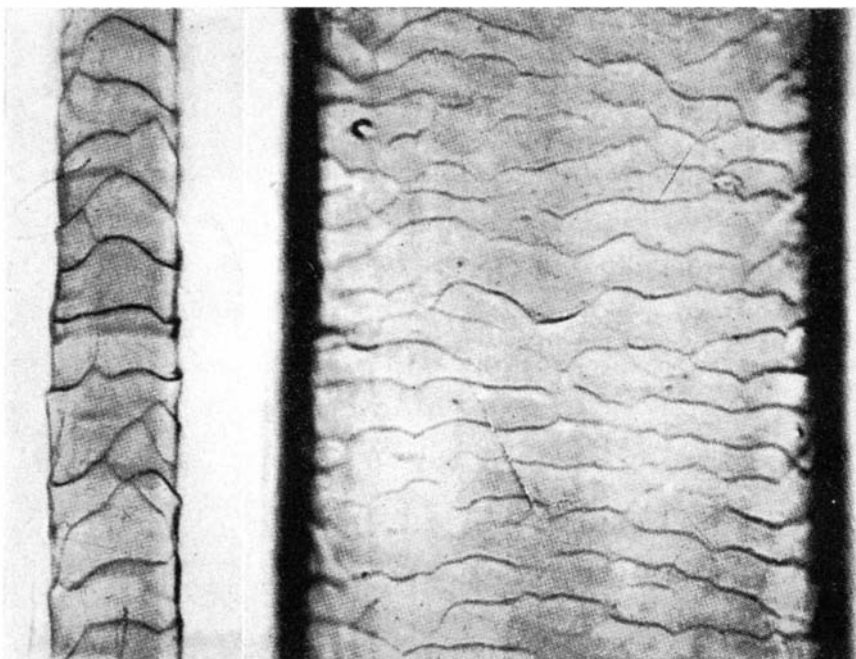
This power of extension and recovery argues the existence of a quite mechanical kind of extension and contraction in the keratin molecule itself. If the stretched wool is steamed it sets and does not return to its original length. The steam affects in some way the keratin molecules when in the stretched condition, preventing them from contracting again. That the stretched keratin

molecule susceptible to steam is in a different condition from the unstretched molecule is suggested by the fact that unstretched wool is remarkably resistant to the effects of steaming; four hours' steaming does not have a serious effect on it. Stretched wool is permanently affected by steaming after a number of minutes.

With these and many other facts of textile technology to go upon, Mr. Astbury set out to discover why they should be so. What is the structure of wool and hair that it should have the peculiar properties it does?

Examination by ordinary microscopes, however powerful, tells little except superficial information. It will reveal the shape of the outside of fibers (Figure

ray photographs which definitely proved that wool fibers are at least partly crystalline. This was sufficiently interesting, but he also made the fundamental discovery that wool fibers give two kinds of X-ray pictures, according to their condition. Unstretched fibers give the X-ray picture of the type shown in Figures 2, 3, 4, 5, and 6. Stretched fibers give the picture of the type shown in Figures 7, 8, and 9. He calls the X-ray picture of the type in Figure 6 that of keratin in the *alpha* condition; Figure 8 that of keratin in the *beta* condition. In general, fibers showing the *alpha* keratin picture are unstretched, those showing the *beta* keratin picture are stretched. Human hairs, unstretched wool, porcupine quills, all give the *alpha*



From *Philosophical Transactions*, after Astbury and Street

Figure 1: At left a merino wool fiber magnified about 800 diameters, and at right a human hair magnified the same amount; showing the scales on "wools"

1), which is very useful for studying processes which depend on the scale or shell of the fiber, as many important textile processes do. But it will reveal nothing about the inner core of them, because the units out of which fibers are made are a thousand times too small to be seen by ordinary light.

Previous workers had been uncertain whether wool had a structure detectable by X rays and therefore crystalline. By skilful technique and long exposures Mr. Astbury succeeded in obtaining X-

keratin X-ray picture. Stretched wool and natural silk give the *beta* keratin picture.

The latter point is very interesting. When silk worms spin their silk, and spiders their webs, they stretch their fibers. Some natural process causes the fibers to set in the stretched condition. Consequently, natural silk will not stretch, and shows the *beta* keratin picture. Under suitable treatment and reagents it will shrink. Thus wool and silk are keratin at the extremes of its natural

forms and have certain contrary properties.

In order to be sure that the X-ray pictures were due to the structure of the interior of the fibers and not to the scaly exterior, it was necessary to de-scale the hairs and fibers used. This was done by drawing them through powdered glass, or by pulling them through a glass capillary tube, like wire through a die. With the latter arrangement the scale on the hairs could be seen being peeled off under the microscope.

The wool fiber begins to change from *alpha* into *beta* keratin when it is stretched about 30 per cent, and the X-ray photograph changes from the type of Figure 6 to that of Figure 8.

The X-ray photographs show that the keratin molecules in unstretched wool are made up of units about 5.15 hundred-millionths of a centimeter (or Angstrom units) long. The *alpha* keratin molecules are built up into the wool "bricks" or structural parts whose size, according to Speakman, is 36 by 2 millionths of a centimeter. His method of determining the size of the "bricks" will be described in a later paragraph.

THE X ray reveals not only the outline of the complicated keratin molecule but the outline of some of the chief parts of the molecule. When the wool is stretched into the *beta* condition a new unit of length appears, a quantity only 3.32 hundred-millionths of a centimeter. At first sight this seems to indicate that the keratin molecule *shrinks*, on stretching. The correct interpretation is that the molecule lengthens, but that certain of its sections become more prominent. The *alpha* keratin molecule, 5.15 Angstrom units long, appears to change into a molecule with two prominent halves when it is stretched to a length of 6.64 Angstrom units; that is, it begins to show itself in two parts each 3.32 units long. Now 6.64 is 29 per cent greater than 5.15, so one would expect wool to show this change in structure—this tendency to show its molecules as having two halves—when extended 29 per cent. Experiment shows that the wool does begin to give X-ray photographs showing molecular parts 3.32 units long when it is extended 30 per cent. So this theory of the structure of the wool molecule agrees with experiment extraordinarily well.

Besides this, Mr. Astbury finds that with suitable treatment a wool fiber can be made to behave like an elastic chain. It can be made to contract 30 per cent of its length and extend 100 per cent of its length. But these changes are the limit. No known treatment will enable the wool to stretch more than 100 per cent. This fits in beautifully with the theory.

The X-ray photographs show that the *alpha* keratin molecule of unstretched wool 5.15 units long stretches into mole-

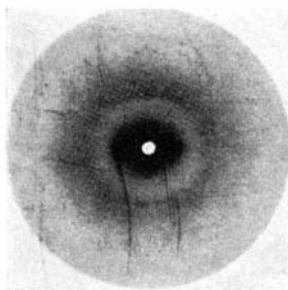


Figure 2: X-ray picture of de-scaled human hair

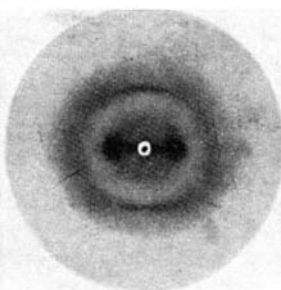


Figure 3: X-ray picture of a porcupine quill tip

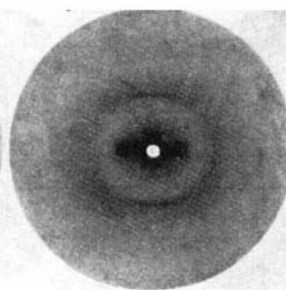


Figure 4: An Australian 64's merino wool fiber

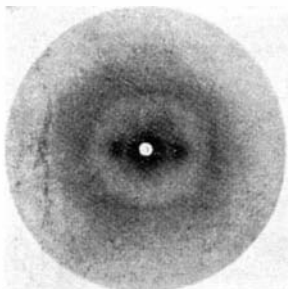


Figure 5: English Cotswold wool, no soap scour

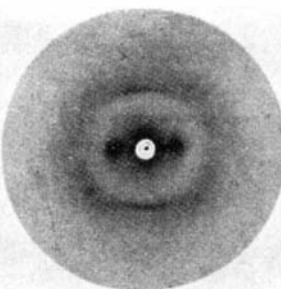


Figure 6: Same, scoured with soap. No extension

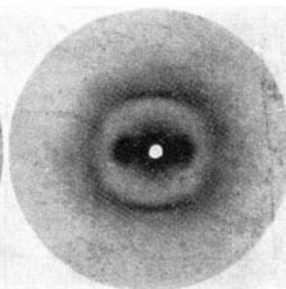


Figure 7: The same fiber at 35 percent extension

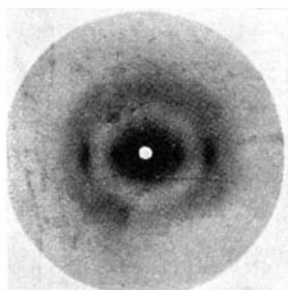


Figure 8: Again the same with 70 percent stretch

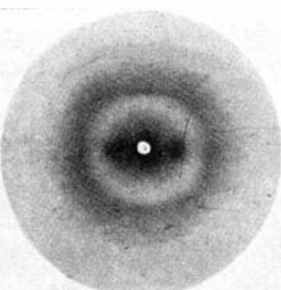


Figure 9: Human hair at a 30 percent extension

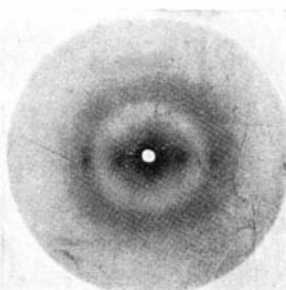


Figure 10: Same after 8 minutes in sod. sulfide

cules of two parts, each of length 3.32 units. Further stretching produces an extension into three parts each 3.32 units long; that is, 9.96 units long over all (See bottom of Figure 11). This is about 100 per cent more than 5.15! When the 5.15 *alpha* keratin molecule is shrunk it contracts 30 per cent, that is, to a length of about 3.32 units! Thus the behavior of wool fiber as an elastic chain of molecules can be described not only qualitatively but quantitatively by the model of the keratin molecule Mr. Astbury's work suggests. His skeleton formulas for the *alpha* molecule and for the *beta* keratin molecule are shown in Figure 11.

Thus the elasticity of wool is due to the power of the keratin molecule to behave like a concertina—it can expand and contract like a machine. This is the first time that the mechanism of perfect reversibility between two possible shapes of a complicated molecule has been demonstrated. Similar reversible changes probably account for the elasticity of rubber and skin.

The size of the bricks into which the keratin molecules are built up has been deduced by J. B. Speakman from an ingenious study of the elasticity of wool

fibers under varying temperature and humidity. Dry wool fibers immersed in water extend only 1 per cent in length but 18 per cent in thickness. Since there is good reason for believing that the fiber bricks merely clasp layers of water molecules to their surface, these figures indicate that they are 18 times as long as they are broad. The fiber swells by packing layers of water molecules between its bricks, not by changing the bricks themselves; these remain impervious to water. They can be shown to be about 2 millionths of a centimeter broad. Since swelling in water is 18 times greater across the fiber than along it, and the layer of water molecules is equally broad over the sides and ends, the brick is probably about 18 times as long as it is broad; that is, about 36 millionths of a centimeter long. The change in rigidity on swelling also indicates that there are many more breaks across than along the fiber; that is, that the brick is much longer than it is broad.

The thickness of the wool brick is deduced from ingenious experiments of quite another type. Since the bricks clasp water molecules to their sides only, the number they can clasp is de-

terminated by their shape. If the bricks are reduced in size the amount of water they can hold is reduced. Now the chemical, sodium sulfide, is able to dissolve the constituent bricks of wool. Wool which has lost 57 per cent of its weight by solution in sodium sulfide is found still to have the same appetite for water

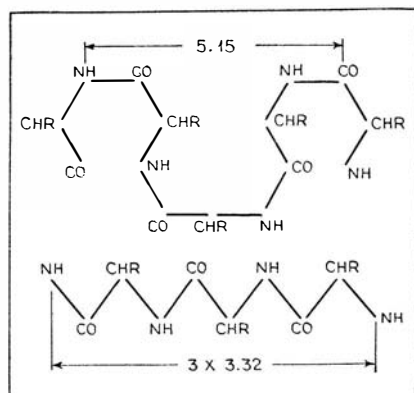


Figure 11: Skeleton formulas for alpha and beta molecules of keratin

in the proportion of its weight to the original weight of wool.

This remarkable experiment shows that the sodium sulfide must destroy only the thin edges of the bricks and not their main faces. The bricks of wool must be long, narrow, thin plates; for only if they were in that form could they preserve the same ratio of surface area to weight, as they were eaten away.

MARRIOT observed also that hair whose weight had been reduced 26 per cent by dissolving in sodium sulfide still contained the same proportions of nitrogen and sulfide. This of course would be true if the hair brick were in the form of a long thin strip whose edges could be eaten away by sodium sulfide but whose faces could resist it.

From these various data the wool fiber brick is deduced to be 2 millionths of a centimeter long, with its length more or less parallel to the length of the fiber. When swollen in water the distance between the main faces of the bricks is about half a millionth of a centimeter, but when dry the distance is only about 6 hundred-millionths of a centimeter.

That hairs are probably made of bundles of long thin bricks is shown by the behavior of de-scaled hairs in suitable reagents. If the scale or rind on hair is taken off, the core of the hair tends to disintegrate into a loose bundle of still finer fibers. The phenomenon does not occur when the hair retains its hard scale, because this is resistant to reagents and holds the constituents of the core together.

Mr. Astbury's experiments and theory explain the change in molecular structure which causes wool to have different properties when stretched than when unstretched. The skeleton molecule he deduces for all wool and hair fibers is

shown in Figure 12. The first model, at the left, shows the molecule of unstretched wool. It consists of two closed hexagons of atoms bonded together. The second model shows the molecule of stretched wool.¹ The hexagons are opened and pulled out, giving the 30 per cent increase in length. Besides the correct increase in length, the opening of the hexagons explains why stretched wool is so much more susceptible to attacks by steam and reagents. These can get at the atoms when the hexagons are opened but not when they are closed. Hence normal hair, wool, and so on are very resistant to bacteria and chemical reagents because of the closed hexagons of atoms in their keratin molecules. The atoms are too much tied up together and interested in each other to be affected by outside atoms.

A study of the X-ray data of the keratin molecules indicates that they weigh about 477 (oxygen weighing 16). Now wool is known by chemical analysis to be largely made up of the substances leucine, glutamic acid, cysteine, and arginine. The sum of their molecular weights is $113+112+103+155=483$, or

¹Editor's note: There is evidence that some readers have been misled by various published models of the atom. Perhaps these models have about them too much of the plausible, finished appearance of finality—as if science really knew what an atom actually "looks like"—and this fact may have conspired to that unfortunate end. The cautious reader will regard models of atoms only as tentative aids to the formulation of at least some kind of mental concept, incomplete though this may be. In the present instance the individual atoms are represented conveniently by spheres, but there is no reason to think an atom actually would look like these spheres if one could be seen. However, what we are studying in the present article is not the nature but the arrangement of the atoms that make up the molecule, and therefore the conventional spheres will serve our main purpose. Science may not know yet what an atom is like but it does know how they are arranged in molecules. The X-ray analysis has demonstrated this very reliably.

approximately the same. The X-ray photographs seem to suggest that the keratin molecule is a spatial combination of these four substances. Perhaps these substances form the hexagons which do so much to confer the characteristic properties on wool molecules.

These X-ray investigations of the structure of biological products, such as fibers from animals and cellulose from plants, are of great industrial importance. They show why raw materials such as wool and cotton have their peculiar properties. They do more than describe or discover these properties. For centuries men have manufactured clothing out of fibers and have learned much about them by rule-of-thumb and practical experience. Now the explanation of the properties of fibers is being discovered. As soon as the structure of fibers is thoroughly understood, scientists may well be able to deduce from the molecular structure of wool possibilities in dyeing and conditioning which blind experiment or accident would be unlikely to reveal.

THE importance of fundamental knowledge of materials to manufacturers is therefore plain and great, but Mr. Astbury considers that the value of his researches may perhaps prove to be even greater in the pure science of biology, for they will help to reveal the special architecture employed by nature in the construction of living matter. Many of the apparently almost insoluble problems of biology will be seen to be much simpler than we have been in the habit of believing, and the structure of living matter may be reduced to variations of a comparatively few fundamental forms.

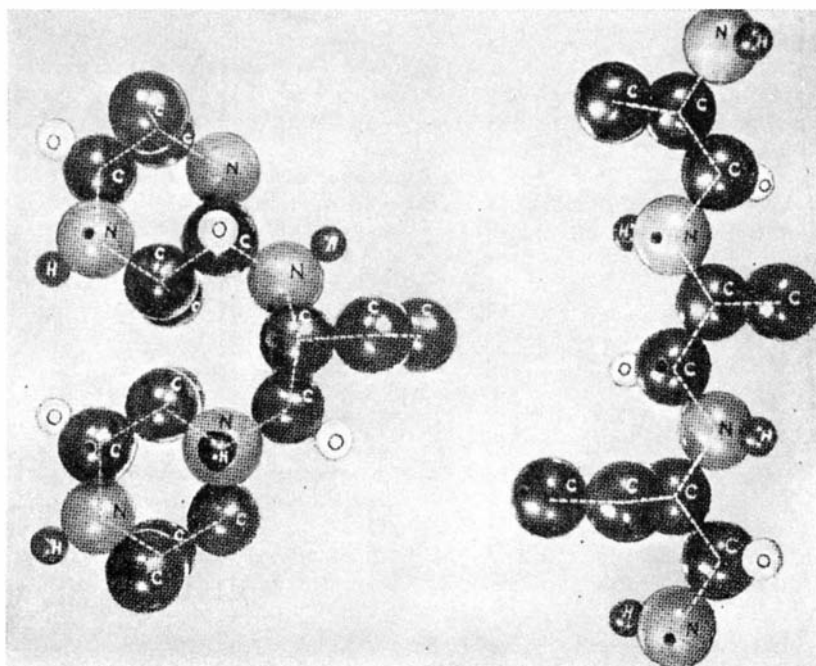
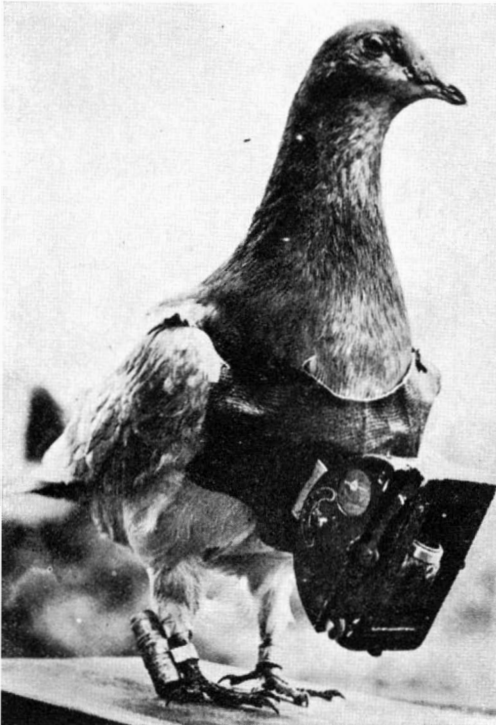
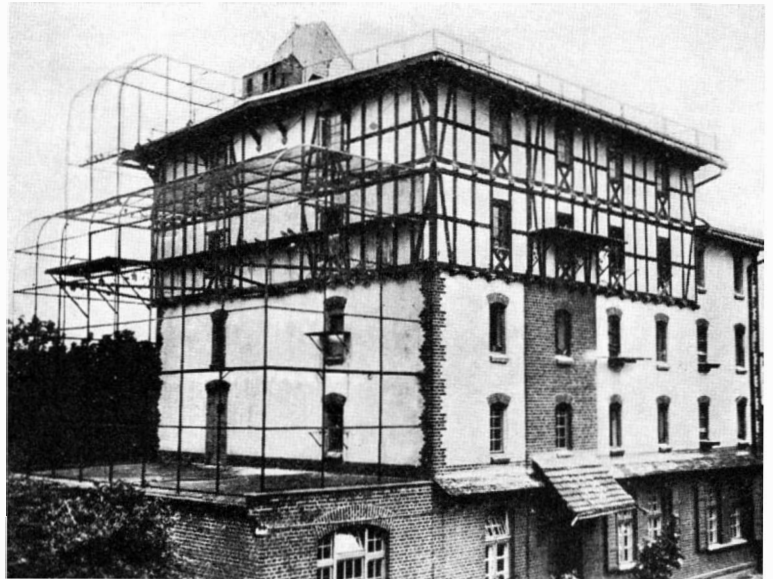


Figure 12: Left. The fundamental model from which hair is built up. It is closed and is therefore resistant to chemicals, but in the stretched condition (right) it is open and susceptible to flexing and "setting" and chemical attack

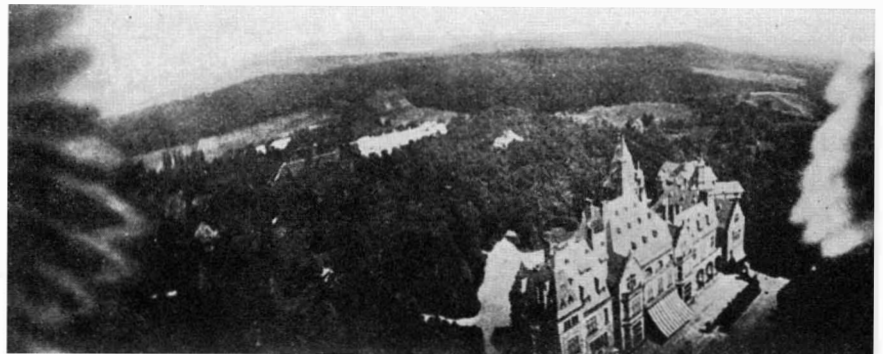
PIGEONS GO TO WAR COLLEGE



An important development in carrier pigeon training has been the perfecting of a small, light camera which can be carried by the bird, and which automatically makes exposures at predetermined intervals. At the right is an enlargement of a picture taken by a pigeon-camera. Note wing tips



In Germany there has been established a training school for carrier pigeons. In the new school building shown, classes are held daily by expert pigeon trainers. The upper floors are equipped as living quarters for the birds, and on two sides are large wire cages for exercise



Left: A bicycle patrol carrying pigeons in a special knapsack from which their heads protrude. Eight trained birds can be carried comfortably by one man in this manner



Right: Another part of the training school equipment is the motor truck shown, equipped with a carrier-pigeon enclosure on the roof

'JOBS FROM JUNK— WAGES FROM WASTE'

A TRUCK rumbles through the residential streets of Buffalo, New York, through the business section, to the poor quarter. Its load is broken chairs, old clothing, papers, worn shoes, yet it seems to run with a purpose as though the load of junk had a destination other than the city dump.

A white-haired man limps down the sidewalk in the same direction, slowly on account of his lame leg and a cane, yet with a purposeful air and a light in his eyes. He, too, seems to have a destination. He has. His goal is the same as that of the truck, a large brick building on the corner of Michigan Avenue and North Division Street. Over the door are the words: "Buffalo Goodwill Industries, Inc.," and inside is the sign: "Jobs from Junk—Wages from Waste."

Within the building other old men may be seen, and old women, and crippled boys and girls, over 100 of them, and every day as truck-load after truck-load rumbles up to the building bringing cast-offs from prosperous homes of the city, they are at work sorting the



Above: Buffalo Goodwill Industries occupies a modern loft building where junk is converted into wages. Right: Over 35,000 capacious bags help save discarded articles for salvage



By JANET B. WATTLES

materials, repairing and remaking them, and receiving in payment a decent living wage.

To provide work for aged, crippled, mentally and physically handicapped men and women who cannot be fitted into normal industry and yet who are eager for the chance to help themselves, is the purpose of Goodwill Industries. Among the 100 or more daily employees

of the Buffalo plant are skilled carpenters, mechanics, shoemakers, seamstresses and clerks, past the age where they are acceptable for ordinary business enterprises and yet able to work at the tasks with which they are familiar. Slow perhaps, but willing, and able to earn something. There are men and women with nervous diseases, mental quirks, social complexes and maladjustments; paralysis victims, capable of training, maybe, in the use of feeble limbs, but who in regular business channels has time to try?

These workers, cast-off from normal business and industry, repair and remake the cast-off materials donated by householders of Buffalo and vicinity. The reconditioned goods are sold in Goodwill stores at low prices to needy folk who could not afford to buy new, and receipts from the sales pay most of the overhead expenses and wages.

In through the basement comes the motley discard from the prosperous life of a busy city. Dresses of silk, lace, and wool, shoes, scuffed out by hurrying feet of doctor or salesman, furniture cast aside for newer styles, household equipment no longer needed when homes are broken up. These goods are collected by trucks, covering the city twice weekly in response to calls from householders.

Little children in Buffalo know what a Goodwill bag is. They have been



"For those who cannot buy new." Reconditioned articles of wearing apparel and household equipment are a boon to the needy. Men's shoes are as low as \$1.20

taught to put into it their outgrown shoes and sweaters, the dolls and toys they tire of. There are approximately 35,000 such bags in homes of Buffalo and nearby towns, being filled with cast-offs to provide work for the handicapped.

IN 1930, the Buffalo trucks made more than 40,000 collections of material. From this "junk" the Buffalo institution paid out in 1930 more than 60,000 dollars in opportunity wages. Since the founding of the institution in 1920, over 550,000 dollars has been paid in opportunity wages to over 6000 different people. This costs the city little, saves them much. It saves waste goods.

The raw material for this work is idle goods in homes of the city. To most families the contents of their attics is a burden, contributing nothing to their welfare or happiness. The contents of the average attic is estimated to be worth about 15 dollars, if sold unrepaired to a second-hand dealer or junk man; the contents of the average bag, unrepaired, about 50 cents.

At Goodwill Industries labor is put into these discarded articles, the labor of handicapped folk, maybe, but careful labor, thoughtfully planned and conscientiously executed. It increases the value of the articles over threefold; the worth of a bag to two dollars, of the attic content to over 50 dollars.

YET this does not bring prices of remade goods as they are sold in Goodwill stores to a high figure. An entire woman's outfit, including silk dress, warm winter coat, shoes, hose, hat, gloves, and purse, can be obtained for \$6.80, and it will be styled to 1932, cleaned, pressed, and in perfect repair. A similar man's outfit with suit, overcoat, shirt, hat, shoes, socks, gloves, collar, and tie, will cost only \$8.50. A bed with springs and mattress costs \$6.50, a reconditioned stove, 10 dollars. A piano may be bought for \$6.85 plus three dollars for delivery.

Thus old articles unwanted by their original owners go back into service to begin a new career of usefulness. In 1930 more than 300,000 articles were sold in the four Buffalo stores to needy men and women.

Proceeds from these stores net nearly enough to pay overhead expenses and a decent wage to workers. However, because most of the workers are not normally efficient, they often do not earn the full amount which they are paid. Therefore a small subsidy (about 15 percent of the payroll), privately donated, is generally necessary each year to keep red ink from the ledger.

The cost to the community, however, is a small part of the saving to charity organizations and city tax budgets. Almost every employee, if not working and

earning part or all of his own way would be entirely dependent on charity.

The saving in human contentment cannot be measured.

As the goods are remade, so thousands of human lives have been rebuilt by this work. The Buffalo institution can point out dozens of men and women who would be dependants—wretched, useless burdens on society—were it not for the saving medicine of work.

Watching dull eyes brighten at praise for a bit of a task well done, watching bent shoulders of a cripple straighten and grow stronger day by day as he worked at his light tasks, watching tortured nerves eased by the pleasant routine of manual labor, and social and mental complexes giving way to friendly co-operation in wholesome contacts and group projects, gave to the Buffalo men and women engaged in this work a new insight into the possibilities of remaking individuals.



Scissors end the life of unrepairable garments; cut them into rags



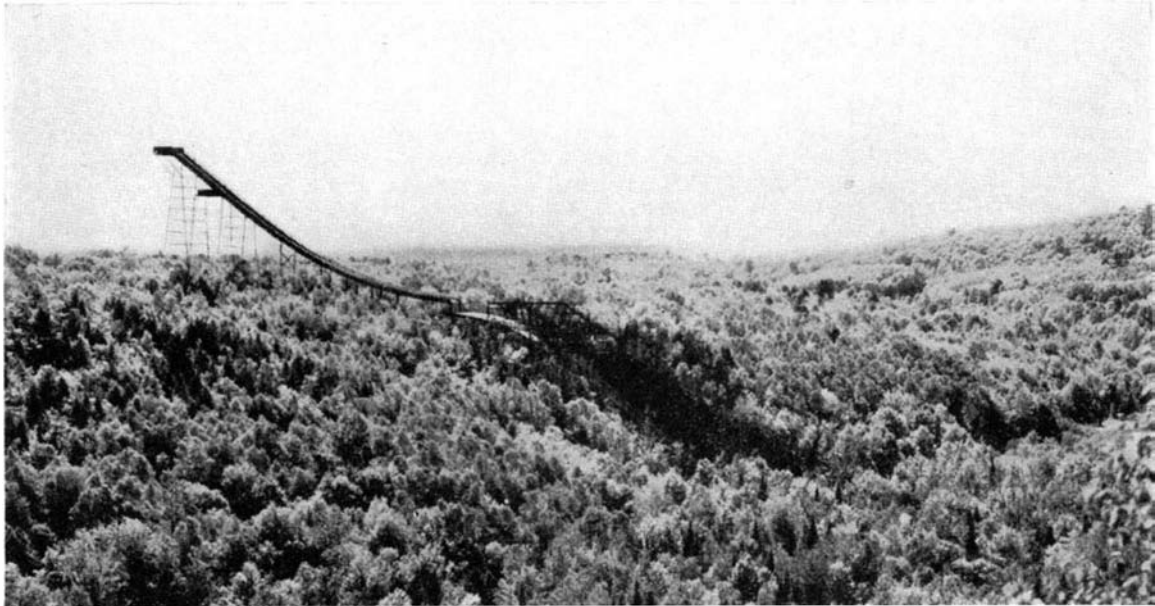
The motley discard from prosperous homes comes to the sorting floor. Careful sorting and remaking increase the value of old materials about 200 percent



Skilled craftsmen whose fingers have grown too slow find employment

Now the forces of social activity, religious and educational opportunity, medical treatment, and individual advice and encouragement are brought to bear on each employee to help him make the most of his handicapped life. Rehabilitation is the constant aim of the institution. Goodwill workers represent all races, creeds, and nationalities. No distinction except that of need and sincerity is recognized.

Over 60 cities in the United States and various communities in foreign countries have Goodwill Industries institutions now at work salvaging men and materials. Last year United States Goodwill organizations paid out over 2,000,000 dollars in opportunity wages to handicapped employees. There are waiting lists in other cities, too, and attics full of idle goods are to be found all over America.



Rugged nature at her best—or worst—provides a setting for the new steel tower and hill of the ski jump at Lucerne-in-Quebec. The structure was built in six weeks under difficulties during bitter winter weather

ENGINEERING A SKI-JUMP TOWER

By ROBERT DOBELL FORSTER

SCIENCE is today playing a big part in the sport of ski jumping—a far bigger part than the casual observer of this thrilling winter sport would imagine. Increased distances in leaps are becoming a common occurrence, but they are not being attained at the additional risk of life and limb. They come as the result of careful research by ski-jump designers. Hills for jumps of 130, 160, and 200 feet have come into being, and jumping the latter distance does not impose any greater hazard than far shorter leaps of a generation ago.

The common tendency among those who scan the sport in an expert way is to judge a man by the distances he has cleared. That hardly means a thing beyond demonstrating that he is capable of handling a big hill without mishap. That he can outleap others in competition and still accumulate points on style is a greater factor.

Ski federations are not encouraging record-breaking jumps that are likely to endanger the competitor. They feel that over-emphasis on great distances is detrimental to the sport. Skill and courage can be brought to the fore on 160- and 200-foot hills, thus making the contest open to a greater number of skiers.

The Seigniory Club at Lucerne-

in-Quebec in this respect followed the policy of Lake Placid, and a year ago a tower and hill for 200-foot jumps was constructed, safety for the competitors being of paramount importance. Erection of this mammoth structure in a few weeks some 75 miles from Montreal is a triumph for engineering under difficulties. What was an almost impassable

wooded hillside in early winter gave way quickly before axes and dynamite, and in six weeks the world's most costly ski jump was standing on its site.

In many ways the new Lucerne jump, composed principally of steel, is the twin of the Intervales Hill at Lake Placid, New York, where the Winter Olympic Games are being held this year, the dimensions and general profile bearing great similarity throughout.

When the plans were drawn up for this new Canadian hill which already has seen eastern records broken, all the fine features of the Placid jump were incorporated in the blue prints, together with other advanced ideas on jumping gathered from different centers on this continent. As a result it is judged by experts and jumpers as the safest big hill in the world, with a landing that presents no undue dangers to a man clearing over 200 feet.

Graded down to the minutest degree, this landing is far easier to take than the slopes under most jumps of far smaller dimensions. It is safer to make a long jump than a short one on this hill, a hundred feet, for example, barely taking one over the brow, while a leap of 175 or even 200 feet brings the skis down in perfect contact with the sharply angled slope. There is an artificial



Arne Finsberg, of Montreal, makes a standing jump of 215 feet on the new artificial hill

steel brow on this Canadian hill, which is placed on the crest of the slope, thus adding considerable length to the landing. While a man might be making 200 feet and more he is never far from the ground, for the flight of the skier parallels the brow of the hill as he flies forward from the take-off, and his height in the air probably varies from fifteen to three feet from the profile of the hill.

The temperature—and, incidentally, the snow condition—gives a jumper plenty to ponder over, for the weather has considerable bearing on the speed attained. On an unusually fast day a skier might encounter no end of trouble with too high velocity, and outleap the landing slope, with disastrous consequences to himself as he lands on a flatter angle. This can be overcome to a certain extent by the application of waxes to the bottom of the skis, but at both Placid and Lucerne another provision has been made to sidestep this danger. When the judges feel that there is a possibility of outleaping the landing slope, they can resort to a safety measure without detracting very much from the exhibition. In the framework of the chute, 36 feet from the top, is an intermediate platform. The jumpers can start from that intermediate point without holding in their leaps, having ample assurance that their 60 or 70 mile per hour velocity will not carry them past the 39-degree slope of the landing hill.

BREEZES are troublesome to a jumper, and are another factor that must be well considered. A cross wind, for example, might temporarily turn the skis as the jumper is in the air, and set him towards the side of the landing as he descends. Headwinds cause a jumper to lurch far forward as he goes over the lip of the take-off, have plenty of “lean” and thus break the pressure of the wind on him, while in lighter winds he can keep more erect, but never lean backwards, for then he will not keep the fronts of his skis on the landing. Things happen in the flash of an eye as a jumper descends to earth, but falls are so sharply angled that nothing more serious than a minor shakeup usually occurs.

Proper timing most certainly is a big thing in ski jumping, and inaccuracy in judging the spring from the take-off invariably is accompanied by poor results. Intensive study of ski-jump chutes has brought about the practical elimination of a tangent preceding the take-off. In its place has come a sweeping arc that remains constant from the

starting platform to the lip of the jump, a feature on hills such as at Lake Placid and Lucerne, and popular in European centers. The redeeming thing about the tangent chute is the opportunity it gives the jumper to get poised for his spring, giving steadiness as he prepares to whirl through space. It has its bad points, however. One is the loss of speed it contributes as a jumper prepares to “take off.” After descending at a slope of 33 or 35 degrees, the angle suddenly changes as the chute flattens out, and the last 30 or perhaps only 15 feet are covered on a six-degree slope, the final stages bringing about a constant loss of velocity.

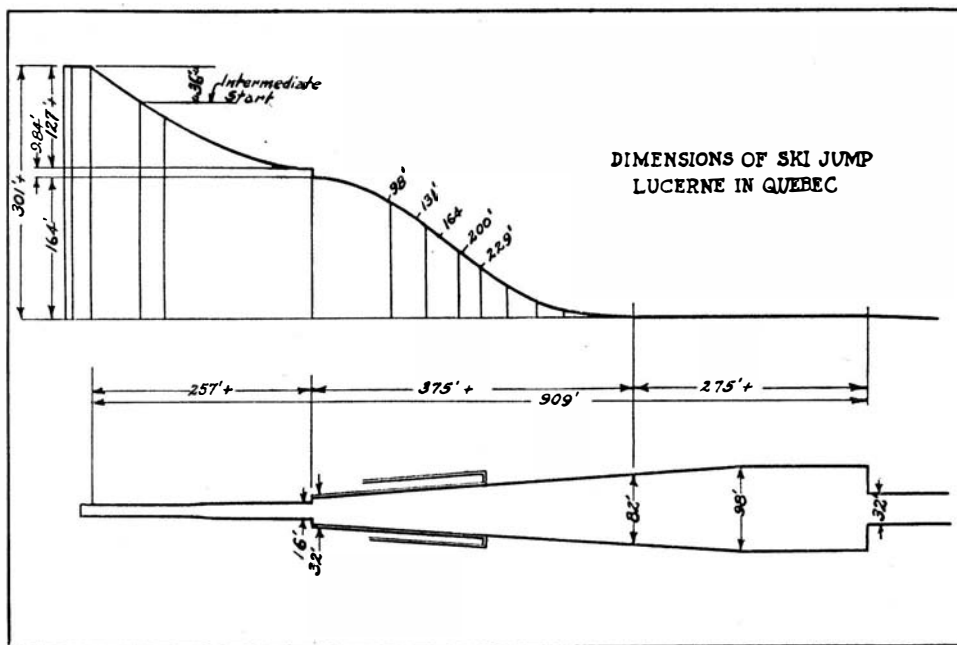
Uniform steadiness throughout the entire length of the run is the greatest feature of the curved take-off, for the variation of the arc is almost negligible. Loss of speed, therefore, is brought to a minimum. There is no last minute change in pressure on the legs and body, the curve being practically the same throughout. Thus a jumper may time his spring by eye, in the split-second interval he has after leaving the tower, and the disturbing influences such as change of the tremendous air pressure and slackening of speed will not hamper him in his leap.

All these factors were taken into consideration in the design of the Lucerne



A glimpse down the 16-foot chute. The stands flanking the landing accommodate 2000 people

jump. On November 25, 1930, Harold L. Furst, operating manager of the Lucerne-in-Quebec Community Association, made his first attack on rugged nature in the interests of advanced skiing. Down came virgin forest in the path of his woodsmen. Boulders and ledges were blasted out of the way. By December sixth, with winter well set in, the hill was completely cleared, and the footings for a great steel tower put in. Thirty-four thousand cubic yards of rock and earth were cut out of the precipitous mountainside, while at the foot of the hill a thousand cubic yards



Outline drawing showing the approximate dimensions of the jump. The constant curve of the take-off, the landing distances, and the intermediate starting point are indicated



Crouching for the spring at the take-off at the Seignory Club jump

were used for grading. The top of the hill was cribbed and filled in with gravel, giving the slope additional length, while rocks and gravel were used for grading to make it uniform. Two hundred and thirty cubic yards of concrete went into the footings to support the steelwork, and four one-inch dowels were sunk eight feet through concrete and rock to give the structure assurance of a permanent foundation.

Two hundred men were on the job at one time to speed the hill towards completion, and 100 tons of steel, of angle construction, were used for the framework. Into the air shot a giant steel tower, 143 feet in height, the take-off for the loftiest jumping chute in the world!

THE chute did not claim all the steelwork; neither did the spectators' stands. The landing hill in its natural state was short for leaps of over 200 feet, but the architects had already prepared for this. Their remedy was an artificial brow of steel closing the gap between the take-off and the cribbed upper portion of the hill. During the first week of January everything was in readiness but the snow. That was not long in coming and shortly afterwards Nels Nelsen, of Revelstoke, British Columbia, who in 1924 was credited with a world-record leap of 234 feet, was the first person to take flight over this man-made hill.

What an imposing sight the new structure was. Sheltered from the winds, with a northeast exposure, so that the sun could not shine directly on the slope, the jump could hardly have been better located. The whole surroundings lent beauty to the hill, for the landscapers, in cutting away trees, had not been ruthless with the axe, and a fringe of well-formed evergreens stood out

prominently around the boundaries of the clearing. There was ample accommodation for spectators, for not only were stands raised on both sides of the jump, extending to the foot of the hill and seating 2000 persons, but there was room for thousands more at the extremities of the level below the landing.

During the latter stages of the construction three of us scaled the steelwork and pine flooring of the tower and chute to dizzy heights, and the sight that met our eyes was enough to send shivers through us. On all sides were rugged woodland, trees, rocks, snow; all the characteristic physical features of the mountainous Laurentian country were dwarfed from that height. Directly below was a long steel-bodied chute, boarded-in here and there, a very precarious-looking slide and as yet not a very safe place to play.

A near-precipice was the landing hill, huge boulders and gravel filling giving it a rounded contour, but altogether a forbidding-looking spot. Farther away still, on the level, was a clearing in the woods, landscaped and smooth, almost a hundred feet wide, the only safe looking feature about the whole undertaking. Getting out of that frost-bitten steelwork was enough to signal caution as well as inspire fear, much less to entertain thoughts of clamping on skis.

What a place to jump! It looked like suicide! On the opening day, however, 160 feet was common distance on a chute that was slowed up considerably by mild weather. Hardly a spill was registered as top-notchers and second-raters thumped down on the steep landing slope. They were experiencing something new—jumping ridiculous distances without fear or caution on a scientifically perfect hill. Record after record was broken last winter. Harold Bagguley, of Ottawa, holds the present record for the east, with a leap of 217

feet, while Arne Finsberg, a Montreal Norwegian, was close behind with 215 feet. Anton Lekang, of Brooklyn, was sensational on this hill, but could not hold his landing when well over these marks, taking a fall jump for a distance of 235 feet.

Ski jumping looks more dangerous than it really is, and broken bones and other serious accidents are few and far between. Thornley Pickering, of Montreal, who for close to 20 years has been active both as a competitor and an official, can hardly recall an accident of any seriousness during the long term in which he has been associated with ski jumping. At all the principal centers in the east he has been in close touch with the sport, yet only twice has he seen bones broken in a landing crash. At Briarcliff an overzealous movie cameraman edged too close to the landing slope in an effort to "shoot" a jumper, and in the resultant collision the jumper came out second best and suffered a broken arm. Another incident was at Ottawa when a jumper gained too much momentum on an icy chute, to lurch crazily over the side of the landing slope, and receive a concussion of the brain and a serious shaking up.

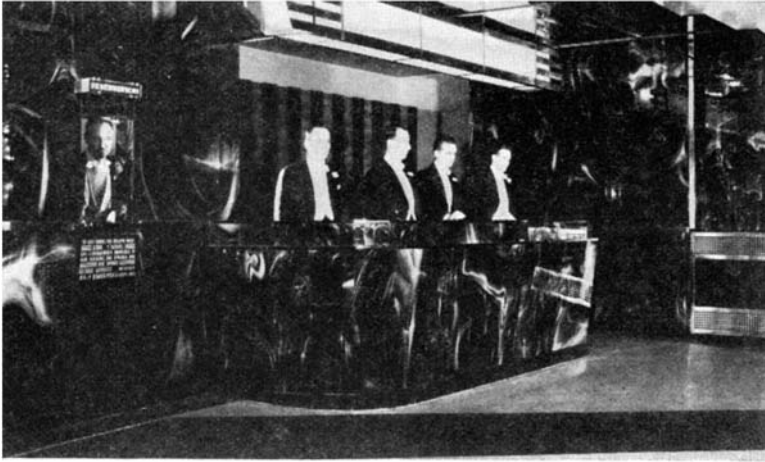
DDOUBLE deck stands have come to be an institution in baseball, enormous saucers have accompanied the popularity of football, and tremendous arenas now encase hockey rinks. With the advancement of sport, tremendous ski hills are being built which will popularize this winter pastime to a great degree.

C*The job of recovering the 5,000,000 dollar treasure of the sunken liner Egypt has called for much ingenuity and the use of unique equipment. Dramatic illustrations of the job will be published soon.*

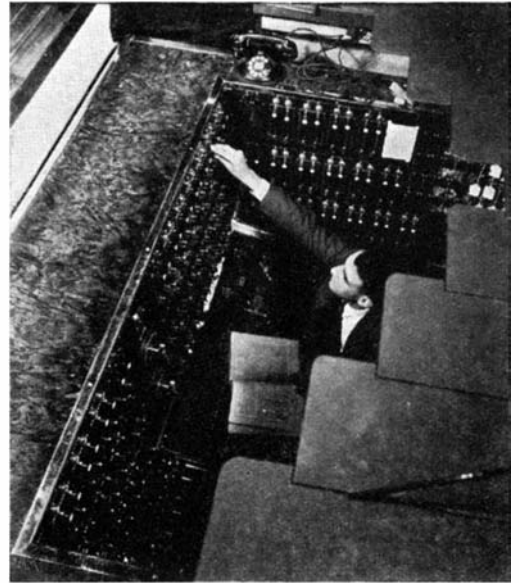


A view of the construction work on the jump. While the landing slope was being graded below the hill, the steel towers and the stands were erected above

A NEW STYLE THEATER, FRONT AND BACK



All photographs courtesy Earl Carroll



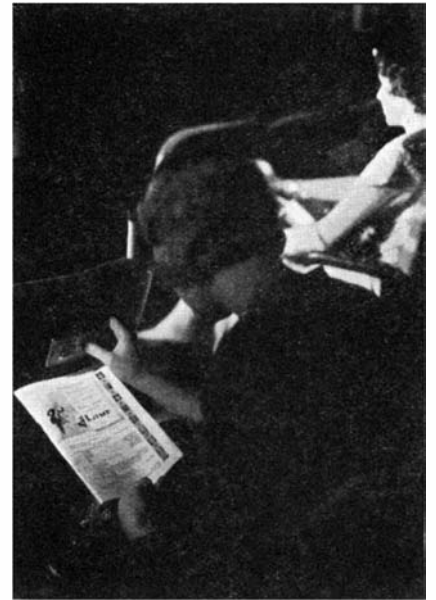
The light control director at work in front of the curtain, controlling every house light

The box office nuisance in the discard. These gentlemen are selling tickets over a counter



THE largest legitimate playhouse in the world, the Earl Carroll Theater in New York City, was conceived with the idea of presenting at three dollars per orchestra seat, great scenic effects and a large chorus of girls on a huge trick stage. This one theater contains more novelties than the last quarter century has produced. The lighting effects are the most unusual ever conceived and they are all controlled by a light director who has abandoned shirt sleeves for evening dress, for he is in "front of the house." The "enemy of the people" has his sinister grating removed and tickets are sold by four urbane gentlemen. The accommodations for the members of the company even include refrigerators for orchids.

Left: Shower stalls in which powder, not water, is used. Spray guns are used to apply an even coating to the body



A tiny light on the back of seat enables those behind to scan program



Exit the old stage door keep—a grouchy Cerberus. A courteous girl takes his place. This is one of the revolutionary features



In the mirror room the examples of pulchritude can gain a view from any angle so the "lady artists" may appear at their very prettiest

OUR RAILROADS MUST BE SAVED

By F. D. McHUGH

"SOMETHING must be done to aid the railroads," said our small town friend. "Look at that huge truck crowding the road, loaded down for a long run, competing with the railroads. My taxes pay for its right-of-way, and yet the railroads have to maintain themselves and stand security for our banks and insurance companies. I tell you, something should be done about it!"

This opinion volunteered by a man having, to our special knowledge, no direct connection with any railroad, was most surprising. When, a few days later, a similar remark was made by another man, the truth dawned that people are beginning not only to think about the crisis that confronts the railroads but also to understand the urgent need for a solution of the problem. The railroads themselves, insurance companies, banks, Wall Street—all have attempted strenuously to show the individual that the railroads' problems are his, and it would seem that he is now beginning to understand. He still has much to learn, however, for the question goes much deeper than truck competition and purely local phases of railroad operation. Even on these points there is much to be said that is not readily apparent.

At present the railroads are suffering

principally from two things: competition and the depression. These two, working together, have hit the roads so hard that there has recently been an unloading of railroad securities that amounts almost to a panic. The result is that the financial stability of many of our great institutions, to which are entrusted the savings of millions, is being threatened.

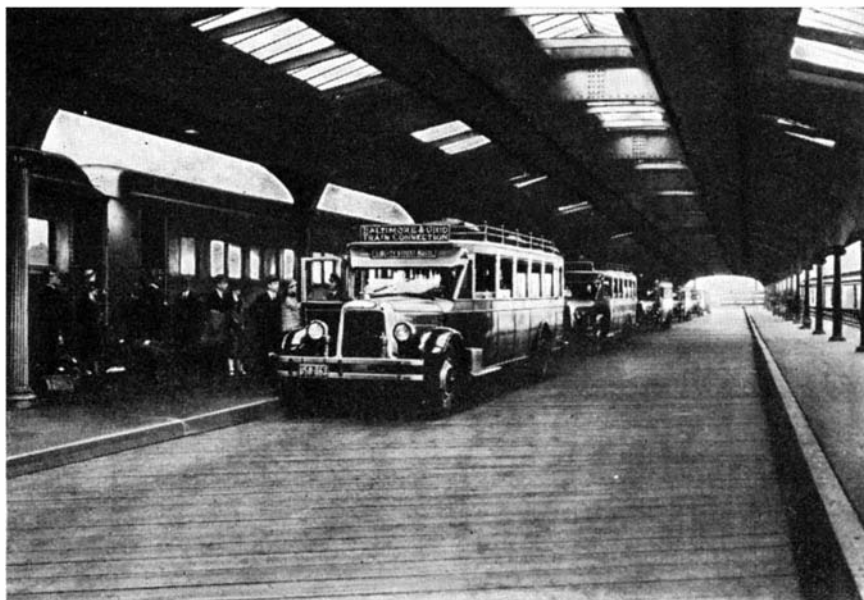
Aside from that fact, our railroads are tremendously important to us in another way. Since the first steam locomotive drew a train of modified stage coaches hardly more than a hundred years ago—and press comments at the time said they would never become a practicable means of transportation—the railroads have followed the pioneer and have pioneered on their own. Without them, the greater portion of our West would still be wilderness; what are now wheat fields might still be in virgin timber or open prairies; our mineral resources would have been scarcely touched; factories would be few and centralized near water; and, in fact, the modern machine age would, most likely, be but a dream of the future. Following the pioneer, the railroads have carried supplies and machinery to him and have returned with the products of his labor and perseverance.



Starting with a few miles of experimental trackage a hundred years ago, the railroads have extended their tracks in a network that covers the nation. At the end of 1930, they were operating about 261,000 miles of line, or, if we include all main tracks, sidings, and yard tracks, about 429,000 miles. About 95 percent of this total mileage was operated by the Class 1 railways—those having operating revenues of a million dollars or more a year. These thousands of miles of track are a measure of the progress of the nation; they are the arteries of steel along which flows the life blood—the trade and commerce—of the nation. Their continued operation, with an actual instead of theoretical fair profit, is as vital to our future as is our national genius.

SOME years ago railroad securities were made legal investments for savings banks and insurance companies. These two chief agencies for safeguarding the savings of millions of people hold approximately half of all the railroad bonds now outstanding. Thus it becomes a serious matter affecting the man in the street as well as the well-to-do investor if railroad earnings drop so low that insurance companies and savings banks can no longer invest in railroad securities and may be forced to give up what they already have. The welfare of millions—widows, minors, and institutions whose funds are held in trust—depend upon the integrity of railroad investments.

In some states, including New York, laws forbid investment of bank and insurance company funds in bonds of railroads that have not earned annually during five of the six years preceding the investment, one and one half times their fixed charges. Present evidence indicates that, by the time this is in



Courtesy Baltimore and Ohio Railroad

Costly extra service to make railroad travel more attractive on one road. Buses connect the terminal in Jersey City with local New York City stations



Courtesy Baltimore and Ohio Railroad

print, 77 percent of railroad bonds legal for investment by savings banks and trustees, in New York, of a par value totalling 5,877,000,000 dollars, will have been stricken from the legal list at the end of 1931.

If the individual has difficulty in understanding how such investments affect him, at least the effect of the railroads' investment in labor and materials should be clear. The railroads employ something like 1,500,000 persons with a payroll of around two and a half billions of dollars annually. Averaging five persons to the family, this means that the railroads support directly nearly 8,000,000 people, to say nothing of those private investors whose incomes are wholly or in part dependent upon the railroads. No matter what a man's business may be, it takes its share of the billions of dollars paid out by the railroads in dividends, wages, and for supplies each year.

INCLUDING road and equipment, the total property investment of Class 1 roads at the end of 1930 was nearly 27 billion dollars, and the net capitalization of all roads was 18,700,000,000 dollars. In the past eight years, Class 1 roads alone spent nearly 7,000,000,000 dollars for improvements. Thus, in addition to their public service, it is to be seen that our railroads constitute one of the largest customers of the industries of the country. In 1930, for example, the Class 1 roads spent 1,038,500,000 dollars directly for fuel, supplies, and materials. This total included over 306 million dollars for fuel, over 134 million dollars for forest products, and the remainder for steel and iron equipment and parts, machinery, oils and grease, signal and other electrical equipment, commissary supplies, stationery, paints, chemicals, and the like.

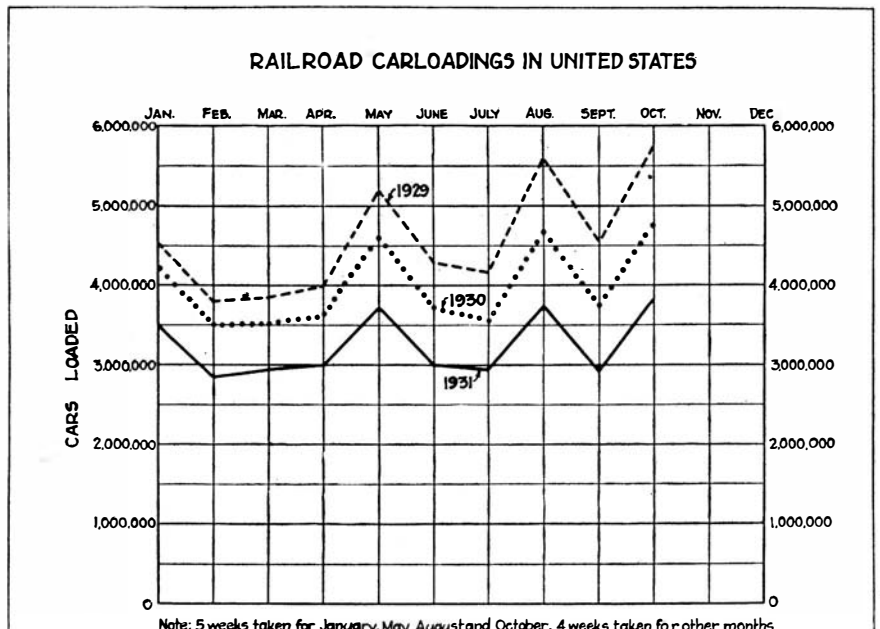
Besides this staggering contribution to the prosperity of the country, the railroads pay over 400 million dollars each year into the public treasury; they are, in fact, our greatest taxpayers.

Despite the pre-eminent place railroads hold in our national economic scheme, however, it is claimed that they have been regulated almost out of existence. There seems to be no general sympathy for them although now and then one sees some evidence of a transitory interest in the problem that confronts them, a sort of futile gesture by individuals that seems always to carry with it a shrug of the shoulders that implies: "But what can I do about it?" This principle of *laissez faire*, so characteristic of the American public, makes it difficult if not impossible for the railroads to have reforms put through

that would give them the vitality so urgently needed at present.

It has been said, for example, that if the public had been overwhelmingly in favor of assisting the railroads, there would have been no delay in deciding favorably to the railroads the question of the 15 percent increase in freight rates on which the Interstate Commerce Commission has held a long drawn out series of hearings and on which the Commission recently rendered a partially negative opinion. The Commission could have decided this question at once but, instead, it gave shippers and others time to register opposition—which they did with a vengeance. The public, vitally concerned, looked on passively.

Since 1922, when the Interstate Commerce Commission decreed for the railroads a "fair return" of 5.75 percent



The "barometer of railroad business": the number of cars loaded with revenue freight in 1931 shows up badly in comparison with the years 1929 and 1930

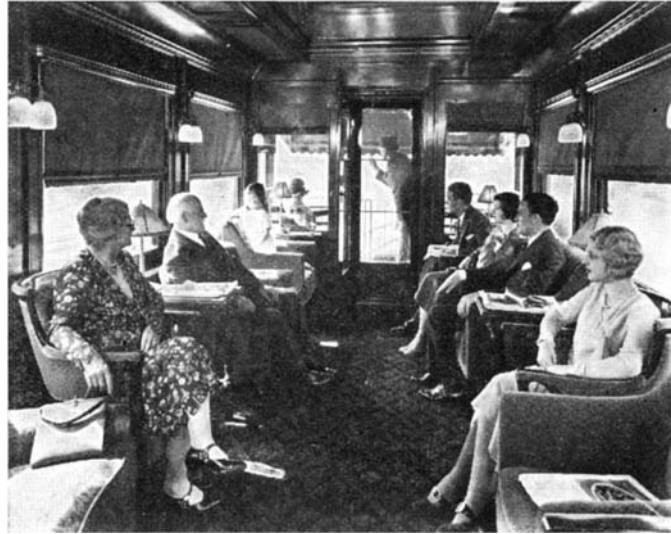
on the value of their properties, they have never been able to earn that percentage of profit even in the boom year of 1929. In the 12 years since the government ceased to operate the roads, their net income has failed by more than three and a half billion dollars to reach the total it should have been under the act. In the first nine months of 1931, figured on an annual basis, the return has been but 2.08 percent; in 1930 it was 3.44 percent; and in 1929, 5.29 percent. In passing, it is to be noted that when the government relinquished control of the railroads, they were badly disorganized and in sad need of repair; and this fact necessitated the expenditure of millions that otherwise might have counted as profits.

Sometime ago the president of a large trunk line told the writer that the railroads were in no worse state than business in general, that adversity had played no favorites in business, industry, and transportation.

Examining the facts, we find that the average price of railroad stocks on November 28, 1931, was 40 percent lower than during the worst part of the depression of 1921 while the average price of industrial stocks was 40 percent higher than it was then. A large brokerage house, in fact, has shown that the average price of railroad stocks is lower than it has been since 1897. Another fact not generally known is that the net operating income of the railroads in 1931 was less than it was in 1902 when their investment was 15 billion dollars below what it is now.

THUS to alleviate their financial condition and bolster up their credits the railroads last June asked for a blanket increase of 15 percent on freight charges. Some expressed the opinion that this increase was mandatory under the law, but the Interstate Commerce Commission refused flatly to grant the request. Instead, it offered a substitute plan for specific rate increases on certain commodities whereby the annual revenues of the carriers might be increased 100 to 125 million dollars, about a fifth what the railroads desired. This substitute plan called for the pooling of all revenues which may result from the specific increases "and the distribution of that fund among the carriers that fail to earn their interest charges, in proportion to their deficiencies." Professor William Z. Ripley sees in the report of the Commission, as a whole, "a distinct betterment of outlook for the future." To this substi-

tute plan, however, the railroads filed an answer, the principal feature of which is the provision that the increased revenues shall not be allocated simply as gifts to needy companies but shall, instead, be lent to them. To administer the funds in this loan plan, the railroad executives proposed the formation



An example of the type of lounge and observation cars being put into service on all roads for greater comfort

of a credit corporation. On December 7, the Commission sanctioned this plan by the declaration that it could "neither approve nor disapprove either the lending plan or the agency the carriers say they expect to use in making the plan effective." In other words, they have given the roads a free hand in this matter.

In the meantime, the carriers have cut their operating costs to the bone, even at the expense of deterioration of their physical properties. Maintenance has of necessity suffered, and the splendid program of improvement which the roads have carried on for years has been curtailed. And yet through all their period of adversity, they have maintained in principle the wage scale of 1929. There have been reductions of forces, to be sure, but one has only to visit any railroad yard to see the reason why: thousands of passenger and

freight cars are laid up and hundreds of locomotives stand idle in their protective coats of white lead.

As an indication of the extent to which this laying up of freight cars is necessary, consider the decline in freight car loadings for the entire year 1931. Freight car loadings are considered an accurate barometer of business conditions but especially of railroad business. We have watched hopefully each week the tabulated figures but only in a few cases have we seen signs of improvement and each time they have proved temporary. Most often these reports read something like the following one, selected at random: "Loading of revenue freight for the week ended on September 19 totalled 742,628 cars. This was an increase of 74,878 cars above the preceding week, when loadings were reduced due to the observance of Labor Day, but a decrease of 209,933 cars below the corresponding week last year and a decrease of 424,767 cars under the same week two years ago."

Again we look for reasons. This drop in revenue freight seems to be out of all proportion to what might be expected to be the result of the adversity affecting business generally. The probability is that the decrease is proportionally too great because, for the sake of economy, l.c.l. (less than carload lot) shippers are using cheaper forms of transportation; and trucking companies and "wild-cat" truckmen, taking advantage of this circumstance, have enlarged their fleets and lengthened routes.

Of all the competitors of the railroads, motor trucks are the most discussed—with apprehension by some and with calm acceptance of their place in transportation by others. Some railroad men deny that they can ever cut appreciably into the railroads' business



Reprinted from our December issue

Truck competition with the railroads is growing rapidly. Companies such as the one operating this unit, however, often co-operate with the railroads

in normal prosperous times, but the Interstate Commerce Commission has stated that it feels that the railroads have under-rated the potentialities of the competition that trucks may offer.

The competition of the interstate truck is not consistently clean, either. The larger, organized trucking companies have been less culpable than the "wild-cat" concerns, but even they have had no restrictions placed upon them as to the acceptance or refusal of shipments and therefore can pick the cream of the business and reject the rest. They can and do vary their rates to satisfy the bargaining propensities of individual patrons whereas the railroads must file their rates with the Commission. They pay no taxes except those covered in their ordinary truck license, and gasoline taxes in states where these are collected. These taxes are in no wise proportionate to their excessive wear of the highways—the free rights-of-way financed by the public. The cost to trucks of license and gasoline taxes amounts to about 7 percent of their gross earnings, or about the same as the taxes paid by the railroads; but the railroads' maintenance of roadway charges run their total up to about 20 percent of their gross earnings.

Trucks have been increased in size, are carrying more trailers, and are running in long "trains" so much more frequently than heretofore that people are beginning to look upon them as a nuisance and danger; and some states have already passed legislation to restrict their length or to prevent their running in trains. This movement, it is predicted, will catch on in other states because, while highways are built as much for commercial purposes as for pleasure, trucks have arrogantly assumed a sort of dog-in-the-manger rôle and crowd pleasure cars off the road.

In these times when business is at low ebb, the small truckman will accept

short-haul freight at any price so long as it affords him the equivalent of daily wages. Nothing can compete with such practice; and it is of primary importance that operators of this sort either be required to conform to the more regular practices of the larger

a fair rate and to uphold the quality and dependability of our service."

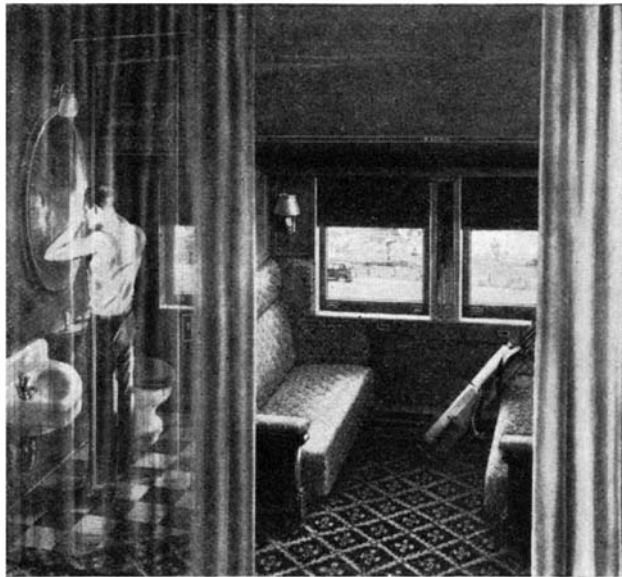
In the same way that the people supply a free right-of-way for trucks, they also supply free waterways for inland shipping. The Rivers and Harbors Bill takes care of that expense to the public treasury. It gave 149,000,000 dollars in 1929 toward the creation of "a great national system of waterways." This, of course, acted to smother railroad competition on certain routes. And yet the railroads are prohibited by law from holding any interest whatever in any water lines, coastwise or inland. This amounts in effect to a Federal subsidy for water transportation, and is discriminatory.

The Federal Government actually owns and operates The Inland Waterways Corporation, a barge line operating on the Mississippi and Warrior Rivers. This corporation pays no taxes and its waterway is maintained by the government without charge to the corporation. In these respects, the corporation is a subsidized carrier operating in competition with the railroads.

Despite this unfair competition the railroads have to face, they are called upon in times of disaster to give a hand-out to those in need, as was the case in the drought of 1929. At that time the Interstate Commerce Commission authorized the railroads—practically begged them—to reduce rates on shipments to relieve the drought sufferers. During the present economic crisis the Administration has repeatedly urged the railroads to maintain employment regardless of reduced traffic.

IN the last few years the railroads have seen spring up a new form of competition that promises to take much of their most profitable business. This is offered by the network of 175,000 miles of pipe lines that carry oil and natural gas back and forth across the country. Loss of revenue from shipments of oil reaches a large figure since the pipe lines have already wrested from the railroads something like 6,000,000 tons annually of oil carrying business. The competition offered by the natural gas pipe lines, though not so obvious, may in time be appreciably large, for where natural gas is used there is a decreased demand for other fuels. Already pipe lines are carrying about two trillion cubic feet of natural gas annually.

The competition of private automobiles has taken large toll of the passenger traffic of the railroads. Buses, (Please turn to page 122)



Courtesy The Pullman Company

For the railroad traveler's convenience: a new Pullman arrangement—a section having its own dressing room

companies or be prohibited by law from using such cut-throat methods of business.

Congressional discrimination against the railroads in not placing the interstate trucking companies under the supervision of the Interstate Commerce Commission, or regulating their operations as those of the railroads are regulated, is claimed to be the principal cause of the growth of truck competition against the rail carriers. Some of the trucking companies have endeavored to stifle agitation for truck regulation but fortunately not all of them feel that way. The president of a large truck transportation system recently told us that he was in favor of Interstate Commerce Commission control. Asked if his opinion was shared by many others, he told us it was. "It will force the 'wild-cats' out of business," he said, "and enable us to charge



Buses have taken a large number of passengers from the railroads and airplanes are taking a steadily increasing number. Railroads are slowly adopting both

SCIENCE TRAILS THE CRIMINAL



The gun room is a veritable museum of firearms. Examining a revolver and firing a test shot into a basket of cotton waste to preserve markings. The firing range is adjacent

By **ALBERT A. HOPKINS**

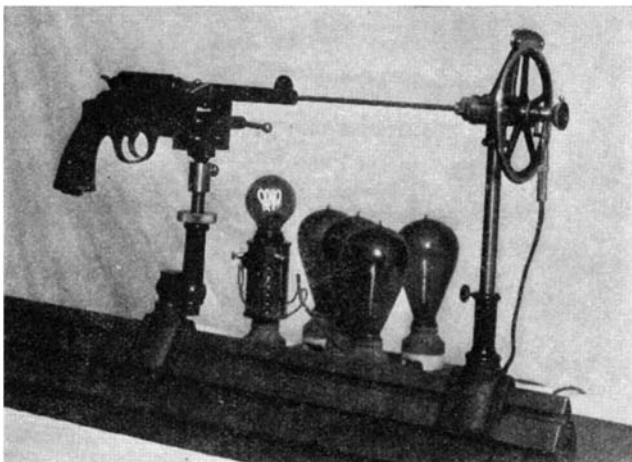
THERE are all kinds of laboratories—analytical, diagnostic, pathological, X ray, and a multitude of others, as well as the great research laboratories which are making over the world. In Chicago there is a crime laboratory. Poor Chicago, regarded as the crime center of the universe, probably got the laboratory as an “accident of birth.” Anyway it is there and is ready at all times to help combat crime by making an expert analysis of the physical traces left by the criminals. The Scientific Crime Detection Laboratory is affiliated with Northwestern Univer-

sity and gives courses to classes of not over 50 enrolled students. It is a non-profit-making organization for the utilization of all the resources of modern science for the benefit of police officials and all those in need of such help. The institution is directed by Colonel Calvin Goddard, one of the world's most famous firearms experts.

A pleasant afternoon can be passed in visiting the various rooms where intensive research is carried on along unique lines. Originally about 60 subjects were laid out for consideration but the number is being reduced so that

more stress can be laid on such subjects as firearms, handwriting, typewriter identification, methods for detecting deceptions, reconstruction of crime scenes, and so on.

We can readily visualize students bending over desks and listening to such lectures as: “Pitfalls in Forensic Ballistics,” “Study of Glass Fractures,” “Methods of Burglary Protection,” “Codes and Ciphers,” “Sketching a Crime Scene,” “The Bank and the Crime Problem.” These and many more are real problems which are not knocking at our door, perhaps, but they are important to the students, especially when combined with laboratory practice under competent instructors. These



The helixometer is an instrument for measuring the pitch of rifling in gun barrels, and for the study of rust



Col. Goddard is examining a weapon from breech to muzzle to see whether it has been fired since last cleaned

teachers have made a long study of the devious ways of the criminal and of the tell-tale evidences which are so often present and can be found if the investigators have proper vision.

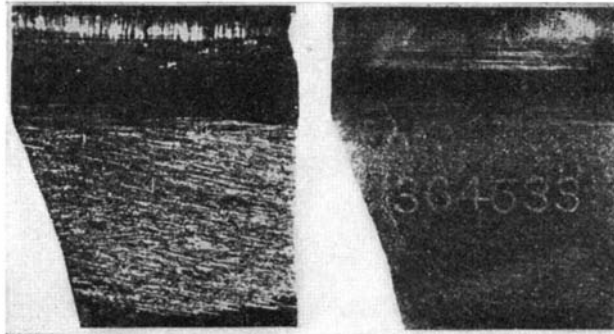
Naturally, firearms form a very important subject for study and every known instrument and device for the study of guns and ammunition is provided. The article on "Scientific Criminology" in the SCIENTIFIC AMERICAN for October, 1930, describes how bullets and firearms are matched for identification and studied for evidence. There are, however, several phases of the subject which were not treated in this article. One instrument we noticed at the laboratory which was new to us was the "helixometer" which is illustrated. This is an instrument for measuring the pitch of rifling in gun barrels. The device has other uses. For example, the condition of the surface of a weapon's bore from breech to muzzle can be studied. The long narrow tube carries a tiny lighting element and a prism at one end and at the other an eyepiece. When introduced into the bar-

rel of a small arm it is possible to note the presence or absence of rust or fouling and to determine most accurately whether the piece has or has not been fired since it was last cleaned. The type of powder used can also be determined in many cases.

Another thing which interested the writer was bringing back, as it were, serial numbers on guns. The principle underlying the restoration of serial numbers on revolvers is the fact that when the figures are stamped into the metal the effect is present not only on the surface, but changes in the metallic structure take place which penetrate deep into the substance of the object marked. In effect, columns of molecules immediately underlying the area struck and running vertically down into the metal, undergo physical changes as a result of the compression to which they are subjected when the die is driven into the surface above. As a result, even though the surface face be ground off and the numbers disappear, the application of the proper acid reagents will cause their reappearance, since the com-



Upper Right: Common method employed by crooks of removing serial number of gun by filing. **Below:** Etching process to restore filed-off numbers. **Right:** Revolver part before and after etching treatment to restore the identifying numbers



pressed columns and uncompressed metal surrounding them respond differently to the acid action. It is, of course, possible to remove enough metal to make restoration difficult or impossible, but to do this would in many instances involve destroying the part upon which the numbers appear.



pressed columns and uncompressed metal surrounding them respond differently to the acid action. It is, of course, possible to remove enough metal to make restoration difficult or impossible, but to do this would in many instances involve destroying the part upon which the numbers appear.

The gun room is an interesting place where there is kept a remarkable collection of revolvers and other firearms. The collection is so complete that in most cases even a gun of obsolete vintage may be brought out for examination or comparison. Ammunition of all kinds is stocked for use and an excellent rifle range is provided. Thus there is available practically every means of identifying the gangster's pistol.

Before we leave the subject of guns we must mention a gas pistol and gas "billy" which are the newest pieces of armament for our peace officers. The gas "billy" was developed for police use and has rarely or never been found in the hands of crooks. The gas pistol is used by police and by a still larger number of law-

abiding citizens who find in it a means of defense against prowlers and footpads. It is not permanently disabling, does not conflict with concealed weapon laws in many states, and still gives a sense of security and reasonable protection. If fired at close range toward the chest of an assailant it will temporarily blind him and give the victim ample time to escape.

We asked Colonel Goddard if he did not think we were backward in this country and what was, in his judgment, essential to efficient crime detection. He said: "There is an organization existing in every foreign center of any size, where scientific methods of studying the physical traces of a crime are developed and applied. Here are trained the expert criminal investigators who visit crime scenes, carrying little satchels full of



Ammunition room where Lt. Wescott is fitting a shell into a sawed-off shotgun



The gas "billy" and the gas pistol are valuable police aids. They are not used by crooks

foreign police commissioner that I recall who was not a doctor of law, medicine, science, or philosophy. Admission to the scientific police school in Vienna requires the equivalent of at least two degrees—the usual A.B. or B.S., and one graduate degree. I failed to meet a single higher official not college trained." This is a pretty strong brief for police laboratories and better police training.

There is a small but growing museum in connection with the Chicago Laboratory which is perhaps not as interesting as that in the Police Academy in New York or the famous or infamous "Room 33"—the "Black Museum" of Scotland Yard.

The Director's annual report shows commendable activity along manifold lines, particularly as regards court cases where many convictions were obtained on the evidence of members of the staff. The

specimen bottles, reagents, and so on, study the premises, locate and fixate the latent finger print, the fragment of a button, the mark of a rubber heel, the human hair clutched between the dead fingers, and what not. These bits of evidence are gathered with utmost care, labeled, tagged, bottled, and so forth, and taken to the laboratory for analysis by expert physicists, chemists, and microscopists. At the same time a legal-medical expert from the local institute of legal medicine who has visited the scene in conjunction with the investigator from the police laboratory is working out such features of the case as require a distinctly medical education for their proper approach. Their findings are laid before the prosecutor who has the ability, based on his specialized training, properly to interpret them. The presiding judge has himself been a prosecutor and needs no interpreter for the language of science. The jury knows that the medical and laboratory experts are competent and credible. What a pleasant contrast with the conditions under which we work in America!

"And the police in general. I met no

American Journal of Police Science, now in its second year, is published in connection with the Laboratory.

Of course, we could not leave the Laboratory without trying out the "polygraph" which was demonstrated by Leonarde Keeler of the staff of the Laboratory.

THE chart reproduced gives a polygraph record entitled "Location of Hidden Object." This test was performed on a member of a party at which the polygraph was being demonstrated. One of the guests hid an object in a room of the house. A map of the floor plan of the house was then prepared and each room given a distinguishing number. The subject was then connected to the apparatus, and the blood pressure, pulse, and respiration recorded continuously. After a few moments for obtaining a normal curve, the subject was asked, "Did you hide the object in room one?" Some 15 or 20 minutes later, the subject was asked, "Did you hide the object in room two?" And so on throughout the map of the entire floor plan. The object was located by an examination of the reactions recorded on the graph. The blood pressure curve slowly rose up to and including the question referring to the room in which the object was hidden. After that point, the curve slowly descended, indicating relief.

Briefly the apparatus consists of three units, one recording continuously and quantitatively the blood-pressure and pulse, another giving a duplicate blood-pressure curve taken from some other part of the subject's body, the third unit recording respiration. The curves are recorded by means of lever arms and fountain pens on a roll of paper continuously fed by a motor. Our illustration shows a subject undergoing a test. As far as can be determined, 75 percent or more of the guilty suspects have confessed to their crime after being subjected to the test.

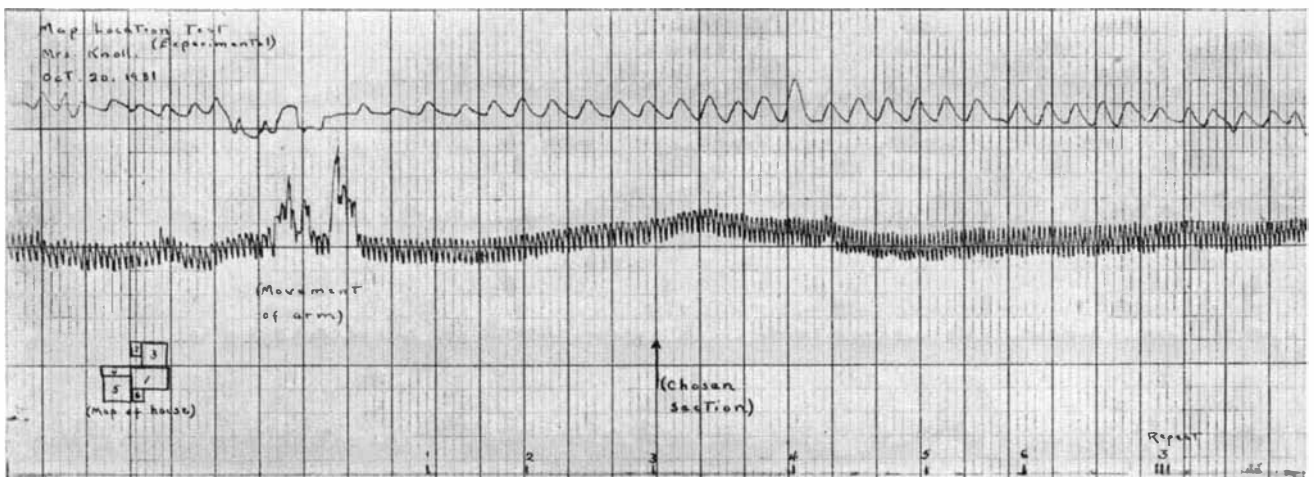


Photo above: The designer, Mr. Leonarde Keeler, of the polygraph or the so-called "lie detector" giving a demonstration of a deception test. Chart: This is one type of record

made by the apparatus, which combines a sphygmomanometer and pneumograph, showing a deceptive test using a map of a house. The test is described in the text on this page

A SNOW AVALANCHE "CAUGHT IN THE ACT"



QUICK action on the part of a photographer resulted in a series of unusual photographs showing, step by step, the progress of the fall of an avalanche on the Wetterhorn, the famous peak in the Bernese Oberland range. The interesting series is reproduced on this page, numbered in the order in which they were taken. The photographer was in the act of photographing the mountain from the Great Scheidegg Pass when the first rumble of the fall was heard.

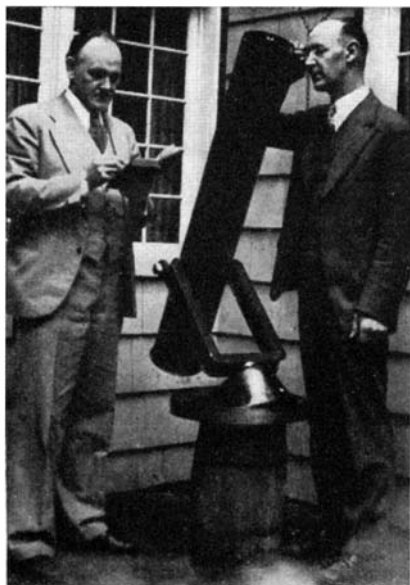


A set of rapid snapshots recorded the first rush of the snow, the subsequent falls against the mountainside, and the de-

positing of the snow at the foot. In the final picture, 5, at the left, a man is standing near the edge of the great mass of snow, to indicate its extent. As to avalanches in general, it is interesting to note that thunder or even a loud shout is said to be sufficient to set in motion a mass of snow that is poised on the steep slope of a mountain. For this reason, guides in mountain regions where avalanches are common often enjoin absolute silence when crossing danger-

ous spots. Avalanches are sometimes started by the loosening effects of spring rains, or even by gusts of wind.

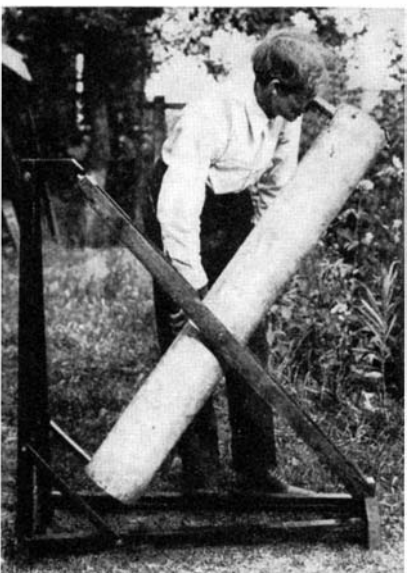
AMATEUR ASTRONOMY



Messrs. Sutter and Evans, with the "Emden" telescope that started it



E. B. Snyder of the Tacoma Daily Ledger and his 8-inch reflector

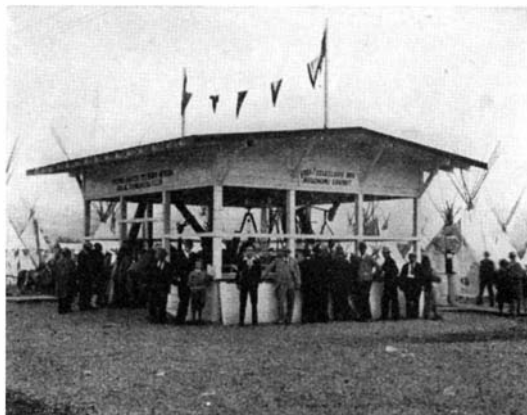


E. F. Doecher used the simple yoke mounting on his 6-inch telescope

THUS does Mr. George Croston of La Grange, Washington, Secretary of the newly organized association known as the "Amateur Telescope Makers and Astronomers of Tacoma," head an informal account of the thriving activities in and around the city of that name. It would appear from what Mr. Croston writes that there had been a severe epidemic of amateur telescope making in his locality and that this epidemic still rages uncontrolled. It is only typical, however, of a wider epidemic which has overtaken the nation, for similar societies of amateur telescope makers and astronomers now exist in Springfield, Vermont (the mother society); and in Pittsburgh, Chicago, Los Angeles, Seattle, and Little Rock, Arkansas. Mr. Croston's vivid account follows:

Amateur telescope making in Tacoma and vicinity had its inception in the possession of a seven-inch brass shell by Mr. W. H. Sutter, who is a collector of curios from all over the world. This shell is a war souvenir of the German cruiser *Emden* which was destroyed by the Royal Australian Navy in the World War.

Mr. Llewellyn Evans, on seeing this shell, suggested that it would make a fine tube for a telescope and, acting on this suggestion, they began at once to make the speculum. With some mechanical assistance from the writer an



Photographs by Griffin and Wileox

Watching a demonstration of mirror grinding at the fair. Note teepees in background

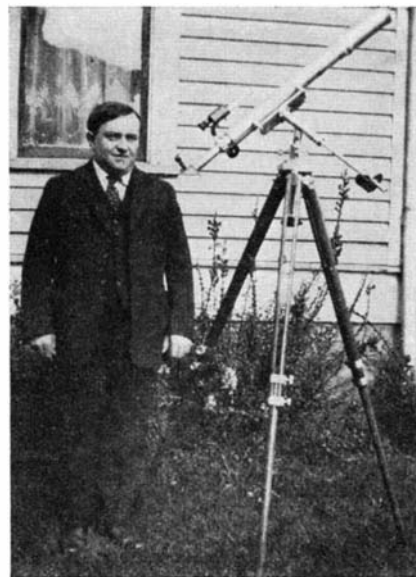
excellent reflecting telescope was the result. Since it was the first ever made in this city it was an item of news that was not overlooked by the newspapers and as a result of this publicity several other telescopes were constructed within less than a month.

From this spark has started a smudge that has apparently smoked out all the aspirants for amateur astronomy in this section of the so-called "Wild and Woolly West." Telescope makers began to appear in astonishing numbers and the need of an organization was so apparent that the association now known as the "Amateur Telescope Makers and Astronomers of Tacoma" was the outcome of a meeting held on June 22, 1931, with 20 members present representing eight telescopes.

By August the membership had increased to 33 and the observing equipment consisted of four 12-inch reflec-



Earl Sowles can descry tree limbs on mountains 100 miles distant



E. L. Roberts chose the refracting type of telescope—harder to make

IN THE WILD WEST

tors, one of them a binocular; five six-inch reflectors; four eight-inch, two four-inch, and three small refractors; and other things under construction, including a 75-foot sun telescope and a spectroscope.

We were particularly fortunate in having as a member of our club, Mr. A. D. Lundgren, a dealer in marine supplies and port-hole glasses, who let members have glass at such a low price that the impulse to "do it now" was irresistible, and as a result apparently everyone in this part of the country with a strong right arm and a can of Carborundum is now busy making a speculum.

Such amazing activity attracted the attention of the management of the Western Washington State Fair at Puyallup, Washington, and an invitation to exhibit the results of our work was promptly accepted. A committee was appointed to handle the details, and the

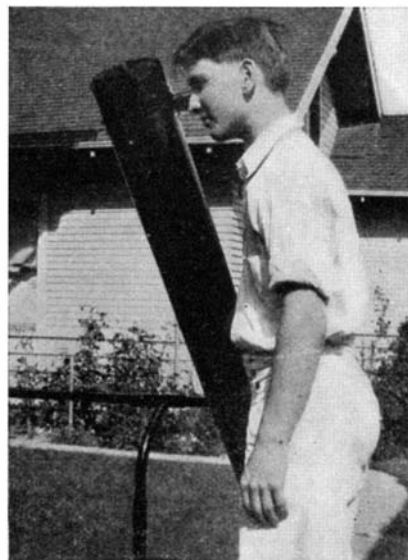
Fair officials built a special building free of all cost, for the exclusive use of the amateur telescope makers, and installed five concrete bases around the building for the installation of some of the larger instruments for public use.

WE had 20 telescopes on exhibition and in addition there were 26 transparencies showing the moon, Saturn, nebulae, constellations, and so on; also materials, books, speculums, laps, grinding machines, testing apparatus—all labeled with instructions as to where the materials could be obtained. Demonstrations in speculum grinding and other processes were a continuous feature day and night, as many as five speculums being under way at times.

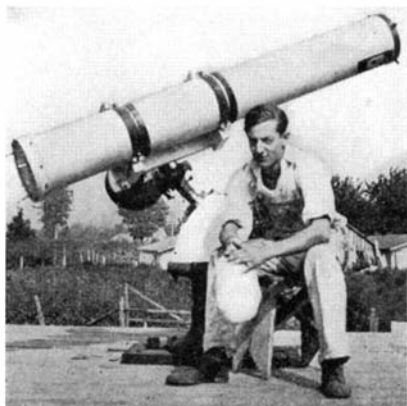
The interest created was tremendous. A conservative estimate puts the number of visitors at our exhibit at over 100,000. Many of these in the evening made use of the outdoor telescopes. At one time I counted 26 persons standing in line to look through mine, and about 100 for another. Three hundred signed our register to be notified of our next business meeting; a number of additional telescopes were brought to light and an unknown number started.

One of the possible reasons for the sudden popularity of telescope making on the Pacific coast is the unusually clear atmosphere that prevails. It consists of air—not factory smoke.

The SCIENTIFIC AMERICAN book, "Amateur Telescope Making," has been and is our chief source of information in all this work and every copy is working overtime.



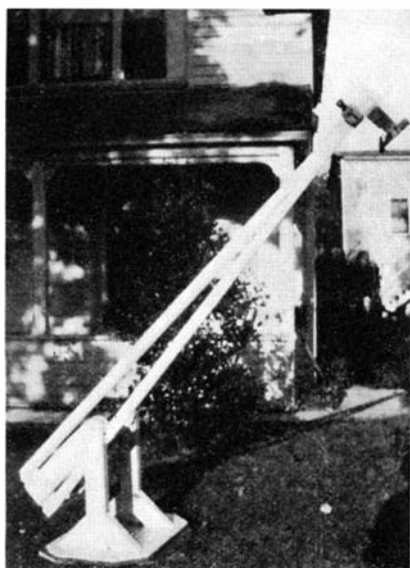
Bob Becker used ordinary stove pipe for the tube of his 'scope



Paul Welzel of Puyallup, Washington, and his reflecting telescope



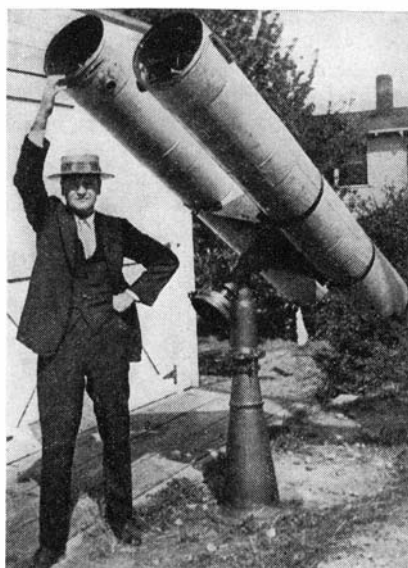
Ben Nicholson and his 12-inch modified Springfield mounting



E. Olson's mounting, simply made of wood, is as efficient as any type



George Croston, club secretary, who wrote the account published above



Martin Rassmussen with his giant binocular of two 12-inch reflectors



Thousands of watchful guardians patrol our National Forests, or scan the wooded areas from look-out towers, but they are often handicapped by lack of rapid communication. The radio sets described should do much to reduce this handicap

RADIO AND FOREST FIRES*

By CHARLES E. RANDALL

SOME day fighting forest fires will be a relatively simple matter. The forest officer, sitting at his desk, will straighten up as the loudspeaker announces a smoke sighted in Buzzard Canyon. He will press the appropriate buttons and twirl the dials that will dispatch a flying squad to the blaze. And he will watch the speedy smothering of the fire on his television screen. That happy day may be in prospect, but it has not yet arrived. Steady progress is apparent, however, in the adaptation of modern scientific and mechanical aids to fire control. One of the recent lines of investigation is in the use of radio, and already radio is promising to have an important part in the future communication system in the National Forests.

Since 1927 the United States Forest Service has been at work on the problem of adapting radio to forest-fire prevention. Experiments last year reached the point of actual trial under field conditions.

In attacking this problem the Forest Service had to start almost from scratch. Although the use of radio in combating forest fires has not been unknown in recent years, Canadian foresters and one or two states having done some pioneer work with it, the Forest Service

*Courtesy *American Forests*, Washington, D.C.



The combination radio transmitter and receiver in use in the forest

found many perplexing questions unanswered.

How much radio energy would green timber absorb? Could the "shadow" effects of mountains in the rough country found in most National Forests be

overcome? These and many other questions had to be solved by experiment. If the radio apparatus was to be used in the remote, back-country places where it would be of greatest value, it would have to be rugged, since it must often be transported by pack animals or on the backs of men. The power available for portable equipment would be limited because the weight and bulk must not be too great to be packed over steep, narrow trails and through dense woods. The problem of inefficient antenna systems due to space limitations in heavy timber would have to be met. Then, too, inexperience, so far as radio is concerned, of the temporary men employed in fire crews and of the short-term fire guards on the National Forests would have to be considered. Few of them would have knowledge of radio technique or of code. Unless the apparatus was simple of operation it could be used only by a few technically qualified forest officers, or else a large staff of trained radio operators would have to be maintained.

What was needed was specially adapted equipment that would combine high efficiency with simplicity, lightness and durability. Hundreds of trials were made, radio experts were consulted, but the Forest Service was unable to find existing apparatus that

would meet all of the rigorous and exacting tests of service in the National Forests. The service therefore set about to design a set of its own.

To D. L. Beatty, forest inspector in the Northern National Forest Region, was assigned the "radio project." He has handled the work from the beginning. Out of Mr. Beatty's experiments came the development of specially designed apparatus which shows excellent promise. It is light enough for quick transportation. Apparently it is tough. It has been jogged over mountain passes on the back of a mule, bounced over rutty mountain roads in a truck, without smashing a tube or displacing a button. The set has been checked by the Naval Research Laboratory and the Bureau of Standards. A number of engineers and manufacturers have praised the efficiency and simplicity of the apparatus.

The new Forest Service set is a combination transmitter and receiver. As designed it weighs, with case, phones, key, batteries, and antenna wire, about seventy-nine pounds. The battery equipment will give a season's use for the receiver and about twenty-five hours' continuous service for the transmitter.

LAST summer, under Mr. Beatty's direction, the new apparatus was given preliminary trial in field work on the Columbia National Forest, in Washington. Results were most encouraging. In one case—when the Sepsican fire broke out in the forest—sole reliance was placed on the radio for communication, and radio helped save the day. Following is an account from the record of a month's work with radio on the Columbia National Forest:

"We have a central radiophone station and seven portables in operation, at distances varying from 14 to 45 miles airline. One lookout has radio as his sole means of communication. The other portables are being used by road and trail crews and are moved from point to point as the crews move. The portables communicate with each other and with the central station by continental code, at prearranged intervals. The central station uses voice.

"The power output of the portables is small, but seems to be ample for ordinary conditions. I have copied a portable with ease at a distance of 350 miles airline. Hence it would appear that the safety factor for transmission over a distance of 25 miles, which has been the Forest Service objective, is large.

"The portables have been moved about considerably both by truck and pack and have stood up under it satisfactorily. No special care is taken in preparing the equipment for shipment. The tubes are not even removed from their sockets as the portable is moved about."



Courtesy U. S. Forest Service

An airplane on forest-fire patrol in the Cleveland National Forest, California. Radio can link such aerial observers with ground forces to great advantage

Several important questions are yet to be answered. For instance, what is the traffic saturation point for a central station? It appeared likely, in the field tests made so far, that two simultaneous fires in addition to the regular schedules with the portables would be too much for one central station to handle with accuracy and dispatch.

Another possibility that is receiving attention is that of radio communication between airplanes used in fire patrol and forest officers on the ground. Aircraft are becoming increasingly important for quick transportation of men and supplies and for reconnaissance of going fires and areas of high fire hazard. If immediate communication between aerial observers and ground forces can be established the value of aircraft in

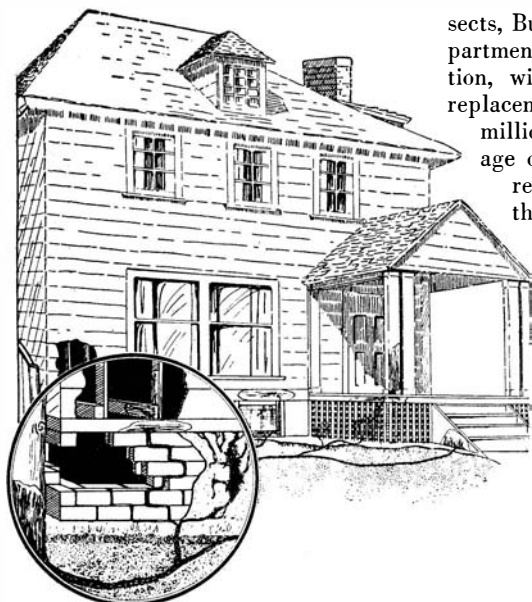
fire control will be greatly enhanced.

For some time to come it is likely that the use of radio on the National Forests will have to continue in the experimental stage. Even when all technical difficulties have been overcome it will take some time to provide and install adequate equipment, to train personnel for technical supervision and to work out administrative problems involved in large-scale radio communication. Meanwhile Old Man Fire shows no signs of being accommodating enough to postpone his depredations. The Forest Service for some time to come must continue to place its main reliance for communication on its 37,000 miles of telephone line already strung up and the line yet to be built to complete the National Forest telephone system.



The red enemy creeps through the hills, destroying vegetation and killing or driving before it the wild life that is such a valuable part of our great forests

GREEDY 'WHITE ANTS' COST US MILLIONS



The three principal means by which termites get into buildings from the ground

sects, Bureau of Entomology of the Department of Agriculture. "Such destruction, with the necessary repairs and replacements, is estimated to cost 40 million dollars per year. This damage occurs in both cities and rural regions and is due primarily to the improper construction of buildings.

"Careless building or construction without regard to possible damage by termites not only jeopardizes the integrity of the structure, but also renders liable to injury the contents of the building. While this serious damage and loss can be prevented by proper construction of buildings, it is very difficult to get rid of termites when once they have infested a building."

Any material that contains

cellulose (the chief constituent of wood) is liable to attack by termites. Damage by termites to material stored in buildings is due to the fact that the building itself is infested. Wooden shelving, flooring, and other fixtures or building parts which are infested by termites lead to indirect attack.

FOR the sake of illustration, let us look at an actual average case from Dr. Snyder's file of "criminal records" of these destroying "ants." It is that of a young married couple, living on a salary, who had purchased a new house on the installment plan and were very proud of their home. One spring morning a year later the wife discovered a large number of flying ants in the house. Investigation showed that the insects had entered through untreated woodwork in contact with the ground. Also they had worked up through the interior of the wall, after gaining entrance through poor grades of mortar in the foundations and by means of earth-like shelter tubes or covered runways built by the termites over impenetrable masonry foundations.

Repairs to shut off the subterranean termites from the earth, where they obtain the moisture so necessary to their life, were estimated to cost over 500 dollars. The house was being paid for in installments and the family was living on a budget. In such cases as this, when the repairs have been made and paid for, and the notes at the bank cannot be met, the banker is likely to take a hand and start the wheels in motion to discover the trouble with the local building code which makes such things possible.

By S. W. LONG

ENEMIES, "boring from within," threaten thousands of American homes—that is, if the houses are improperly constructed and are wholly or partly of wood. These enemies are not aliens. In fact, as to lineage, they are "Americans of Americans," for their family tree shows that they have occupied for something like 55 million years the section of the North American continent which is now the United States.

Long ago, the United States Government took a hand in the matter of combating the depredations of termites or "white ants," as they are commonly called; these being the "enemies" referred to above. At present, the fight is on in earnest.

While less appealing to the imagination than the activities of the United States War College in planning for the defense of American shores, the work that the Department of Agriculture is carrying on against termites is of comparable importance. There may—or may not—be another war on our hands, but it is a fact that termites are destroying millions of dollars worth of forest products annually.

"Few people realize the large amount of damage caused to the woodwork of buildings by wood-destroying termites, or 'white ants,' in the United States," said Dr. Thomas E. Snyder, Senior Entomologist, Division of Forest In-



Winged sexual adults of a subterranean termite—enlarged five times



Line marking northern limit of damage by subterranean termites. Calls for help in combating the menace of termites are frequent from cities below this line

The danger of attacks by termites is especially present where houses are built on land that has recently been cleared of trees, as in many suburban developments. In such instances, the termites are deprived of food in the form of stumps and other dead wood, with the result that they invade the houses erected on the site. Termites are present in the United States in the section below the line on the map on the opposite page.

TERMITES are not true ants, although they look much like them and live in large colonies made up of different forms. The winged male and female termites which are seen "swarming" for a short time in the spring and fall are on their way to start new colonies. These parent termites are not injurious, but their descendants, the wingless workers of the new colony, are very destructive. These latter are rarely seen, because they do not crawl about in the open but stay underground or in wood. If they want to reach woodwork above ground, they build earth-like tubes to crawl through.

Thus termite damage is always hidden inside the wood. The interior rafters, joists, beams, or other timbers of a structure may be entirely eaten out before the insect vandals are noticed, since they leave a protective outer shell of the material they are destroy-



Illustrations courtesy U. S. Department of Agriculture

Earth-like tubes constructed by subterranean termites over brick wall in a dark, heated, damp basement. Inset: Near view of shelter tubes, showing structure

ing. Such damage is then hard to repair.

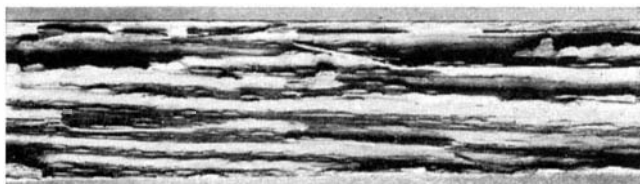
There are two kinds of termites—the subterranean and the non-subterranean. The latter do not reach the wood by means of a tunnel, but attack it directly. Instead of following the grain continuously, as do the subterranean termites, they excavate through it longitudinal chambers of limited length.

The greater offenders, however, are the subterranean kind. They do the greatest damage to buildings by weakening the supporting timbers. These ground-nesting termites cannot live without moisture, and this they get from the earth. If shut off from moisture in the earth they dry up and die. Non-subterranean termites are not so dependent on moisture.

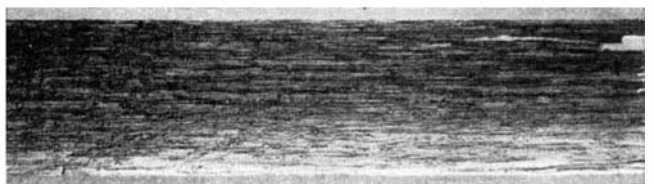
There is the most urgent need for provisions in building codes to cover termite-resisting construction. To this end, several governmental agencies are stressing the necessity for such precautions. A few hundred dollars additional—say 2 percent of the first cost—spent in the beginning in proper building construction may save thousands of dollars in repairs and replacements later. It is much simpler and cheaper to keep termites out of buildings than to get rid of them and repair the damage after they are once in. The necessary repairs may be too costly for the small householder, but certain methods of construction that will prevent injury, and the use of lumber that has been rendered termite proof by pressure treatment with zinc chloride or creosote, are entirely practical. The methods recommended are described in interesting bulletins prepared by Dr. Snyder and available through the Department of Agriculture for the guidance of builders.



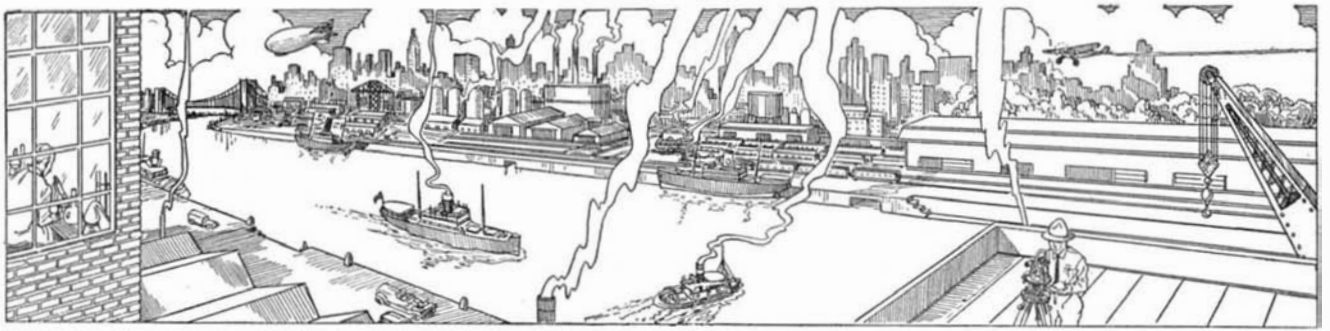
Department of Agriculture "graveyard" in the Canal Zone, a check plot for study of effects of termites, soil conditions, and chemical treatment of woods



Damage to expensive oak flooring by the common subterranean termite. The interior is eaten away but, as shown



at right, the damage is not apparent on the surface and often it is not detected until furniture legs break through



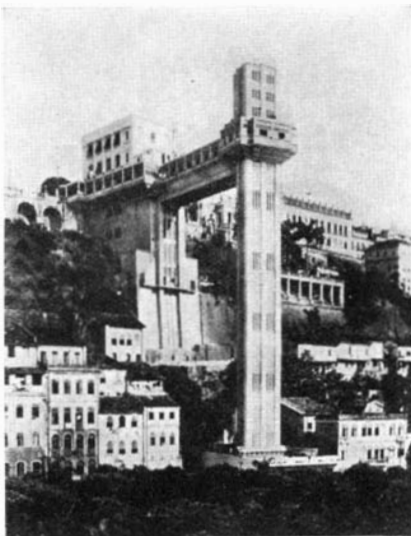
THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Elevating a City's Population

A TRANSPORTATION problem involving moving the greater part of a city's population between an upper and a lower level, has recently been solved by the engineers of the Otis Elevator Co.

Bahia, a city in northern Brazil, supplied the problem. With its business center bordering on the bay, and its residential dis-



Vertical transportation: The elevator tower for a city's population

trict on the top of a steep incline 195 feet above, the question of transportation was always a perplexing one to residents.

Within recent years, as a result of the rapid growth and general progressiveness of the city, the need for modern transportation facilities became extremely acute. To meet this need, engineers were consulted. At their suggestion, the monumental La Cerda Tower shown in our illustration was built. Made of reinforced concrete, 240 feet high, this tower is connected with an older and smaller structure by a bridge. In it are housed two large Otis express elevators, comparable with those in the largest skyscrapers.

When the tower was opened recently, a holiday was called by Bahians. Practically the entire city tried to ride on the new elevators that night. Of the 10,000 fortunate enough to do so, many could hardly be induced to leave even after several trips. On the second day the elevators transported more than 24,000 people, each

Contributing Editors

ALEXANDER KLEMIN

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

A. E. BUCHANAN, Jr.

Lehigh University

passenger paying 160 reis, or a little less than two cents, a trip.

To supplement the transportation supplied by the elevators, the Otis company is now working on an incline railway. This is to have two cars, each with a capacity of 40 passengers, and will run at a speed of 650 feet per minute. It will be located near the La Cerda Tower, and will have an incline of 32 degrees.

Germans Win Nobel Prize in Chemistry

THE Nobel Prize for 1931 in chemistry has been awarded to Carl Bosch and Friedrich Bergius in recognition of research done in an industrial field, where already practical results of commercial value have been achieved. It was Carl Bosch who was largely responsible for the commercial development of the Haber process for the fixation of atmospheric nitrogen, and no one questions the fact that the difficulties overcome in carrying the results of the Haber experiments through the semi-works and commercial stages involved scientific work on a par with that displayed by the originators of the process.

The researches of Friedrich Bergius (see page 69, this issue) have become well known in the United States through his participation in the International Conferences on Bituminous Coal and because of his hydrogenation process for converting coal into petroleum and petroleum into gasoline.—A. E. B.

New Anti-Freeze Compound

AN interesting anti-freeze compound for use in automobile radiators has been produced by German chemists. Although its composition is not indicated, it is now marketed under the name "Glystantin." Mixed with water to the extent of 34 percent, it keeps its liquid form down to minus 20 degrees Centigrade. Below this temperature, a crystalline flocculent precipitate forms within a still liquid medium, which expands only by one half of one

percent. At still lower temperatures, the solution is converted into a fluid paste of about the consistency of ice cream. But even at the lowest occurring temperatures, no solid fractious ice forms. According to *Chemical and Metallurgical Engineering*, the material was used very successfully in the northern flight of the *Graf Zeppelin* recently, where considerable quantities of water had to be kept liquid.—A. E. B.

Weighing an Entire Dam

THE new Koon Dam, which is to be located in the valley of Evitts Creek, Bedford County, Pennsylvania, will be the first dam in the history of large construction projects to be weighed. The dam is to be solid concrete with a maximum height of 90 feet and a length of 726 feet. It will raise the water level 67 feet above Lake Gordon.

All ingredients which will be used in making the concrete are being accurately weighed and compounded with proper corrections for the weight of the surface moisture in every batch. Material is dumped into separate bins by endless conveyors. These bins serve as storing places for such ingredients as sand, gravel, and cement. By pressing a button in the scale house, material is taken from the desired bins by an endless conveyor and dumped into the scale hopper.

The flow is automatically cut off by the scale when the correct amount has entered



The operator who checks the materials for the concrete of Koon Dam

the batching hopper. The materials are weighed over a large automatic scale which is equipped with a graphic recording device which records every weighing, the time of weighing, and what it has weighed. The batch is then dumped into the mixing hopper by the pressure of an electrical button.

This weighing is entirely automatic and the human element is absolutely eliminated. This insures the highest quality of cement because, with this new device, it is possible to determine absolutely the moisture content of each aggregate, thus proportioning the cement to meet exact specifications. The weighing equipment used is unique in the history of large construction projects and was developed by engineers of the Toledo Scale Company especially for the new Koon Dam.

Air Filter Aid to Hay-Fever Victims

PEOPLE who suffer from hay fever may soon be able to have air filters installed in their homes which will remove irritating pollen from the air. Experiments just concluded at the University of Illinois Research Hospitals have demonstrated the practicability of relieving hay-fever patients of distress by means of air filters. The filters used were adapted from the commercial form by Dr. William H. Welker and were used in an extensive series of experiments conducted by Drs. Tell Nelson and Ben Z. Rappaport.

People suffering from hay fever, according to Dr. Rappaport, were relieved of most of their symptoms in from one half to one and a half hours after entering a room in which the air had been drawn in from the outside through these filters. Patients who were used in these experiments slept well except on very hot nights when the room was uncomfortable because of the heat, but patients suffering from asthma were only partly relieved.

“Actually, very severe cases of hay fever who find life almost intolerable for two months,” Dr. Rappaport said, “are greatly

benefited. The filtration is at best, however, simply an adjunct to treatment by immunization.”

People who are only partially relieved by immunization treatment, he pointed out, can be benefited by using in addition a filtering machine in their bedrooms, thus exposing them to pollen only when they must be outdoors. A good percentage of the 2,500,000 to 6,000,000 people who have hay fever in the United States can in this way be partially aided.—*Science Service.*

Spraying Orange Trees Alters Fruit

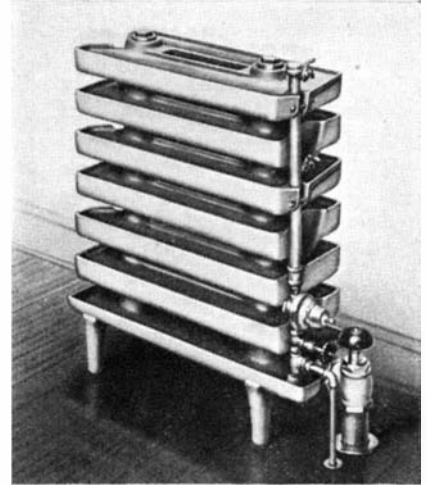
ORANGES produced by trees sprayed with lead arsenate not only differ in chemical composition from normal oranges but they have a considerably lower vitamin-C content than oranges from trees not so sprayed, according to E. M. Nelson and H. H. Mottern of the Bureau of Chemistry and Soils. Doctor Nelson has completed a series of experiments which have demonstrated that besides causing a considerable loss of vitamin C, spraying with lead arsenate reduces the acidity of the juice and decreases the sucrose, with a corresponding increase in invert sugar. The principal orange-producing states have laws prohibiting the use of arsenical sprays on this crop. Spraying oranges with lead arsenate involves no danger of arsenic poisoning, according to the bureau.—*A. E. B.*

A Humidifying Radiator

TO meet the long-felt need for a method of properly humidifying the always-too-dry and unhealthy atmosphere of a home or apartment that is heated by steam or hot water, a new humidifying radiator has been announced by the Timken Detroit Company. Called the Timken-Airlux, this unit is a specially designed humidifying radiator to be connected to steam, vapor, or hot-water heating systems. In appearance it is similar to conventional heating radiators, except that the sections run horizontally rather than vertically. Each of these

sections is designed with a flange around its edge which forms a water-evaporating trough on its upper surface.

Water from a city water line is supplied to the unit, passing first through a shut-off valve, then through a pressure reducing valve, and finally through a pet-cock directly above the topmost evaporating trough. Each trough is designed with an over-flow incline at one end and after the surface of the pan has been entirely covered, surplus



Unique form of the new radiator that humidifies as it heats a room

water flows down this incline into the trough next below. When the second pan has been filled, it likewise overflows in the same manner and this process continues until each of the pans has been filled.

The radiator evaporates an amount of water proportionate to the amount of heat supplied. The humidification requirement varies in relation to out-door weather conditions and a larger amount of water must be evaporated in cold weather when more heat is likewise needed. Under those conditions the entire operation becomes automatic and no attention whatever is needed. The amount of water supplied to the radiator is slightly in excess of maximum needs. There consequently is an unevaporated surplus which is carried to the sewer.

Special air passages are placed in the center of the radiator sections, providing plentiful circulation of air over the surfaces of the heated water pans, so that all of the evaporated moisture is carried off and used advantageously. Only one unit is needed to humidify the average home properly.

Warns Against Radio-Active Waters and Radium Emanators

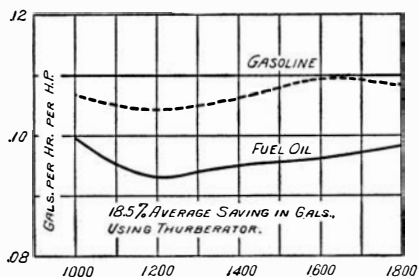
WARNING against the use of radio-active waters and radium emanators, frequently promoted for the cure of a great variety of diseases and ailments, was contained in a report by Dr. Harrison S. Martland, medical examiner of Essex County, City Hospital, Newark, New Jersey, to the *American Journal of Cancer*. From long study of the effects of radium poisoning in the luminous watch-dial painters, Dr. Martland has concluded that it is dangerous to increase the normal radio-activity of the human body, on the strong presumption that increased amounts of radio-activity over a number of years may produce cancer.

“To drink, over long periods of time,



Stripping operations on the site of the Koon Dam in Pennsylvania. To get perfect concrete, all materials going into the dam will be automatically weighed

radio-active waters containing radon may allow a small amount of active, long-lived deposit to enter the body, part of which may finally be deposited in the bones and other organs as more or less insoluble salts," he stated. Such deposits of insoluble salts of radium and other radio-active substances were responsible for the development of fatal cancer (sarcoma) in the



watch-dial painters, Dr. Martland showed in the report.

Some of the radio-active waters for sale, when taken according to directions of the promoters, would require to be swallowed each day an amount of radio-active substance equal to that taken by some of the dial painters, he found. These substances are in soluble form in the water, but they are changed in the blood to the more insoluble carbonates, phosphates, and even sulfates of radium and mesothorium and eventually reach the bones. Once deposited there in insoluble form, there is no way known now to eliminate them from the body or to protect it from their fatal bombardment of alpha particles, with the exception, possibly, of methods of treatment similar to those used in the treatment of chronic lead poisoning.

Radium emanators, and the waters of natural radio-active springs were objected to by Dr. Martland on the same grounds.—*Science Service.*

Fuel Oil Used in Gasoline Engines

THE necessity of reducing operating costs of commercial motor vehicles is becoming daily more apparent. Automotive manufacturers realizing this are devoting much time, money, and research toward the development of an automotive type of engine capable of using a heavy, inexpensive fuel oil.

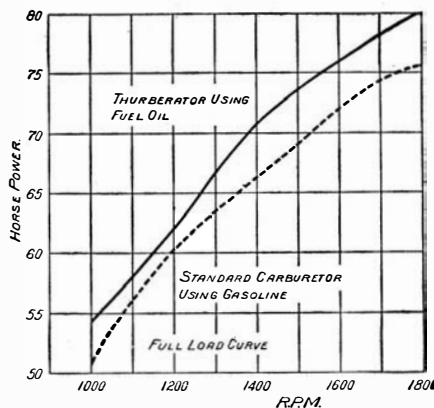
Many futile attempts have been made to adapt the standard spark-ignition gasoline engine to the use of heavy oils. A study of these attempts discloses that the failures were due to an incomplete knowledge of the entire subject. In the majority of cases, the attempts were made by a single individual of inventive mind, but with an inadequate knowledge of automotive engineering and the technical problems involved.

Realizing that such a development could not be successfully completed by a single individual, a corporation was formed for the purpose of enlisting the services of individuals and companies that would make available a complete knowledge and understanding of the entire subject. This company, The Thurberator Corporation, took over the patents and services of Luman T. Thurber in this field of endeavor; the result has been the perfection of the Thurberator, a device which makes

possible the use of fuel oil in a gasoline engine. This system may be applied to any type of standard gasoline engine.

One of the buses of the Public Service Corporation of New Jersey, equipped with the Thurberator, is running in regular service in Newark, New Jersey—a section where traffic congestion is great. Its operation has been satisfactory from a com-

Dynamometer tests were made on a six-cylinder bus engine to determine efficiency of the fuel-oil device, the Thurberator. The same engine run on gasoline and then on fuel oil gave the results shown in these graphs. At left: Fuel comparison. At right: Percent of carbon monoxide in exhaust. Below: Comparison of horsepower output

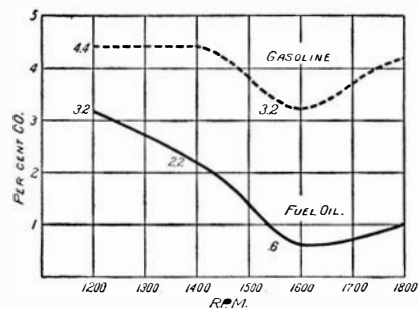


mercial standpoint and the power and economy obtained have been better than those of the gasoline buses operated on the same route.

In the Thurberator, the oil is heated by the exhaust to a point slightly below its initial boiling point. A small stream of air, also heated by the exhaust to a temperature 100 degrees Fahrenheit in excess of the oil temperature, is mixed intimately with the hot oil, producing a hot air and hot oil-gas mixture much too rich for combustion. The hot air and hot oil-gas mixture is conducted to the engine ports by means of two intake manifolds. Immediately before entering the cylinders, the rich mixture unites with the correct amount of cold air required for combustion. A metering device insures the correct proportion of rich mixture and cold air at all positions of the throttle for clean combustion.

The parts of the device in the present design are arranged as follows: The exhaust pipe runs forward, across the front

of the engine, downward, and toward the back to about the center of the engine where it passes through a rectangular fuel-oil float chamber, heating the oil on its way out. The exhaust pipe, as far as the oil float chamber, has a jacket in which air is heated. This heated air is fed to the rich-mixture carburetor. A spray bar, a hollow bar with small holes drilled on

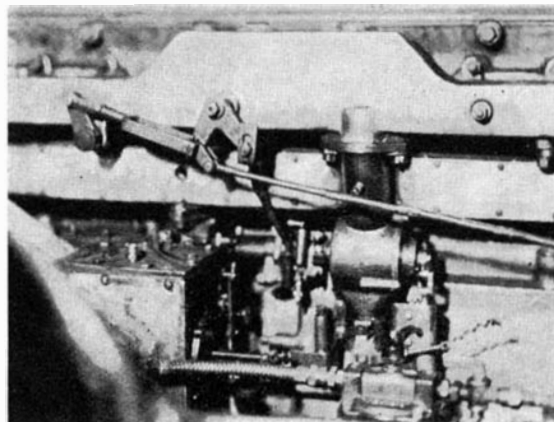


each side, meters the fuel as the barrel throttle above it is opened and successively exposes the holes to the hot air stream. The resultant mixture, too rich to burn, is delivered to the lower of two manifolds, whence it passes to the upper pure air manifold at three points very close to the engine ports. A barrel throttle admitting pure air to the upper manifold is connected to the rich-mixture barrel throttle by a shaft so that both throttles work together. This insures the correct proportion of rich mixture and air for proper combustion at all throttle settings. Behind the fuel-oil float chamber is a gasoline float chamber used when starting a cold engine.

The Thurberator is arranged so that the engine starts on gasoline in the usual way and continues to run on this fuel until the fuel oil has reached its proper working temperature. At that temperature the gasoline is automatically shut off and the hot fuel oil turned on.

Many drivers of the Thurberator-equipped bus in regular service find it handles precisely the same as the gasoline operated bus except that it has greater power and more speed. Ordinarily the driver can not tell when the shift from gasoline to fuel oil takes place.

Some of the advantages claimed for the Thurberator, when applied to the standard gasoline engine, are as follows: Low fuel cost; low carbon monoxide gas content in exhaust gases; no smoke during operation of the engines; dependability, smoothness, simplicity, and flexibility of operation; fire hazard reduced.



View of the left side of a bus engine equipped with the Thurberator. This apparatus has been so perfected that it may be applied to a standard gasoline engine without change in engine design

Heading The Thurberator Corporation is Mr. Walter J. Rich who had a large part in making talking pictures available to the public through the medium of the Vitaphone. Luman T. Thurber, the inventor, is a prominent engineer of wide experience who has done special research work in the University of Munich and the Massachusetts Institute of Technology. The C. B. Roberts Engineering Company, a firm of engineers who design, construct, and operate oil refineries in all parts of the world, have been of invaluable service in the practical application of the invention to the internal combustion engine, through Mr. D. W. Robb of the Roberts organization.

Lead Solution Used to Recover Tin From Scrap

A NEW method of reclaiming the tin plate from old tin cans has been developed by Prof. J. W. Hinchley and was described by him before a recent meeting of the Institution of Chemical Engineers. The tin plate is treated with a solution of 4.45 percent lead, 10.25 percent caustic soda, and 85.3 percent water. At a temperature of 90 degrees Centigrade, the tin is removed, by this solution, from the tin plate in a few seconds and until the lead in the solution is nearly all displaced the rate of attack is high.

In the reaction, for every two atoms of tin dissolved, three atoms of lead are deposited. Because of the deposition of finely divided lead it is necessary to agitate the tin plate to ensure its removal from the surface of the material, and revolving drums are used so that the process becomes a continuous one. The sodium stannate solution obtained is treated with caustic lime, by which a precipitate of calcium stannate is obtained and the caustic soda solution regenerated for use. The precipitated lead is placed in a tower with the regenerated caustic soda, and air is blown through. After 20 hours, the original treating solution is obtained by the hydration of the lead and its solution in the liquor.

—A. E. B.

A Curious Airplane Test

IN the recent Deutschlandflug competition conducted in Germany with light planes, a totally different method of awarding prizes was followed than is customary

in airplane races. Speed was disregarded altogether and points were allotted as follows:

Test	Max. points obtainable
(a) Dismounting and refitting.....	6
(b) Manner of starting engine and time required.....	7
(c) Length of starting and landing stretch.....	10
(d) Lowest speed in the air.....	27
(e) Fuel consumption.....	20
(f) Equipment and comfort.....	30
Total.....	100

Some of the tests were very curious. For example, there was a folding and door-wheeling test. Competitors had to fold the wings and roll the plane through a door frame with the least possible loss of time.

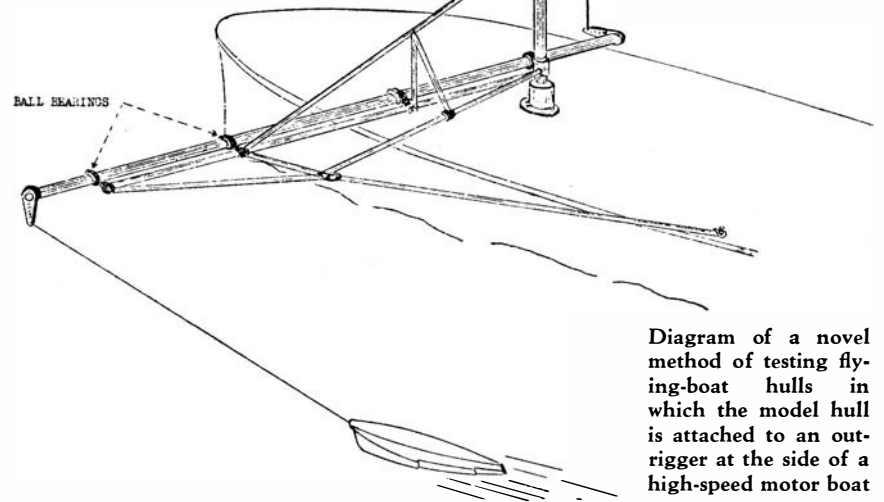


Diagram of a novel method of testing flying-boat hulls in which the model hull is attached to an outrigger at the side of a high-speed motor boat

We believe that contests of this type should be very useful in producing progress in the light plane. Points obtainable for general comfort, feasibility, fire prevention, slow speed, low fuel consumption, and so forth, are in some ways better things to strive for than the very high speeds to which we now point with such pride.—A. K.

Studying Flying-Boat Hulls

THE design of a flying-boat hull is, in many respects, a much more difficult matter than the design of the hull of an ocean liner. True, the hull of the surface vessel has to withstand enormous waves, have enough stability to minimize rolling, and enough fineness of line to give the ship

from 200 to 1500 feet in length in which the model can be towed by a carriage riding above the water. There are only three channels of this type in the United States and they are expensive to build and maintain.

Igor Sikorsky has a novel method of testing hulls. This is shown diagrammatically in our sketch. A motor boat is employed, capable of a speed of 35 miles an hour. The float to be tested is pulled by a light tow line attached to its bow. The tow line in turn is attached to a simple lever mounted on a torsion tube long enough to get the model hull away from the influence of the motor boat. As the tow line pulls on the lever, it turns the torsion tube, which in turn works on the scale of a calibrated spring balance. The speed of the motorboat is carefully measured at the same time by placing a pitot tube in the water far enough below the boat not to be disturbed by waves. While this method of towing only gives the drag of the hull and not its lifting properties or pitching properties, and while it cannot be considered an absolutely scientific instrument, nevertheless it should be exceedingly useful to the practical designer and Mr. Sikorsky is to be highly complimented on his simple yet original method.—A. K.



Courtesy Flight

Folding and "door-wheeling" test in a recent German air competition

Bus and Plane Co-ordinated

TRANSCONTINENTAL and Western Air, Inc., the so-called "Lindbergh Line" and the Greyhound Bus Line, have made a national hook-up. Buslines operating over a widespread system from coast to coast, will act as feeders to the airline.

picking up passengers and express packages from intermediate cities and bringing them to the airport. The new bus-air service is an important step forward in our air-transport system.—A. K.

The Oehmichen Helicostat

THE French *l'Aérophile* describes a new type of aircraft which has been termed the Helicostat by its inventor. This comprises an airship with a capacity of some

avoid nose-dives and stalls. When the revolution indicator speeded up excessively, it was known that the plane was diving and the stick was pulled back accordingly. When the revolutions dropped below a certain mark, the plane was known to be approaching a stall, and the controls were pushed forward. With these improvised blind-flying instruments, 20 minutes in fog or cloud was a long, long time; but even this crude instrument flying was found to be better than trusting to one's instincts.

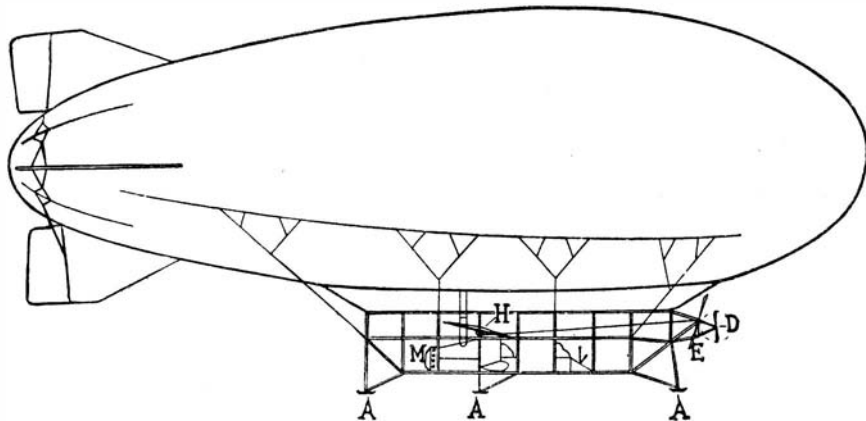


Diagram of the Oehmichen Helicostat. At H are two lifting airscrews; E, D are directional screws; M is the motor; and A-A-A are the three landing bumpers

18,000 cubic feet of gas. Under the airship is an open-work structure in which the pilot and passenger sit in the open as in the airplanes and airships of early times. A single motor of 40 horsepower is employed which drives, first of all, two screws—H in the drawing. Since these screws rotate in an inclined plane they produce both an upward and forward thrust. At the very front of the open structural work are screws with variable and reversible pitch so that they can be made to give either no thrust at all, or thrust in either direction and thus give ample steering force.

What is being sought by the inventor of this combination of airship-helicopter is, first of all, a method of experimenting with lifting screws which is perfectly safe owing to the support given by the buoyancy of the gas bags. Next, a type of craft which will be able to go up or down, forward, or hover with the utmost flexibility.

For the immediate future, it is possible that the Helicostat could replace the captive balloons still used in naval air services. While it is hardly to be expected that much speed will come from a machine of this type, yet it may have useful though limited application.—A. K.

More About Blind Flying

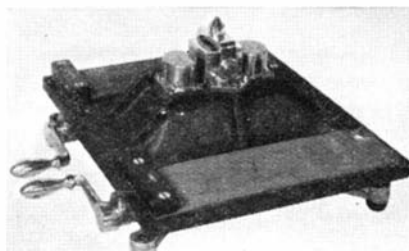
COMMANDER P. V. H. Weems' book on "Air Navigation," recently published, is one of the best and most comprehensive treatises on the subject now available. The chapter on "Blind Flying" is of particular interest.

It seems now to be definitely established that blind flying by instinct is well nigh an impossibility. Lost in black clouds or fog, the best of pilots may lose control and find his ship nose-diving, side-slipping, or stalling.

As early as 1918, experienced pilots "made shift" to fly blind with the aid of the old magnetic compass to keep on a heading, and the revolution indicator to

Now we have available the well-developed Ocker system of training for blind flying (See page 430, December 1930, SCIENTIFIC AMERICAN) and a number of very refined and reliable instruments.

Major Ocker first convinces the student



The Wobblemeter, a device for determining the degree of fatigue of a pilot before or after a flight. At right: The Wobblemeter in use

that his physical senses cannot be trusted. The student is blindfolded and placed in a testing chair which is revolved to the left. The subject tells in what direction he is being turned. However, when the chair is slowed down and finally stopped the student still thinks he is turning to the left. He is then permitted to see for himself that he is standing still and that his sense of direction has misled him. Next, he is permitted to use the blind-flying instruments and learns that instrument indications are contrary to his sense of balance and motion. Systematic training in an enclosed cockpit of a dual-control plane, followed by flying through clouds at a safe altitude, then night flying in cloudy weather with a few of the best available instruments, finally lead to fair ability in such work.

Major Ocker has found that a portion of the dizziness experienced by the student is due to the fact that he has no point of reference. When the illusions inherent in all blind flying are avoided by the use of instruments, a large portion of the dizziness disappears.

Some of the instruments now in use for

blind flying are the Sperry artificial horizon, directional radio and radio-phone, the Sperry automatic steering device, and ordinary panel instruments, especially the turn and bank indicator.

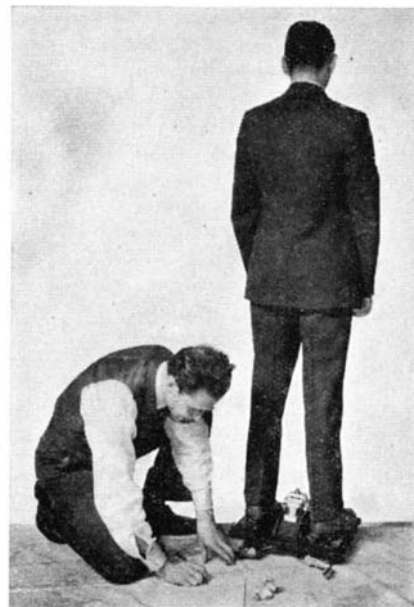
Nowadays, reports frequently come in of pilots encountering the most severe fogs and surmounting all the attendant difficulties. Pilots do not hesitate to make radical and frequent changes of direction to avoid fogs but they no longer feel so unhappy when enshrouded in gloom, and such confidence is naturally communicated to the passengers.—A.K.

The Wobblemeter

DEVELOPED by Dr. F. A. Moss and demonstrated by the Pioneer Instrument Company, the Wobblemeter is a new and rather startling instrument designed to test the effect of flight fatigue on passengers and pilots.

The Wobblemeter weighs about 14 pounds and measures 15 by 12¾ by 9 inches. The apparatus consists of two foot rests fitted to a base in such a way that they are free to oscillate or turn in a horizontal plane after the operating levers are released. The subject taking the tests attempts to balance himself while standing on the foot rests, the total amount of motion made in the attempt being recorded by two meters, one for fore and aft motion and the other for lateral motion. The total amount of motion used to reach and maintain equilibrium in a stated unit of time, usually one minute, is an index to fatigue or lack of fatigue.

When it is desired to determine the fatigue due to an airplane trip, the test procedure is as follows: Before the person enters the plane his initial index of fatigue is established. Suppose that this index is 35 before a flight of 200 miles and has increased to 48 after the flight: The



48/35 ratio of the two readings, which equals 1.37, gives the measure of the fatigue occasioned by the flight in question.

The lower the ratio the better the riding qualities of the flight. It would be interesting to find how the ratio of fatigue after flying compares with the ratio of fatigue after riding in an automobile or a jolting train. This instrument might also

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In this country, we are in the midst of an adult educational movement. Home study courses are being taken by about 1½ million people which is nearly twice the total number of students in our universities, colleges and professional schools. University home study courses are especially important in this movement because they offer careful guidance under experienced educators. ☼ Columbia courses have been prepared to meet the special requirements of study at home. They are sufficiently elastic to be adapted to the students' individual needs. Everyone who enrolls is personally taught by a member of the University teaching staff. ☼ In writing, mention subjects which interest you, even if they are not listed, as additions are made from time to time. ☼ Our Home Study Department offers also complete high school and college preparatory training through courses covering the equivalent of four years of high school study. We shall be glad to send our special high school bulletin upon request.



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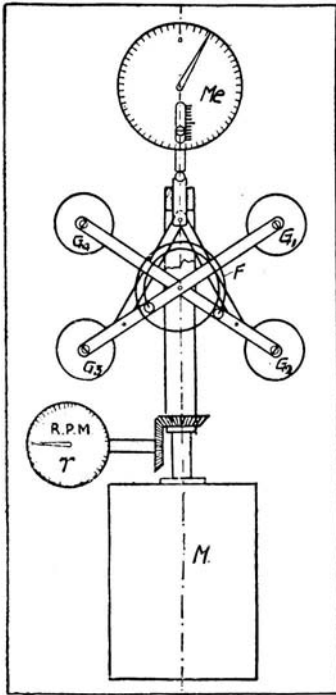
be used to test rapidly the fitness of a pilot before going up. If for example, the pilot's usual index is 15 and it is found on a certain day that his index has risen to say 45, that would be a warning that he should not take charge of a plane on that particular day. Other applications of the Wobblemeter are obvious.

Some curious observations have already been made. Thus, tests have shown that when subjected to the same fatiguing conditions, most people will have the same

is driven at a speed of 1200 revolutions per minute by an electric motor. The pendulum arms carry weights which are acted on by gravity and by centrifugal force. A spiral spring is connected to the pendulum arms in such a manner that when the arms close up or spread out the spring is contracted or expanded. A pointer which indicates the motion of the pendulum arms is geared up to a high ratio so that its travel on the indicator dial is quite perceptible.

The spring tension and the speed of revolution of the cross pendulum and the centrifugal force acting on the cross pendulum are all independent of gravity. The only variable as the plane rises above the ground is the weight of the pendulum balls G_1 , G_2 , G_3 , and G_4 . As the plane gains altitude and the force of gravity diminishes, the balls move out and the pointer rises on the dial. Of course, there are many difficulties to contend with, such as changes in spring tension due to differences in temperatures, and so on, but the instrument is absolutely correct in principle and in recent flight tests, changes in the dial reading were found when the aircraft rose only a few feet at a time. Further progress with this altimeter will be watched with much interest.

It may be noted that the entire instrument complete with motor weights 17 pounds, though it is expected to reduce this weight ultimately to seven pounds.—*A. K.*



Courtesy Flight
Sketch of the front view of the Braun altitude meter. See the text

ratio of final reading to initial reading, whether the initial reading be high or low. Another curious result is that there is a difference in balance in favor of women. A decrease of steadiness of equilibrium with age has been noted. Apparently ease of maintenance of equilibrium changes with the time of day, the best average balance being found around 2 P.M. Most normal male persons in an unfatigued state will register between 30 and 40 units per minute.—*A.K.*

A Gravity Altimeter

AS is well known, no altimeter based on the ordinary barometric principle will show true height above the ground. The readings of a barometer show merely the pressure at a given height, and while lowered pressure is indeed an indication of height, the readings of the instrument are affected by general atmospheric conditions, which may vary from hour to hour or even from minute to minute.

A young Austrian engineer has now attacked the problem of measuring height from a totally different point of view. The principle on which Herr Braun's work is based is that the force of gravity varies inversely with the distance from the earth's surface. Unfortunately, the variation with height is so small that an extremely delicate instrument has to be employed.

The Braun altitude meter is shown diagrammatically in the sketch. The instrument consists of a cross pendulum which

What a Modern Engine Can Do

OUR photograph shows the latest Pratt & Whitney Hornet engine mounted in an Army plane. This is probably the most powerful radial air-cooled engine in the world. It is supercharged and supercompressed, and the propeller is geared down in the ratio of 3 to 2. At ground level, this engine, weighing only 915 pounds including carburetor, oil regulator, air screw, propeller hub, and so on, delivers 750 horsepower. Of course, it would not be safe to maintain such enormous power at ground level indefinitely but the engine can be used at open throttle at 8000 feet when its power sinks to 575 horsepower. The principle followed by the designers of this engine is to supercompress and supercharge at ground level to the limit, and thus still have ample power for the altitudes at which Army observation is most effective and where most air fighting is done.—*A.K.*

United States Aircraft Carriers

WE have discovered that, in two short items that we recently quoted from other sources, an erroneous idea of the tonnage of the new aircraft carrier *Ranger*, now building, was given. One of these articles, in our last October issue, concerned the use of stainless steels in the new carrier; and the other, in our last November issue, discussed building activities of the Navy. In neither of them was the tonnage of the *Ranger* actually given—which perhaps accounts for the errors—but in each case statements indicated too great a tonnage for the new carrier. The *Ranger's* designed displacement is 13,800 tons.

The United States has in commission at present three carriers; the *Lexington* and the *Saratoga*, of 33,000 tons each, and the

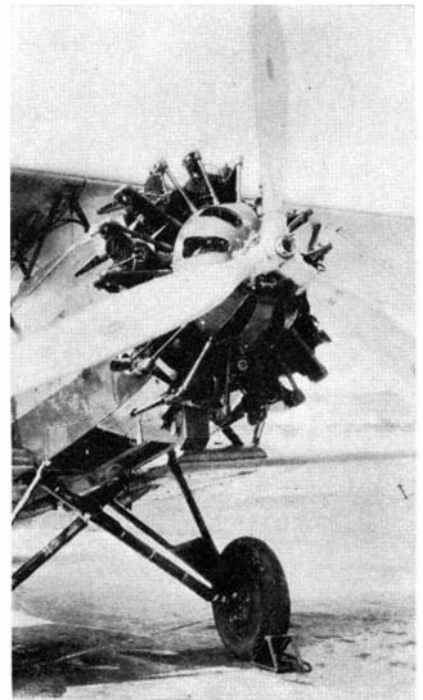
Langley, of 10,286 tons. The *Langley* is experimental and may be replaced at any time. Hence, under treaty terms, we consider only the *Lexington*, *Saratoga*, and *Ranger*, built and building, totalling 79,800 tons. This leaves a balance of 55,200 tons that can be built by us in this category to bring the total up to our treaty allowance of 135,000 tons.

A New Property of Neodymium

RODS of quartz, in which a compound of the rare metal neodymium had been dissolved, when heated in a Bunsen burner have been made to send out a new kind of light. This quartz was prepared by Professor R. W. Wood, of Johns Hopkins University. When heated, the rods give a light, the spectrum of which does not include all the colors but is crossed by dark bands. A white-hot, incandescent wire, like that of tungsten in an electric lamp, gives white light in which none of the colors is missing. The neodymium, however, has the unique property of sending out only special vibrations of its own. Light passed through cold neodymium or other rare earth compounds has these same colors removed from it.—*A. E. B.*

Learning to Fly on the Ground

AT the Glenn Curtiss Airport at North Beach, New York City, an interesting co-ordinated plan of flight instruction has been successfully tried out. The students receive their training first of all in a so-called co-ordinator. This is a propellerless plane balanced on the ground and facing



Pratt and Whitney supercharged engine, one of the most powerful air-cooled engines in the world

into a strong breeze from a separately mounted propeller. In the co-ordinator, the student tries to maintain equilibrium in the strong and oscillating breeze of the propeller slipstream and gets almost all the sensations of flying without leaving the

(Please turn to page 115)

“An Authoritative Discussion of a Vital Question”

Some of This Book's Valuable Chapters and the Subjects Handled by Dr. Stemmerman in His Personal Teachings

- More and Happier Years
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- Preventing Constipation.
- Germ-Life in the Intestines
- Encouraging Good Germs to Supplant Bad Germs
- Flatulence . . . Acidosis . . . Heartburn
- Three Myths: Liver Disease, Stomach Trouble and Bilioussness
- Bad Breath and Body Odors. Their meaning and Correction
- Hemorrhoids or "Piles"
- The treatment for Hemorrhoids
- Insomnia; Nervousness
- Constipation and Its Effects on the Sexual Functions
- Constipation and Skin Troubles
- Constipation and the Prostate
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- Dangers of Fasting
- New Drugless Way to Cause Bowel Action
- Headache—Chronic and Occasional
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- Colitis and Other Results of Constipation
- Is the Enema a Friend?
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- The Cure by Relaxation and Milk Diet
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- Reviewing Some Drugs Used in Constipation
- Yeast—A Great Hoax
- Furnishing the Body With Heat, Energy and Repair
- When Do We Eat?
- Weakening the Staff of Life
- Baking Powder, the Sinner
- Food Idiosyncrasies
- What Will You Have to Drink?
- Shall We Eat Fruits and Vegetables?
- Husband in the Kitchen
- We Survey Certain Foods
- The Beneficial Necessary Soup
- Spinach, Lettuce, Liver and Other Pleasantries
- Too Much Sugar Will Shorten Your Life
- Food for the Aged
- The Management of Constipation



Wm. H. Stemmerman, M. D.
—New York University and
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Will Bring You Longer and Happier Life

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A large percentage of the American people, young, middle-aged and elderly, suffer from constipation, occasional or chronic, and very frequently in entire ignorance of this cause of their troubles. From this almost universal disease many other diseases result. Constipation is in fact a great destroyer, whose toll of breakdowns and suffering, inefficiency and tragedy no man can measure.

Dr. Stemmerman's new book is the result of thirty years of intensive study and practical experience. It is scientifically correct, by the best modern medical precepts and authorities. It is comprehensive, easily understood and downright interesting. You need this book, if you choose to win more abundant virility and long life.

You owe yourself a knowledge of the latest accomplishments of modern science in the treatment of that most prevalent disease, constipation. Therefore WE HAVE PREPARED FOR FREE DISTRIBUTION AN ENTERTAININGLY WRITTEN AND EASILY UNDERSTANDABLE BROCHURE, which contains for young or old, man or woman, valuable information regarding constipation. This information is ordinarily not readily available

to the average person nor is it to be found in such clear, everyday language as we present it in this brochure. For example, it contains THREE COMPLETE CHAPTERS, namely, "Insomnia," "Is Exercise Worth While?" and "Shall We Eat Fruits and Vegetables?" from "Intestinal Management." All this is in addition to a full review of Dr. Stemmerman's great new book which is now being used by hundreds of people throughout this country as a complete guide to health.

It is vitally interesting and extremely important, to you, to read in this brochure the facts regarding the ultimate evil effects of neglected or improperly treated constipation.

On the other hand, it is comforting to know that Dr. Stemmerman has perfected easy, harmless, but positively effective methods for quickly relieving the disagreeable symptoms of constipation and for permanently causing this real disease to disappear.

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A Simple Test of the Intestinal Functions

After luncheon chew and swallow about six ordinary charcoal tablets, obtainable at any drug store. Next morning note the color of the evacuation. If the color inclines toward black, AND IF THE BLACKNESS HAS DISAPPEARED BY FOLLOWING DAY, elimination is good. If blackness still shows, then your elimination is delayed and faulty. Try this easy test and it may point out the cause of your headaches, dizziness and those dull and dreary days that lower your resistance and efficiency (from "Intestinal Management," page 26).

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

TWO months ago in this column we spoke of the work of the English amateur telescope maker J. H. Hindle, and published a description of his 20½-inch Cassegrainian-Newtonian reflector; also of his test for the Cassegrainian, which employs a spherical mirror in place of the usual flat. We offered to lend interested amateurs a monograph on the Cassegrainian and

committee—we can't have any dissension.)

King Cassegrain—John M. Pierce, who about six years ago made the first American amateur's Cassegrainian we know of (see photograph).

Crown Prince—R. W. Porter, who made the next one.

Patron Saint—J. H. Hindle.

Duke—Horace E. Dall, also of England, whose new Cassegrainian is described below.

This is as far as we self-appointed politicians could get in the matter of selecting officers, because no other eligible candidates were known—none had made Cassegrains. However, we suppose we will need a few more potentates such as counts and barons, and here is an opening for some aspiring young man to become royalty. All the other members will be rated as mere slaves, villains, and churls, unless we can think up enough offices to go around. Those who complete compound telescopes may select and name their own office.

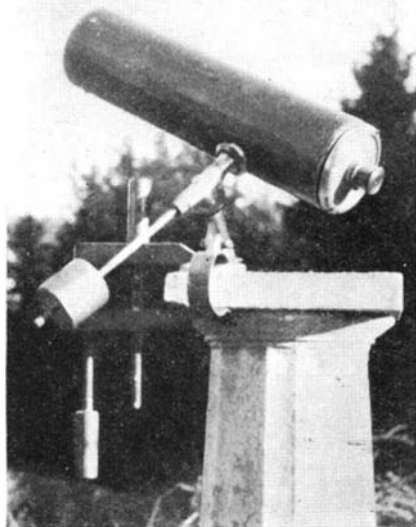
This is to be the only club on earth with no by-laws, no constitution, no initiation fee, and *no dues*. It will be very (oh very) exclusive and very high-hat. As the present writer never has made a compound telescope he cannot be a member, but will sit outside the lodge door and shiver. If anyone can prove completion of jobs prior to those of the potentates, the latter will be duly deposed, demoted, and beheaded. Until an aspirant establishes proof of completing a compound telescope he will be entered on the books as a basement member and regarded as some lowly form of life—just protoplasm. Mr. Hindle's monograph is still available to those who will promise to return it promptly. Let's go!

HERE is what Mr. Dall, who is a professional maker of optical work, es-

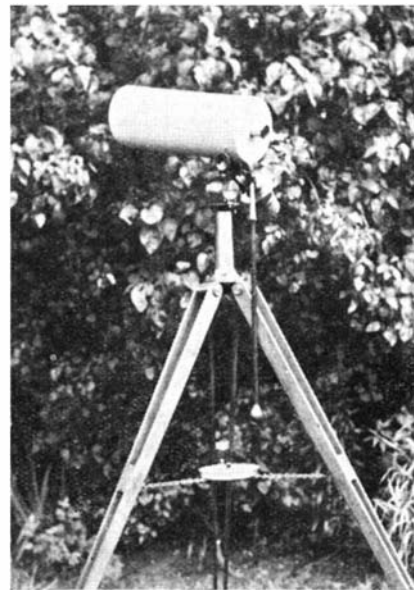
pecially one-piece Tolles eyepieces, writes from 186 Dunstable Road, Luton, Bedfordshire, England concerning his Cassegrain:

"I believe I am correct in saying that my latest telescope—just completed—is by far the smallest and lightest telescope of its aperture and power and quality of performance in the world. The clear aperture is 6 inches. The overall length, including eyepiece, is 19 inches, and the weight complete with finder and all is only 5½ pounds. The image is erect, as I intended it primarily for terrestrial work, and the eyepiece gives a comfortable eyepoint and wide angle of view, with no small eyeholes as on Gregorian telescopes.

"The construction is a modified Casse-



"King" Pierce's 4-inch Cassegrain



"Duke" Dall's new Cassegrain

Gregorian types, written by Mr. Hindle, and about a score of the more advanced workers have borrowed this monograph, all except one returning it promptly. That many, it appears, are now making compound reflectors and some of these, we are delighted to learn, are to be Gregorians. Except for the Gregorian Mr. Hindle has made (not yet described), we think no Gregorians have been made since the well-known maker Short died 150 years or so ago. This type has been practically extinct. We now hope to revive this "lost" art, thanks mainly to Mr. Hindle. None of us "know it all" about these types but we shall all work it out together and perhaps make some improvements in the art.

So now is the time for all good amateurs (who can) to make a Cassegrainian or a Gregorian, and while we are at it let's have a little fun out of it. It is therefore proposed to organize a new society, on world-wide lines, and for short call it the "Cassegrainian Club," and it is our secret purpose to run it strictly by Tammany Hall methods. Accordingly we have fixed up the following slate of officials of the proposed club, on which all Cass-Greg specialists are invited to vote. (All adverse votes will be thrown out by the election

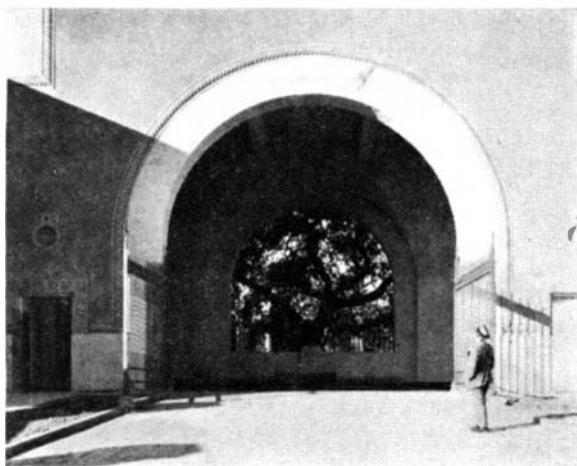


Photo by Oscar S. Marshall

R. W. Porter gazing into the Great Mystery, the big arch at the shops of the California Institute of Technology, through which the 200-inch mirror will someday be wheeled out to a waiting world. When this will occur, and what the mirror will be made of—these are the mysteries still undecided by all but some highly imaginative newspaper men

grainian, and the angle of the final image is relatively narrow, that is, *f*.13, enabling ordinary eyepieces to behave well and high powers to be comfortably applied. Focusing is by rack and pinion—you can see the handwheel just under the tube. The focusing range is from 20 feet to infinity.

"The tube is of stout seamless aluminum tubing and the whole is finished with a beautiful light blue-gray crystalline enamel. In the photograph it is shown mounted on a portable equatorial stand which is supposed to carry a 3-inch refractor. The small weight and moment of inertia of the present telescope enables this stand to mount it far more rigidly than the original 3-inch refractor. Hand pressure causes vibration on the latter which takes several seconds to die down, whereas similar pressure on the 6-inch causes vibrations which are damped down almost instantly. The short tube gives other ad-

vantages. Wind pressure is reduced, and the effects of tube currents are minimized. Moreover, the eyepiece is so close to the declination and R. A. axis that the height and position of the former does not vary more than a few inches for all parts of the sky.

"Naturally the accuracy of figuring the optical surfaces must be extremely high for a telescope as short as this, but I have succeeded well in this and can resolve double stars down to the limit of the aperture.

"The mirrors were lacquered with a coat much less than 1/25,000 inch thick on a whirling table, and this should last well for years."

HERE are a few odds and ends: Has anyone made a built-up (cemented) glass disk and has it proved satisfactory?

Several misguided workers have requested the "conductor" of the present department to publish his photograph. Being a victim of the shrinking violet complex he cannot accede to this ghastrly request, but in case of really dire need see "A.T.M." page 35, the larger of the two figures.

The attendance at the Adler planetarium in Chicago is now way past the million mark. They say that a fair share of those who witness this performance make immediate tracks for the nearest astrologer and have their horoscopes cast by the same stars. And this is the age of science!

The planetarium for Los Angeles has been held up by a legal squabble, but St. Louis is soon to have one.

Hale spectroheliscopes are now in use or have been ordered by the widely distributed stations listed below. All these are professional; there is not as yet a single spectroheliroscope made by an amateur. Mr. Gustavus Wynne Cook of Wynnewood, Pennsylvania, an amateur astronomer (the possessor of a 30-inch reflector by Fecker!) owns one but did not make it himself.

Spectroscopes are in operation at the Royal Observatory at Greenwich, England; Department of Solar Physics at Cambridge University, England; Federal Observatory at Zürich; Astrophysical Observatory at Florence; American College at Beirut, Syria; Observatory of Solar Physics at Kodaikanal, South India; Carnegie Institution, at Watheroo, Australia; National Institute of Astronomy at Nanking, China; Commonwealth Solar Observatory at Canberra, Australia; Dominion Observatory at Wellington, New Zealand; Apia Observatory at Apia, Samoa; Mt. Wilson Observatory at Pasadena, California; Pomona College at Clairmont, California; University of South Dakota at Vermilion; Yerkes Observatory at Williams Bay, Wisconsin; Adler Planetarium at Chicago; Ohio State University at Columbus; Carnegie Institution at Huancayo, Peru; Vassar College at Poughkeepsie, New York; Bell Telephone Laboratories, New York; Massachusetts Institute of Technology at Cambridge; Franklin Institute at Philadelphia. Several others are likely to be put in use and, according to Dr. George Ellery Hale, a general scheme of co-operation for the detection of eruptions on the sun's disk will be organized. Will some enterprising amateur please make a spectroheliroscope? Are we to let these mere professionals get ahead of us in this manner? The situation is scandalous.

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CURRENT BULLETIN BRIEFS

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

RECORDS OF CURRENT EDUCATIONAL PUBLICATIONS (Quarterly January 1—March 31, 1931, Bulletin, 1931 No. 9) gives full data as to the outstanding articles in educational periodicals and important new books in the field of education. *Superintendent of Documents, Washington, D. C.—15 cents (coin).*

ENDURO and ENDURO, K-A-2 are two pamphlets which give basic information on the selection and treatment of these stainless alloys of irons which lend themselves to deep drawing and forming operations owing to their low carbon content. *Republic Steel Corporation, Youngstown, Ohio.—Gratis.*

WEIGHTS OF VARIOUS WOODS GROWN IN THE UNITED STATES (Technical Note No. 218) gives a valuable table showing the average weights and specific gravities. *Forest Products Laboratory, Madison, Wis.—Gratis.*

HYDRAULIC TABLES AND OTHER DATA is a compilation intended for those using hydraulic pressures for load-producing purposes. The tables are particularly clear. The properties of various sections are clearly set forth. These are two pages of beam formulas. Some of the data have never appeared in print. In writing, state company and position. *Baldwin-Southwark Corporation, Philadelphia, Pa.—Gratis.*

REDUCING TEXTILE COSTS AND TROUBLES (Bulletin No. 104) gives an outline of the application of water softeners to the textile industry. It is a really scientific study of the problem. *The Permutit Company, 440 Fourth Avenue, New York City.—Gratis.*

ELECTRIC MELTING POTS gives much information on a rather obscure subject. *Harold E. Trent Company, 618-640 N. 54th Street, Philadelphia, Pa.—Gratis.*

DESIGN OF GAS BURNERS FOR DOMESTIC USE (Circular of the Bureau of Standards No. 394) gives general information regarding the most favorable design for burners for domestic purposes. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

BILLBOARDS AND AESTHETIC LEGISLATION, NEW APPLICATIONS OF THE POLICE POWER by Lucius H. Cannon, is a timely publication, for never before has there been such great interest in the matter of preserving the natural beauties of our countryside or the more artificial beauties of our cities. The pamphlet gives a wealth of information as to legislation in various states and there is an excellent bibliography. *St. Louis Public Library, St. Louis, Mo.—25 cents.*

AIR NAVIGATION MAPS (Aeronautics Bulletin No. 10) lists and describes the three sectional airway maps and the 28 strip maps published for the guidance of airmen flying along the airways on or off the routes of the Federal Airways System. Maps issued by the Army Air Corps and the Hydrographic Office are also listed. *Aeronautics Branch, Department of Commerce, Washington, D. C.—Gratis.*

CHEMICAL MAP OF THE WORLD is a large and beautifully executed map showing the location of the raw materials as well as some of the methods of producing. *National Wholesale Druggists' Association, 51 Maiden Lane, New York City.—25 cents.*

LIFE CHARACTERISTICS OF PHYSICAL PROPERTY (Bulletin 103) by Robley Winfrey and Edwin B. Kurtz, deals with the movable life curve and the rates of renewals of particular examples and types of physical equipment. The method was applied to 65 sets of original life data for property such as steam railroads, agricultural implements, motor vehicles, et cetera. *Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa.—Gratis.*

AMERICA'S STAKE ABROAD (Foreign Policy Information Service, Vol. VI, No. 24, 1931) by Dr. Max Winkler, gives a vast amount of information on foreign investments, war debts, and related subjects. *Foreign Policy Association, 18 East 41st St., New York City.—25 cents.*

SK WATER LEVEL TELEVISORS describes an electrical instrument used for indicating water levels in boilers and tanks at one or more distant points. It gives information as to the transmitter, distributor, and indicator and is illustrated with beautifully executed colored figures. *Schutte & Koerting, Philadelphia, Pa.—Gratis.*

TIMBER GROWING AND LOGGING PRACTICE IN THE SOUTHERN APPALACHIAN REGION (Technical Bulletin, No. 250, August 1931, U. S. Department of Agriculture) by E. H. Frothingham has an introduction by R. Y. Stuart. Forestry in the United States is no longer merely a theory or a subject for discussion; it has gotten down to concrete things in the woods. This is a valuable treatise and is well illustrated. *Superintendent of Documents, Washington, D. C.—30 cents (money order).*

THE INFLUENCE OF ATMOSPHERE AND TEMPERATURE ON THE BEHAVIOR OF STEEL IN FORGING FURNACES (Engineering Research Bulletin No. 21) by D. W. Murphy and W. E. Jominy, is a remarkable study in metallurgy giving the results of hundreds of experiments. *Department of Engineering Research, University of Michigan, Ann Arbor, Michigan.—\$1.00.*

SCHOOL LIFE (Official Organ of the Office of Education) is an illustrated monthly which is issued except during July and August. It is filled with interesting matter relating to schools and education. It is both entertaining and informative. *Superintendent of Documents, Washington, D. C.—50 cents a year (money order).*

COMPARATIVE AIR ARMAMENTS OF THE WORLD, AUGUST 1931, gives a great deal of information in graphical form. *Compiled by Carl Byoir and Associates, 10 East 40th Street, New York City.—Gratis.*

RECLAIMED RUBBER (Circular of the Bureau of Standards No. 393) by A. T. McPherson, gives much valuable information in small compass. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE ECONOMICS OF PAINT by Henry A. Gardner shows how millions of dollars can be saved by the wider use of paint. *Institute of Paint and Varnish Research, Washington, D. C.—Gratis.*

WHAT PEOPLE WANT TO READ ABOUT by Douglas Waples and Ralph W. Tyler, is a study of group interests and a survey of problems in adult reading. It is a very important scientific study and is filled with tables and graphs. When we lay down this volume at least we can feel that we know what adults want to read. *American Library Association, Chicago, Ill.—\$3.50.*

ARC WELDING THE STAINLESS ALLOYS describes various methods. While the subject is highly technical it is readily understandable. *Republic Steel Corporation, Youngstown, Ohio.—Gratis.*

EVOLUTION (Reading with a Purpose No. 51) is by J. Arthur Thomson, the celebrated scientist, and gives much basic information in a small compass. *American Library Association, Chicago, Illinois.—35 cents.*

HOW TO RUN A LATHE is now in its 29th edition and is one of the most valuable little books we have on lathe work. It is filled with useful illustrations of machine operations and the diagrams and text are very clear. *South Bend Lathe Works, South Bend, Ind.—25 cents. There is an edition in Spanish at same price.*

THE SMALL GENERAL SHOP FOR THE MODERN SCHOOL (Bulletin No. 50, March 1931) deals with equipment for teaching the fundamentals of the following trades: Machine work, electric work, forging, motor mechanics, and wood working. Mechanical drawing is also included. The great work being done in schools is described here in detail. *South Bend Lathe Works, South Bend, Ind.—Gratis.*

**THE SCIENTIFIC AMERICAN
DIGEST**

(Continued from page 110)

ground or even operating an engine.

In the second part of the training, the pupil gets into a taxiplane and drives around the airport as though in an automobile. This work is followed by a number of short glider flights. Then finally a few short hops are made in a dual-control plane with an instructor.

Strange as it may seem, a number of students have soloed—that is, flown alone—after only a half hour's dual flight instruction. Such a co-ordinated system should make for both safety and less expense, and we have always maintained that lessening the cost of instruction is one of the most important factors in making popular flying possible.

An analogy to this system is to be found in swimming instruction, which in professional hands is often begun by lessons on dry land.—A.K.

**More Trained Psychiatrists
Needed**

IN order to meet the growing demand for trained workers in psychiatry and mental hygiene the National Committee for Mental Hygiene has just created a new division of psychiatric education. "The dearth of competent psychiatrists is becoming a major issue in human welfare," is the conclusion of a committee of the American Psychiatric Association which has been studying the problem. "It is no longer merely a matter of over-crowded mental hospitals in which the patients receive but momentary attention from the mental specialists. We are confronted by a matter amounting to a national emergency," their report stated.

Of the 160,000 physicians in the United States today, somewhat over 40,000 are specialists in the various branches of medicine. Of these only 1600 are psychiatrists, or one in 25. In other words, since half of the hospital beds of the country are occupied by patients suffering from mental disease, there are a hundred times as many doctors in physical as in mental medicine, the committee pointed out. This is out of all proportion to the magnitude of the problem of nervous and mental disease.

The new division of psychiatric education will center its work largely around the medical schools, with a view to attracting more medical students to this branch of medicine.—*Science Service.*

Lubricating Oil that Resists Cold

BEHIND the advertisements that proclaim the virtues of lubricating oils at sub-zero temperatures lies a field of chemical research that has seen considerable progress in recent years. For example, a pure hydrocarbon oil known as Parafflow, the addition of from 0.25 to 1 percent of which to the proper grades of motor oils vastly improves their qualities and at the same time eliminates the necessity of expensive de-waxing processes, has been developed by the Standard Oil Development Company. It was described by G. H. B.

**The
SLAVES,
He Freed—
HIMSELF,
He Could Not!**



With the stroke of a pen Lincoln emancipated millions of slaves. But to emancipate himself from the profound depression which so often attacked him, he found well nigh impossible. Time and time again great waves of melancholy rolled over him and threatened to destroy his political usefulness. Lincoln's overwhelming grief at the death of his beloved Ann Rutledge is well known. But it is not well known that during his ensuing period of mental depression he received his greatest help from a physician—a shrewd, common-sense, strong principled man. Nor has the story ever before been told of the influence of physician after physician that was woven throughout the pattern of Lincoln's life.

All of these medical contacts have been gathered into the new and engrossing narrative, "Lincoln and the Doctors", by Dr. Milton H. Shutes, now running serially in *HYGEIA*. Read in the February issue the story of Lincoln's love for Ann Rutledge, her untimely death, his affliction by malaria at the same time, his profound melancholy, and his recovery through the aid of Dr. John Allen.

Every contact of the Lincoln family with the medical profession is told in this absorbing narrative. Especially enlightening is Dr. Shutes' discussion of Lincoln as a psychoneurotic and the bearing of this phase on his life. Subscribe to *HYGEIA* now so you may read this fascinating story which throws new light on the character and personality of Abraham Lincoln.

These are only three of the many worthwhile articles in the February *HYGEIA*. This magazine, published by the American Medical Association, is filled each month with authentic health information, written in non-technical language in an entertaining style. If you are not already a subscriber to *HYGEIA*, get acquainted now through this

**Also in the February
HYGEIA:**

**The Lie Detector and
Truth Serum**

These are only two of the many scientific means of crime detection used by the Scientific Crime Detection Laboratory, affiliated with Northwestern University. Under the supervision of Col. Calvin Goddard, director of the Laboratory, a series of articles has been written for *HYGEIA* by the heads of the various departments whose activities they describe. The first one appears in the February issue. If you're interested in crime and mystery stories, you'll get a thrill out of these explanations of the many ways in which science helps solve crime.

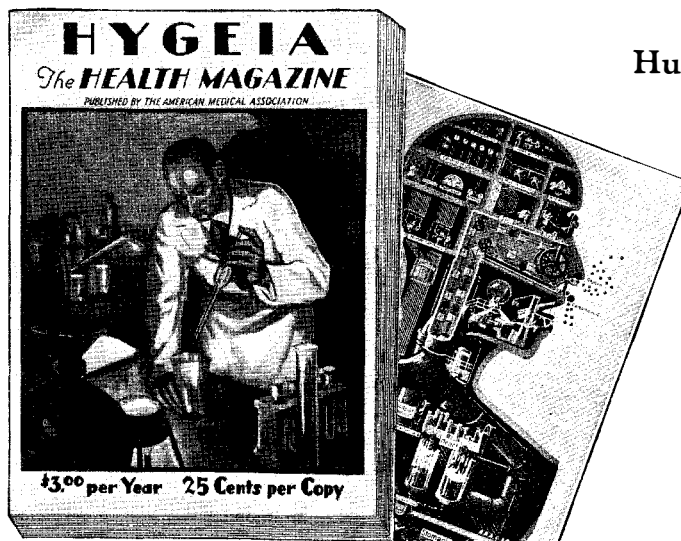
**"The Low-Down on High
Blood Pressure"**

"Let the doctor worry over it; that is what he is paid for", says Dr. Wingate M. Johnson in a most interesting article on high blood pressure. But he also admits that while this advice is most often given it is least often taken. There is helpful information in this article for those who have high blood pressure—and entertaining reading for those whose blood pressure is normal!

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Mrs. Mabel V. Baker, James Block, Room 20, Fort Madison, Iowa, is but one of many men and women trained by the Newspaper Institute of America to make their gift for writing pay prompt dividends. She writes:



"I sold my first article last week. It was a short one entitled 'Baby's Sun Bath.' There were 750 words, that brought me \$25.00 and an invitation to send more."

Another of our student-members who tried is Howard R. Dick, 49 Court St., Canton, N. Y. He writes:



"Thanks to N. I. A. training, I am now working for The Watertown Daily Times as a cub reporter. The city editor has informed me of my first promotion. He is sending me to Canton, New York, to take charge of the Times news bureau in that city."

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Why don't you write?

Davis and A. J. Blackwood before a recent meeting of the American Petroleum Institute.

It has been known for some time that, compared with lubricants containing a certain proportion of paraffin wax, totally de-waxed oils in the crankcase are more viscous or sluggish at low temperatures, thin out more rapidly on heating, are often consumed in larger amounts in motor operation, and display a greater tendency to carbonize under fire. On the other hand, paraffin wax itself tends to congeal in cold weather. As a consequence, the industry has been unable to take advantage of the inherent beneficial effects of the presence of a certain amount of paraffin wax in motor oils.

It is true that certain foreign substances have been employed to a limited extent to reduce the pour point of paraffinic oils, but the effect is usually transient and harmful to the oil to the extent of adulteration. Paraffin, on the other hand, is a pure hydrocarbon, which mixes and blends with the lubricating oil in all proportions. Tests have shown it impossible to separate Paraffin from the treated oil by washing with caustic or sulfuric acid. Long storage, either under freezing or high-temperature conditions, does not injure the stability of the pour points of Paraffin-treated oils, nor does it cause any loss in demulsibility.

Paraffin permits the use of a partially de-waxed product without danger of the oil losing its fluidity at low temperatures. Specifically, it lowers the pour point of the product from 30 degrees, Fahrenheit, taking one example of high-grade oil, to 0 degrees in the treated oil.

Extensive tests of the new discovery at the company's laboratory give promise of the following:

(1) The addition of from 0.25 to 1 percent of Paraffin renders the best grades of paraffin motor and transmission oils perfectly fluid at temperatures far below the point at which they would in the natural state become too heavy to pour.

(2) The presence of a certain amount of paraffin wax in the oil, which the addition of Paraffin permits, tends to maintain a more constant temperature-viscosity ratio.

(3) In cold weather Paraffin speeds up the distribution of the oil from pump to bearings.

(4) It eliminates the necessity for expensive treating processes for removing excess paraffin wax, thus making refining more simple, and, on the other hand, enables the refiner to leave in the oil a part of its valuable natural wax content without fear of congealing.—A. E. B.

Close Races Easy for New Electric Timer

ELIMINATION of many arguments among the "hot stove league" sport fans is seen in a new electric timing device which dispels doubts concerning races "won by a hair."

The new timer was invented by Dr. L. E. Dodd of the University of California. It measures elapsed racing time in thousandths of a second.

The starter's gun breaks an electric circuit which causes the timing device to mark a paper ribbon. At the finish, a beam of light playing on a photo-electric cell, or "electric eye," takes the place of the conventional tape. Interrupting this beam of light causes the timing device to mark the finishing time on the paper tape. Elapsed time for the race is easily computed from the marks.

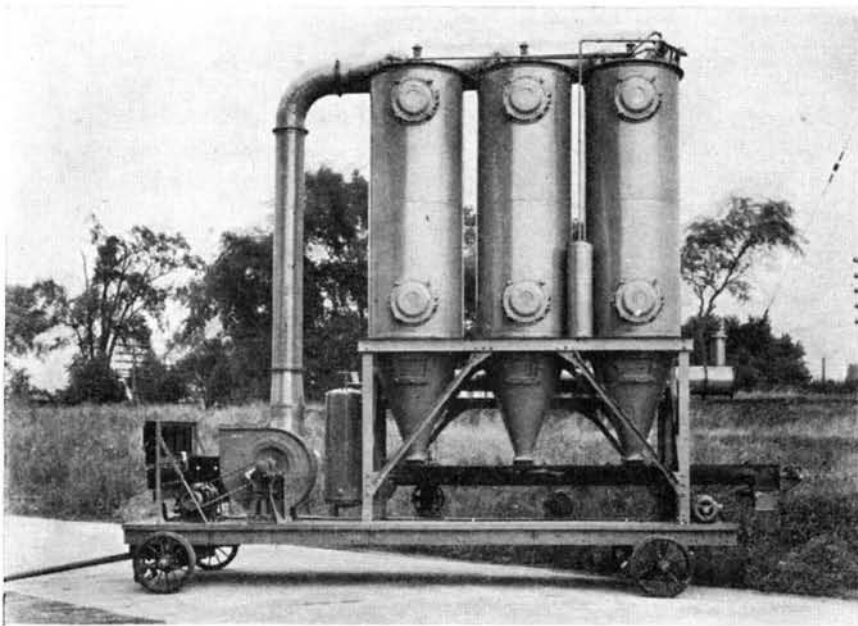
Admiral Taylor's Bow Wave Research

THE John Fritz Medal is awarded by a committee selected from all the most prominent engineering societies of the country. It is the highest distinction in engineering. For 1931 it was awarded to Admiral David Watson Taylor, U. S. N. (Retired), with the following citation: "For



Courtesy Bell and Howell

This novel subterranean movie theater, 231 feet below the earth's surface, is maintained by the Oliver Iron Mining Company at the Spruce Mine, Eveleth, Michigan. It seats 200 people, and movies are shown twice a month, usually one reel of pictures to teach mine safety and then another reel of comedy film



Courtesy Dust Recovering and Conveying Company

Portable, self-contained dust collecting unit recently designed and built for shipment to Russia, where it will be transported from plant to plant to test the fume discharges from smelter stacks. The unit consists of three standard Dracco filters mounted on a truck with the exhauster and other auxiliary equipment

outstanding achievement in marine architecture, for revolutionary results of persistent research in hull design. . . .”

By some curious twist of reference Admiral Taylor's accomplishments have several times been prominently quoted as "halving the coal bill of the United States Navy by the utilization of the bow wave for ship propulsion." To answer several inquiries on this subject the question was put to a high Navy authority and here is the reply: The statement about "halving the coal bill of the U. S. Navy," obviously is an exaggeration and Admiral Taylor, an exceedingly modest officer with a scientist's devotion to facts, probably regrets that statement, which is demonstrably untrue, very much.

There is no positive way of utilizing the bow wave for ship propulsion. The nearest reconciliation of this statement with the facts is that by the "bulbous bow" shape, the resistance offered by water to any vessel propelled through it was somewhat reduced. The smallest improvement in design that reduces the power necessary to propel a vessel effects a considerable saving in fuel but nothing approaching a 50 percent saving.

It will clarify the situation if we add what Admiral Taylor actually did do.

He spent the better part of his life experimenting with models in the model basin at the Navy Yard, Washington. He carefully observed the paths followed by the bow waves (and other waves) set up by the propulsion of his models. By noting particularly the downward path of the bow waves he concluded that a "bulb bow" would set up waves with less resistance, or that a bow of that shape could be propelled at a given speed with somewhat less power. Further tests with models confirmed this view and the U.S.S. *Delaware* was designed with a bulb bow. The success of this design was confirmed by performance and the Navy adopted it. Since that time various other navies have copied it, and some merchant vessels, notably the *Europa* and *Bremen*, have used this design.

Admiral Taylor became the leading world authority on ship design in relation to power and propulsion through the water. He also knew more about the wave forms set up by a ship in motion and it may be recalled that he was called by the British Admiralty as an expert witness in the question of the collision between the S.S. *Olympic* and H.M.S. *Hawke* at Southampton.

Trigonometric Slide Rule

THERE have been any number of slide rules made for various kinds of calculations but for a new one called the Trigonograph it is claimed that trigonometric calculations may be made over a wider range than on other existing devices. The Trigonograph consists of an isosceles triangle of paper or celluloid with a "slide" the length of the hypotenuse, which rotates about a pivoted joint in one of the acute angles.

This new device is a whole trigonometric function table and general calculator combined. A single setting determines the functions of any triangle; and multiplication, division, proportions, structural graphic stresses, and other applied mechanics problems may be performed on it. Additional curves to suit some particular need can be added.

Use of the Trigonograph should be of especial benefit to the student since it demonstrates the simultaneous changing of functions. It is useful also to engineers and draftsmen.

"Element 87" Costs Scientist His Sight

WITH the recent discovery of Element 87 by Professors Jacob Papish and Eugene Wainer of Cornell University, one phase of man's conquest of Nature neared completion. While no practical or commercial uses for the new substance are in immediate prospect, the discovery is of

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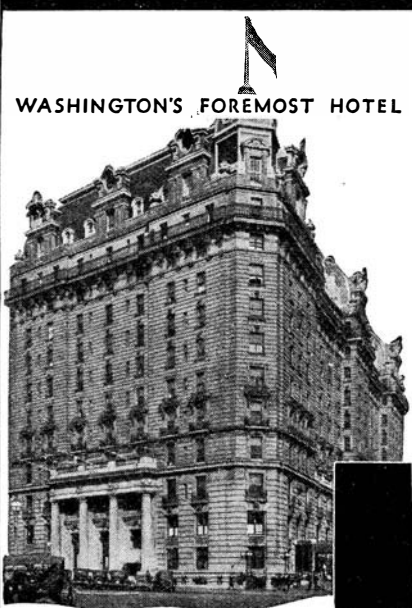
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great scientific interest. The scientists have not actually isolated the element in its free state, but have prepared concentrated compounds from the mineral samorskite.

On November 5, the quest for additional information about the new element caused a tragedy when an explosion in the laboratory of a Finnish scientist, Dr. Aartovaara, blinded him and destroyed the painstaking work of many months. It is believed that the explosion was caused by the radioactivity of Element 87 setting off a bottle of perchloric acid which stood on the laboratory shelf.

Dr. Aartovaara has collaborated for many years with American scientists and supplied Professor Frederick Allison of Alabama with a certain mineral he discovered in permanganite and which Dr. Allison said contains Element 87. A year ago Drs. Allison and Murphy of Alabama Polytechnic Institute announced they believed they had discovered element 87 in "lepidolite" and "uollucite" by using the magneto-optic method.—A. E. B.

What's in a Vacuum?

A NOVEL idea featured the ceremony of christening a new airplane at Schenectady, New York. Instead of using the conventional bottle of champagne, General Electric Company scientists supplied "a bottle of nothing" for the event—a glass flask containing the highest degree of vacuum it is possible to obtain commercially. In spite of the fact that the five-inch glass globe was as nearly "empty" as it is possible to obtain with the most efficient vacuum pumps, it is estimated that the bottle contained:

- 288,300,000,000,000 molecules of nitrogen
- 77,600,000,000,000 molecules of oxygen
- 3,450,000,000,000 molecules of argon
- 644,000,000,000 molecules of carbon dioxide
- 4,470,000,000 molecules of neon
- 25,000,000 molecules of krypton
- 5,000,000 molecules of xenon

Even though there were 370 trillion gas molecules in the bulb, they were far from being crowded. The pressure within the bulb was only slightly more than a hundred-millionth of average atmospheric pressure. In other words, the bulb at atmospheric pressure would have contained a matter of molecules counted in the sextillions, or to be specific, about 28,988,423,520,000,000,000,000 molecules—practically 29 sextillions! Such a vacuum is far more perfect than the one to be found in the evacuated chamber of a Thermos bottle, and is even more perfect than the one which makes possible the modern high-power radio tube, the X-ray tube, and the cathode-ray tube.—A. E. B.

Canada Plans to Make Alcohol From Natural Gas

WASTE natural gas from an Alberta field could be converted annually into about 140,000,000 gallons of industrial alcohol at an operating cost of not more than 25 cents a gallon, if a process developed by the Canadian Research Council were applied, the Department of Commerce announced recently.

According to estimates, if applied only to the so-called stabilizer gases—the gases which are collected at the well heads along with the crude gasoline but later allowed to

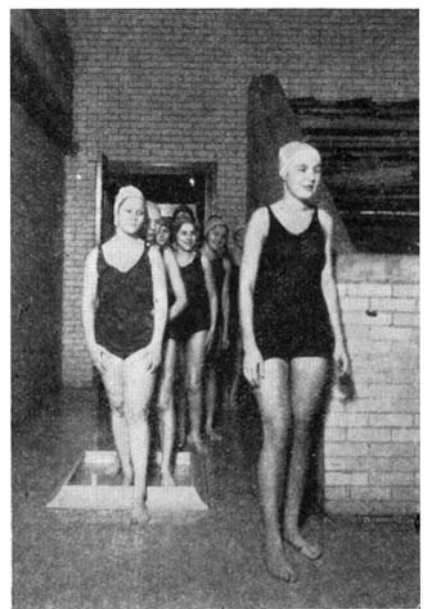
escape into the atmosphere—the process would yield 10,000,000 gallons of alcohol each year, while the 140,000,000 gallons yield would be obtained by use of all the total annual gas waste in the area.

Industrial alcohol used annually in Canada at the present time is valued at more than 2,000,000 dollars. Estimates place the use of the process on the gases at not over 25 cents a gallon, not counting overhead and any charges made for the waste gas required.

The process, it was said, would convert the natural gas into ethylene, from which it is an easy matter to manufacture industrial alcohol and a wide variety of other chemicals.—A. E. B.

Foot Baths for Athlete's Foot

IN our November issue we described a new method of prophylaxis of ringworm of the feet, commonly called "ath-



Solution in the rubber pan prevents spread of "athlete's foot"

lete's foot," by the use of a strong solution of sodium hypochlorite. Since metal pans for holding this solution are out of the question due to the oxidizing action of the solution, and since enamel pans, besides adding a dangerous element in their tendency to cause slipping, soon crack under the constant pressure of walking feet and expose the metal to oxidation, a new shallow rubber pan has been perfected by the Patterson Laboratories.

The new rubber foot baths are moulded from one piece of white solid rubber, soft enough that they are easy on the feet, but stiff enough to prevent spilling the solution. They measure 30 inches by 30 inches outside, being small enough to be located in any convenient doorway or passage, yet large enough to discourage anyone who is more inclined to jump over than go through. They hold four gallons of solution, being deep enough to cover the foot nicely.

Intellect on a Glass Dish

AMONG the exhibits at the Faraday Centenary Exhibition in London was one occupying no more space than does the

human hand, consisting of three glass dishes containing specimens of insulin, adrenalin, and thyroxin, two of them substances which, since they contain the benzene nucleus in their molecule, might be said to have arisen out of Faraday's original discovery of this subject. Probably, says an editorial in *Chemical Age*, all the visitors passed them by, little realizing that they were beholding one of the latest achievements of the chemist, namely, his isolation and synthesis of those substances which control the very functions of the body.

The old physiology was based on nervous regulation of our bodies; the new physiology, which assimilates the old and is incorporated with it, postulates chemical regulation by which is understood that the functions of bodily organs, including the nerves, are influenced by chemical substances circulating in the blood. Thus adrenalin increases the blood pressure and so controls the heart; thyroxin determines whether we are intellectuals or idiots. Both have had their constitutions determined and have been synthesized. Insulin controls our sugar metabolism; some day soon we shall know all about it and synthesize it also.

The exhibit was appropriately labeled, but something much more sensational is needed to bring the achievement home to the public. Science has established the remarkable fact that the highest functions of the brain cannot be carried out in the absence from the blood of a relatively simple substance that we can make in the laboratory. Intellect on a glass dish!—A. E. B.

Automobile Ignition Booster

FURNISHING an intense spark irrespective of a weak battery, weak coil, or the presence of resistor suppressors introduced in the ignition circuit when an



A six-volt dry battery in the ignition circuit assists in starting

automobile radio set is installed, a new ignition booster facilitates the starting of any car under all conditions. This device comprises a relay unit mounted in a neat, compact aluminum case and a compact six-volt dry battery in a convenient mounting. Both units are mounted close together near the engine ignition coil. This unit is

a product of the Burgess Battery Company.

In operation, the ignition booster automatically throws the six-volt dry battery in series with the car's storage battery for supplying the ignition coil with an increased voltage at the moment of starting. The relay unit, actuated by the starting motor circuit, throws in the dry battery. The moment the foot is removed from the starting switch, the relay throws out the dry battery, so that the engine operates on the storage battery alone. Since there is only a momentary drain on the dry battery, it lasts for six months or more, when it may be replaced at small expense.

Cement-Asbestos Pipes May Replace Iron and Steel

CAST from a mixture of cement and asbestos fibers instead of from iron or steel, a new type of pipe is finding wide application abroad. This "fibrocement" pipe resists ferrous and calcareous incrustations, corrosion, and electrolytic decomposition by stray electric currents. Moreover, the elastic limit of fibrocement is almost equal to its breaking load, and the method of manufacture of fibrocement pipes permits the production of tubes of any desired degree of thickness.

Professor Francois, of the University of Brussels, and Professor Van Hecke, of the University of Louvain, who have had an opportunity to study at first hand the Italian piping systems of fibrocement, report the following interesting information. In Genoa, fibrocement has been used in preference to metal pipes in conduits for distributing sea water (street mains, fire mains, and the like) because there is danger that metals will be corroded by salt water. The sea water pipes in certain localities pass through the open air, and in February, 1930, the water froze at -12 degrees Centigrade without injuring the pipes. In the thermal baths of Montecatini near Florence where the water is very salty, iron and steel pipes used as conduits proved unsatisfactory, for they corroded rapidly and were soon incrustated. Fibrocement pipes were unaffected by the water. A conduit which carries water at a temperature of 80 degrees Centigrade and which has replaced a former pipe of iron, requires no insulation since the fibrocement is in itself a sufficiently poor conductor of heat.—A. E. B.

Diamonds in American Gravels

A NUMBER of diamonds have been found in gravel deposits in Michigan, Wisconsin, and Illinois. While the majority of them are small, many diamonds of considerable value have been discovered. The largest so far reported found weighed 21½ carats.

A great diamond field somewhere in the north is believed to be the source of these stray diamonds. Where it is—or was—no one knows. But undoubtedly at some time glaciers swept over it, carrying away with them some of the diamonds, and perhaps even sweeping away the entire deposit. As they moved down over the Great Lakes region they scattered the diamonds among the gravel they left in their wake. Attempts made to find this field have all failed. Probably if still in existence it is hidden in the great wild and inaccessible areas of Canada, and the search for it is on a par

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with the hunt for the proverbial needle in the haystack.

The diamonds found in the gravel beds, having been washed by water, are clean and easily seen. They resemble pieces of glass or clear crystal quartz. Usually they will reflect a rainbow of color without polishing. Therefore pebbles showing rainbow colors are worth examining carefully.—*Science Service.*

Time Broadcast by 'Phone

FIFTY thousand times a day telephone calls for the correct time are made by residents of Manhattan, Brooklyn, the Bronx, and Queens. This means that, on the average, nearly thirty-five persons a minute ask the operator to connect them with M^Eridian 7-1212, the time-giving station. But a single operator at that station, by means of a new system inaugurated recently by the New York Telephone Company answers all these calls by only four operations a minute. The new time service is available 24 hours a day.

Under this new plan, there will be no change in the method of reaching the Telephone Time Bureau over that in use during the last three years. The inquirer calls M^Eridian 7-1212 as at present, and simply listens a few seconds to receive the exact time. It is not necessary to ask the time-announcing operators for the time; in fact, the equipment is so arranged that it will not be possible for these operators to hear any questions asked them.

The time announcement is made every 15 seconds, the announcers saying for example: "When you hear the next signal, the time will be two-fifteen and one-quarter." These words will be followed by a high-pitched tone, automatically produced, marking the time to the exact second. With the time so frequently reported, the company points out that a caller who may fail to understand an announcement will need only to listen for the next one.

The voices of operators selected for this work are tested to meet unusual standards. By the use of lever keys an operator, guided by a volume indicator, may raise or lower the transmission level of her voice. There are 50 telephone operators who have been trained to make the time announcements. They work in one-hour shifts—that is, no

operator spends more than an hour at a time at this position. Those trained are so numerous that it is very seldom necessary for one girl to serve more than one shift a day at the time announcement turret.

The time service equipment is regulated from the United States Naval Observatory at Washington, D. C., through a "grand master" clock in the Western Union building in Manhattan and two "master" clocks in the telephone company's bureau. These two clocks control duplicate sets of announcing equipment, provided to insure continuity of service. Both sets are housed in a turret on the face of which are the signal lamps and indicators which guide the operators.

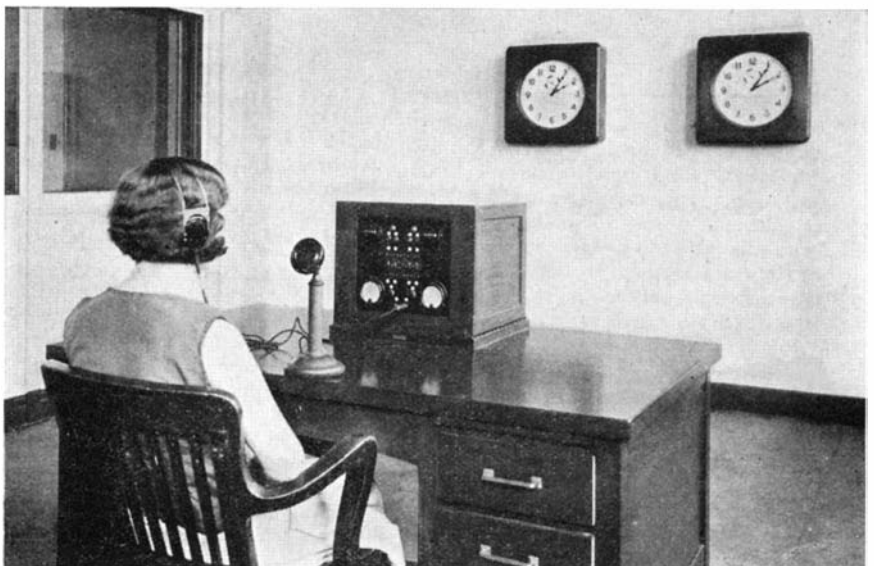
One set of indicators, with faces similar to the mileage register on an automobile, records the time in 15-second steps. At a fixed interval before each quarter-minute change, a green signal lights, and the operator makes her announcement. The tone signal, known scientifically as a "short thousand-cycle tone," follows with carefully regulated precision "to the second."

Light Control in Package Form

A VAILABLE in package form, ready for use by simply inserting the attachment plug into the nearest A.C. or D.C. outlet, a new light control unit is now seeking jobs in the everyday world. Reduced to simple form, this equipment is made possible by a new light-sensitive cell which is rugged, non-critical, and sufficiently stable in operation to be used away from the laboratory. Combined with equally dependable components to form a complete light relay unit, the equipment is available for lay use in factory, store, home, and outdoors.

The Burgess A.C. light relay is designed to operate on the usual 110-volt A.C. supply. It consists of a bridge circuit feeding a 427 type vacuum tube as the amplifier, which in turn actuates a power relay. The circuit contains in addition a power transformer, filter condenser, necessary resistors, and by-pass condensers. A second 427 tube serves as the rectifier.

In the case of the D.C. unit, intended for operation on the usual 110-volt D.C. supply, a bridge is employed, together with the newly perfected 430 type 2-volt tube, voltage

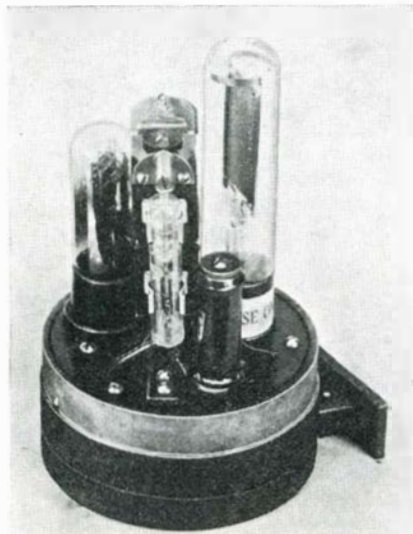


The operating position from which telephone subscribers get the correct time

reducing resistor, circuit resistors, by-pass condensers, and power relay.

Both A.C. and D.C. light relay circuits may be arranged with open power relay contacts when the cell is in either light or dark condition, depending on the requirements of the desired application.

The light relay unit functions by the modification of the light that passes through its window and falls on the light-sensitive



The new photo-electric cell for everyday applications, with its cover removed to show compactness

plate of the bridge. The variation in light causes a corresponding resistance variation in the bridge itself, thereby controlling the flow of current to the amplifying tube in the same circuit. The amplified difference in current flow causes the desired operation of the relay, which in turn closes or opens the circuit of the equipment to be controlled by light.

The simplest application is the control of electric lighting systems, whereby the lights are turned on at nightfall, and turned off at daybreak, by purely automatic means. Another application is the counting of vehicles, packages, parts or other units which pass between light source and light relay, interrupting a beam of light. Still another application is a burglar alarm, whereby an invisible beam of light, made possible by the use of a color filter in the light source, protects a doorway or room. Sorting is accomplished by causing any alteration of shadow or light intensity to

upset a given balance in the light relay, actuating the desired apparatus. The light relay may be arranged to operate an automatic door opener when a truck or a person interrupts the light beam. Placed in a funnel, the equipment gives notice of the presence of smoke. A similar arrangement is employed as a smoke detector for fire alarm purposes.

"Silent Talkies" Teach Deaf to "Hear"

NOW they're making talking movies for the deaf and hard of hearing. These movies might rightly be styled "silent talkies," at least as far as the congenitally deaf are concerned, for the latter receive no sensation of sound as they view the pictures, thought they readily learn to "hear" with their eyes the conversation of the talkie characters.

Ohio State University has been conducting interesting experiments along these lines, according to the Bell & Howell Motion Picture News Service. Under the direction of Dr. G. Oscar Russell, chief of that institution's phonetics laboratories, Miss Marie Mason has been working with talking pictures especially designed to give increased lip reading facility.

Talkies in which lip motions and other facial movements together with body gestures are introduced according to a carefully determined plan, are produced in the laboratory studios. Then the pictures are shown for lip reading study. By means of 16 millimeter motion-picture projectors the movies can be conveniently shown over and over again until every speech movement and emotional expression has been correctly interpreted.

It is easily conceivable that any one with defective hearing can, by viewing with a home movie projector right in his own living room such movies as Doctor Russell and Miss Mason have been experimenting with, gain fine lip-reading facility.

Food More Important for Teeth Than Brushing

THE greater importance of food over cleanliness in prevention of tooth decay and the responsibility of the physician rather than the dentist for proper tooth formation were stressed by Dr. Edward Clay Mitchell of Memphis at a recent meeting of the American Dental Association. "Although we do not wish to discourage



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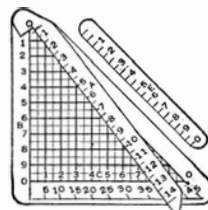
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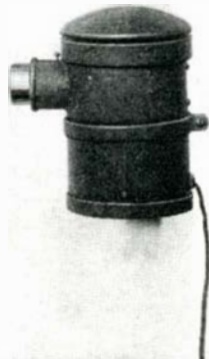


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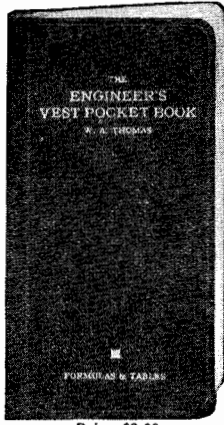
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Light control in package form: The photo-electric cell and the light source

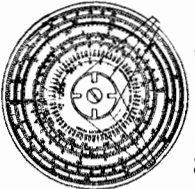
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proper mouth hygiene, it has been definitely shown that a properly fed tooth will not become carious even in a dirty mouth.

"The physician is equally as responsible, if not more responsible, than the dentist for proper tooth formation," he continued. Teeth require feeding the same as any other structure in the body. It is the physician who must teach the mother to watch her own and later her baby's diet in order to insure healthy teeth for the child. Plenty of sunshine and a well-balanced diet, including milk, egg yolk, fresh vegetables, fruit juices, and cod-liver oil are needed by every infant. Early attention to these factors will result in much better teeth for the next generation, Dr. Mitchell observed.—Science Service.

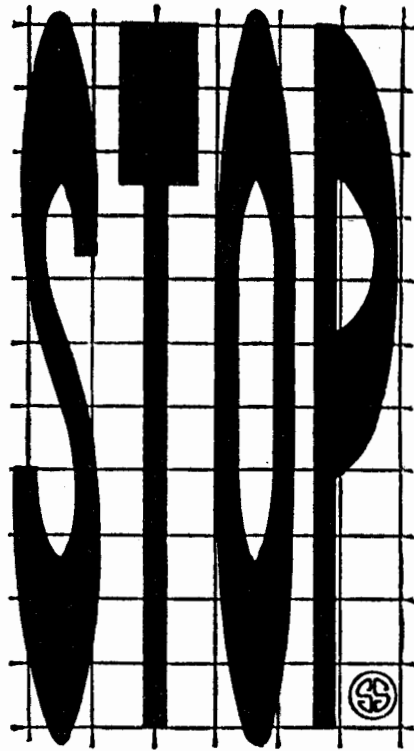
Stretching Pavement Signs Makes Them Readable

THE usual stop sign painted on the pavement to halt motorists before a dangerous intersection usually is speedily run over, not because of carelessness but because a warning in ordinary shaped letters cannot be read until it is too late to stop.

Let the letters be stretched, however, until they are tall and thin, and then the warning can be read easily at three to four times the former distance, the National Safety Council suggests.

"At a distance of six or eight yards ordinary letters are so foreshortened as to become illegible," it was stated. "But if the letters are five and one half feet high and seven inches wide, they will appear approximately square at a distance of 15 yards, and may be read easily at a much greater distance."

Some letters have been designed to give best results for distances from 20 to 40 yards. This in general gives time enough to stop.—Science Service.



Stretched pavement signs are more readable; tilt top of page away from you to get the proper effect

OUR RAILROADS MUST BE SAVED

(Continued from page 93)

likewise, have hit the railroads a hard blow. The airplane, so often scoffed at as a competitor of railroads, also is certainly worth consideration. Airplane passengers on scheduled flights for the first nine months of 1931 numbered 348,507 as compared to 327,211 for the same period in 1930.

With taxes increasing faster than dividends and with all the other odds against them, the railroads are doing their best, within the limits prescribed by Congress, to make ends meet, maintain their service and even improve it, and to pay dividends. Huge electrification programs have been planned in order to provide faster, more flexible service. To allow greater speed to be made, the Pennsylvania has adopted for its New York-Washington route the heaviest rail ever used on any road and is electrifying this complete route. To attract more passengers and incidentally to advertise their roads, practically all carriers have improved the character and comfort of their rolling stock; they have added luxurious lounge cars with every convenience, including telephones that may be plugged in while trains are in stations, valet and barber services, and have made a noteworthy improvement in dining car service and menus. The Baltimore and Ohio in 1930 put into operation between New York and Washington a dining car carrying air conditioning and air cooling equipment similar to that used in "refrigerated" theaters (See SCIENTIFIC AMERICAN, August 1930), and other roads are developing equipment of a like nature. During the summer of 1931 the Baltimore and Ohio applied this air-conditioning principle to two entire trains, and announced a short time ago its application to two more.

TO meet truck competition in freight haulage, a number of roads, particularly one large group in the southwest and three large roads in the western trunk line territory, have inaugurated store-door pick-up and delivery. Usually if the haul is to be for such a distance that trucks might render competition unfavorable to the railroads—say 300 miles—this extra service is gratis; if for a greater distance, there is a nominal charge. Thus competition is on a fairer basis, but to attain this end the railroads must spend money. Where a subsidiary company is formed to handle pick-up and delivery service, no ruling from the Interstate Commerce Commission is necessary as that body has no jurisdiction over such subsidiary. If this service is performed directly by trucks of the railroad company, however, it is subject to regulation by the Commission.

It used to be a common thing to accuse the railroads of being conservative. Such charges arise through ignorance of the railroads' position or through lack of appreciation of the fact that they are not "free agents" but are regulated as monopolies—which they no longer are. They are subject not only to the Interstate Commerce Commission but also to 48 state commissions, numerous city commissions, town councils, and what-not. Furthermore, one must not

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar
Registered Patent Attorney

Cotton Picking Machinery Perfected

A MONEY-SAVING machine which the Labor Department says will do in less than three hours the work that used to take one man 77 hours is ready to take its place in the cotton fields. Mechanical experts of agricultural experiment stations declare that practical perfection of cotton harvesting machinery has arrived. Not only has the machine for picking arrived, but the cotton gin has been more fully perfected to prevent loss of quality by machine picking.

The department said that the labor saving represented by the new machine is a net gain for the cotton farmer.

"The perfected machinery," says the Labor Department's announcement, "is the result of an early idea of progressive cotton farmers who had experimented with gathering fallen bolls with a horse drag, at the same time stripping from plant the bolls that had not fallen.

"The first drag was a section of a picket fence constructed of wooden slats bound together with interwoven horizontal wires. This was dragged over the cotton rows in such a manner that the wires caught the bolls, stripping them off the stems, and left them lying on the wooden strips of the drag.

"But the drag gathered so much rubbish the cotton could not be ginned. Not to be discouraged, the farmer ran the stuff through his threshing machine, thus cleaning out enough of the rubbish to enable the gin to separate the fiber from the remainder.

"The idea was taken up by other farmers and the experts of the agriculture experiment stations got to work on it. First a rude sled was constructed with a V-shaped slot for catching the stalks and stripping off the bolls. The bolls were worked backward by the forward motion of the sled into a wooden box. The first cotton sleds stripped only one row at a time but were soon widened to cover two, three, and finally four or more rows."

More About Use of Word "Mahogany"

A PETITION of Mahogany Association, Inc., and American Walnut Manufacturers Association for leave to intervene in the matter of Gillespie Furniture Company, Los Angeles, has been denied by the Federal Trade Commission.

Last July, the Commission dismissed a complaint charging this furniture company 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. (See page 285, October 1931, SCIENTIFIC AMERICAN.)

Commissioners Hunt and McCulloch

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.

voted in the negative as to the commission's action in denying the petition for intervention, Commissioner McCulloch filing a memorandum of dissent which follows:

Certain dealers in what is conceded to be true mahogany furniture, who claim to be injured by the sale of furniture made of wood from the Philippine Islands designated as Philippine mahogany, filed a petition with the Commission to intervene and asking for a rehearing of the case. This petition was filed within 90 days after the rendition of the Commission's order dismissing the complaint against respondent, a dealer in Philippine mahogany.

The Commission now dismisses the petition and I dissent from that action. The majority base their action dismissing the petition, in addition to adherence to the views entertained by them in dismissing the complaint against respondent, on the further grounds that (1) notice of the presentation of the petition has not been given to the respondent; (2) that intervention of those not originally parties to the record is not allowable after final action of the Commission; and, (3) that the Commission has not, under its rules, the power to grant a rehearing after 90 days from the original hearing.

At the time that the Commission dismissed the complaint against the respondent, I made public expression of my dissent from the action, and I have nothing further to say on that subject save that I now adhere to the views then expressed on the merits of the case. But I am unwilling to allow the other grounds on which the majority base their dismissal of the present application for rehearing to go unchallenged.

The rule which the majority invoke in support of the present action declares that the Commission may "at any time within 90 days after the entry of such order, for good cause shown in writing and notice to the parties, reopen the case for such further proceedings as to the Commission may seem proper."

(1) As to the failure to give notice, it is sufficient to say that the rule does not require notice before expiration of 90 days after the order was rendered. The petition may be filed at any time within the 90 days specified in the rule, and then due notice given before hearing. The rule does not require the petitioner to give notice. But even if the rule be otherwise construed, it does not seem just for the Commission to let a petition, filed in due time, lie dormant until the expiration of the

specified time and then reject it for want of notice. I am unwilling to approve so technical a practice under a rule designated to afford an opportunity for correction of errors of the Commission which may, perchance, have been made.

(2) There is no rule or practice which prohibits an application for intervention with request for rehearing after final action by the Commission in a corrective proceeding. There should be no such rule or practice. The Commission represents the public in the protection of its interests, and also that of injured competitors. Such competitors and others of the public may expect protection in the orders of the Commission and if it fails they should be allowed an opportunity for a hearing. No statute forbids. The only statutory limitation in this respect is that an order to cease and desist may be modified or set aside only before it is carried to court for review. When an error has been made by the Commission (we do not claim infallibility), if the counsel for the Commission does not move to correct it, those most interested are, according to present ruling, given no opportunity to call attention to the error.

(3) Finally, the majority say the Commission is powerless, under its own rules, to grant a rehearing more than 90 days after decision. They give the rule the force and effect of statutory law and point to a decision of the Supreme Court of the United States (*United States v. Grimaud*, 220 U. S. 506) as supporting that view.

That case involved a criminal prosecution for violation of Departmental rules concerning grazing of sheep on Forest Reserve lands—an Act of Congress having conferred power to make such rules and prescribed a penalty for violation of the rules. The point of the decision is expressed in a quotation from a former decision in *Field v. Clark*, 143 U. S. 649, as follows: "The legislature cannot delegate its power to make a law, but it can make a law to delegate a power to determine some fact or state of things upon which the law makes, or intends to make, its own action to depend."

That is far from declaring that an administrative agency of the government can bind itself by procedural rules having the force and effect of law made for its own guidance in the dispatch of business. The rule in question being merely a procedural one, a reasonable interpretation is that it requires application for rehearing to be filed within 90 days after a decision is rendered. Such interpretation is in line with the manifest design to ward off belated applications rather than to hamper the Commission in considering such application on merit.

There is an old maxim of the law that "delay of the court harms no one." It should be applied here, though we do not constitute a court. We have no limitation as to term—such as courts generally have. The Commission is always in session when the Commissioners are present in confer-

ence. It loses no power by delay. No statute of limitation bars the exercise of its powers, save in the single respect already mentioned.

The application of the proposed interveners in this case should be considered solely on merit.

Motor Truck Mark Refused

IT has been held by First Assistant Commissioner Kinnan that C. H. Will Motors Corporation, of Minneapolis, Minn., is not entitled to register, under the Act of 1905, as trademarks for motor coaches, motor buses, and motor trucks, two marks consisting respectively of the word "Greyhound" and the pictorial representation of a dog, presumably a greyhound, in the act of running, in view of the prior registration to another of the pictorial representation of a dog, apparently a greyhound, in the act of running, as a trademark to be used upon automobiles, being applied to the radiator caps and the hub caps of such vehicles.

With reference to the similarity of the marks, the First Assistant Commissioner said:

"The applicant contends that the registered mark is not stated to be of a representation of a greyhound and may be that of some other dog. As to this matter, it is quite apparent that the registered mark is of the very distinctive type of animal known as a greyhound and would be so considered by such part of the public as is familiar with dogs of this kind. . . .

"The pictorial representation of the animal is deemed, as was held by the examiner, the equivalent of the name of the animal."

With respect to the argument that applicant's goods are not of the same descriptive properties as those of the registrant, he said:

"It will be sufficient to note here that the registration is not limited to pleasure vehicles and further all these types of vehicles are frequently made by the same manufacturer. It is thought confusion of origin would be quite probable if the applicant's mark appeared upon its goods in the same market with the goods of the registrant."

Descriptive Store Name Not Registrable

IN *ex parte* the H. D. Lee Mercantile Company, Assistant Commissioner Moore held that a print bearing the notation "High Grade Food Stores, United for Service, Quality and Economy," is not registrable under the Act of 1874 since it does not describe an article of manufacture.

In his decision, after citing from a decision in which it was stated that the Act of 1874 had been uniformly construed ever since its passage as authorizing the Commissioner to register a print only when it describes an article of manufacture, and pointing out that the rules of this Office so state, the Assistant Commissioner said:

"The applicant's print in no sense is to be used for an article of manufacture, nor does it pertain thereto. On the other hand, the words which constitute the essentials of the print are merely descriptive of food stores, suggesting that such stores are high

grade; and the words, 'United for Service, Quality and Economy' are merely descriptive of the purpose of such stores. A distinction should be observed as between words which are descriptive of stores and those which are descriptive of the articles of commerce sold by the stores."

Paint Labels Must Be Truthful

THE Federal Trade Commission has ordered Para Paint and Varnish Company, Cleveland, Ohio, to discontinue representing by labels on cans containing paint, the following: That the paint so offered for sale contains 30 percent carbonated white lead or 15 percent zinc oxide or certain other ingredients in certain proportions, or that the paint has a certain vehicle content in certain proportions. In each of these instances the order contains the phrase "unless and until" the paint has the qualities represented.

In its findings the Commission declares that the label descriptions of the composition of the company's ready-mixed paint do not truthfully represent the content of the cans to which they are affixed.

Rupture Cure Censured

THE Federal Trade Commission has ordered John G. Homan, of Steubenville, Ohio, who manufactures and sells under the name, New Science Institute, appliances for treating hernia or rupture, to stop exaggerating the value of his system and to cease disparaging the products or methods of treatment offered by competitors. Homan's device is an attachment called "Magic Dot," while most of his competitors sell trusses, which appliances, in general, the medical profession has approved, although Homan characterizes them as "old fashioned," "barbarous," "torturous," or "unclean."

Homan is directed, among other things, to stop asserting that science has condemned trusses as a treatment for hernia because they are obsolete or because they prevent or retard the cure of hernia or rupture, and that his instrument is the latest invention for this treatment and has rescued men and women from the doom of rupture by trusses.

He is to cease alleging that by use of his device, also variously designated "Magic Dot Outfit," "Airtex-Magic Dot Combination" or "New Science System," every reducible hernia or rupture can be supported or can be cured generally or in a considerable proportion of the cases.

In applying for a patent Homan described his model as a "means for retaining a supporting pad or like therapeutic device in place, and especially relates to a device to be used in connection with present forms of hernial trusses and body supports." The words "Magic Dot" were registered as a trademark.

The article now offered differs from that which Homan sold at the time the Commission's complaint issued, and is said to be less effective, but both have been and are distributed under the trade name "Magic Dot." He sells his original device now only when orders are received from those who have used them previously. His principal business is the sale of an appliance more nearly resembling the standard truss than his original device.

The Commission found Homan's appliance to be neither a development of science nor a discovery or invention adapted to, or useful for the treatment of hernia or ruptures in advanced stages. The device was found to be useless either for curative or palliative purposes except in less than 5 percent of the cases of rupture. It was learned that rupture in children may be cured in a majority of cases by Homan's method, and, the Commission found, "in an extremely limited degree there are moderate cases of rupture in adults which his appliance, or appliances, may hold in place, and thereby a cure may, in some instances, be effected." But it was also learned that "95 percent of the cases of rupture are incurable by means of the appliance of respondent, nor can it support the hernial sac in its proper place in 95 percent of the cases of rupture."

First Use of Mark Upheld

IN the trademark interference case of The Colorado Fuel and Iron Company versus Pittsburgh Steel Company, First Assistant Commissioner Kinnan held that The Colorado Fuel and Iron Company had established a use of the term "Guardian" as a trademark for wire fences prior to any date of use of the same mark claimed by Pittsburgh Steel Company, and that the former was entitled to registration.

In his decision, after noting that no testimony had been taken on the behalf of the Pittsburgh Steel Company and that the earliest date of adoption and use alleged in its application is February 20, 1930, the First Assistant Commissioner said:

"The junior party has taken testimony of one witness, D. S. Muckley, superintendent of the wire department of The Colorado Fuel and Iron Company. This testimony is clear enough that the mark was used by the junior party from a date as early as the fall of 1929, or at least some months prior to the claimed date of adoption and use alleged by the senior party. The testimony of the witness is not contradicted nor do any inconsistencies appear to be in it. The exhibits seem genuine and there is no reason for reaching any other conclusion than that reached by the examiner of interferences."

"Stainless" Steel Must Be Stainless

KNIVES and cutlery as sold by B. Rosenberg, an individual trading as Globe Supply Company, New York, shall no longer be labeled with the word "Stainless" and that word shall not be used as part of his trade name, unless such articles are made of steel containing not more than 0.70 percent carbon and from 9 to 16 percent chromium, according to an order of the Federal Trade Commission.

In its findings, the Commission makes known that Rosenberg labeled his knives and cutlery with the term "Stainless" or "Globe Stainless" and that such label signifies an alloy of steel containing the ingredients mentioned above. However, Rosenberg's knives and cutlery are not made of such alloy of steel, but are manufactured from carbon steel plated with chromium and so prepared as to imitate stainless steel.

Books SELECTED BY THE EDITORS

DIESEL REFERENCE GUIDE

By *Julius Rosbloom*

IN our January issue this book was incorrectly priced. The proper amount is \$5.00 postpaid.

COMMUNICATION

By *David O. Woodbury*

THIS is the first of a series of books to be issued under the general title of "Stories of Man's Achievements," and it succeeds admirably in telling the graphic story of the evolution of communication from the days of the first picture writing and smoke signaling down to the present era of high-speed, world-wide radio. Thrilling indeed are the descriptions of the early struggles of those who were and are responsible for the telephone, telegraph, cable, and radio, which we now accept in such a matter-of-fact manner. This is a book that, because it treats of a subject which is such a vital part of our every-day life, will be widely read by those who have not kept up with the rapid development of our communication systems, or who want to brush up their memories and straighten out the proper sequence of events.—\$2.65 postpaid.—*A. P. P.*

WHAT MAKES THE WHEELS GO 'ROUND

By *George E. Bock*

THIS is a picture book of machinery, the main principles of mechanics, the elements of machines, and the sources of power. Unusually clear and definite illustrations quickly show what the text sets forth. Young and old alike can spend many interesting hours studying the drawings and will get therefrom more information and knowledge than is obtainable from days of extended study of the usual more formal presentations. 8 $\frac{1}{4}$ x 11 $\frac{1}{4}$ —54 drawings with futuristic style end papers.—\$2.65 postpaid.

PRIZE WINNERS' BOOK OF MODEL AIRPLANES

By *Carl H. Claudy*

ALL the planes described in this book are prize winners and their exact construction is set forth by the people best of all qualified to talk—the fel-

lows who made them. Not only the specifications regarding materials and cost, but the precise detail plans by which the models were built and the analyses of their behavior in the air, all are clearly outlined. The diagrams are reproductions of the working drawings used by the makers. A most entertaining collection of true stories and a who's who of airplane experts—all of whom have proved their skill by winning prizes with their planes.—\$3.20 postpaid.

THE BOOK OF THE SAILING-SHIP

By *Stanley Rogers*

THE author of those popular and interesting books "The Atlantic" and "The Pacific" here tells in a similarly effective vein, the story of the inception and development of practically every kind of sailing-ship. It is a seaman's manual, a sea history, and a nautical dictionary, covering everything one would want to know about this kind of vessel. The three final chapters deal with treasure ships, famous shipwrecks, and remarkable voyages. Over 100 pen and ink drawings and colored drawings by the author. 278 pages.—\$2.90 postpaid.

MAKING FARMS PAY

By *Cornelius J. Claassen*

AS the manager of a group farm organization busy with 703 farms running over a total of 252,000 acres, the author tells a way out for owner and tenant. It is not theory but gives the instances of how these farms are made to pay. Full of workable suggestions to every absentee owner of farm property to tenants and farm operators, to bankers, life insurance companies and other financial institutions, and individuals with capital invested in farm lands. Congressional Farm Relief is not the solution but the helpful assistance of experienced farmers who are also good business men. A direct, informative, and provocative account of what actually has been accomplished.—\$2.20 postpaid.

GAME BIRD SHOOTING

By *Captain Charles Askins*

A SPORTSMAN has here written about game birds for the sportsman. He has treated the subject from the point of view of the man who loves

a gun, a dog, and the open country, and has made "no serious attempt . . . to describe the various game birds according to the standards of the ornithologists." All domestic and imported upland game birds and water fowl are described and illustrated, and the reader learns how each species may best be hunted. Interlarded as is the text with descriptions of happenings in the author's decades of shooting, this book will be read and reread by all sportsmen who heed the call of dog and gun. With colored insert of mallard hen and drake.—\$4.20—*A. P. P.*

PRESIDENT AND CHIEF JUSTICE

By *Francis McHale*

THE life and public services of William Howard Taft composed of facts and incidents drawn from a wide range of references and all woven into a most readable and sequential story. Few realize fully the breadth and extent of the activities of the 27th President of the United States, his tremendous capacity for hard work, his unusual mental attainments, integrity and indifference to financial gain, as well as his philosophy under trying conditions and his ability to get along with people.—\$3.20 postpaid.

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Selected by Book Selection Committee, American Association for the Advancement of Science

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FREE-LANCING FOR FORTY MAGAZINES

By *Edward Mott Woolley*

UPON the publication of his 1000th special article, the author sets down the steps by which he climbed from cub reporter to staff writer and then became a free lance. It is the story of a one-track ambition often thwarted for several years, yet always returning to the track again. Much of the inside story as between editor and contributor, unknown to the general public, is most interestingly brought forth. Humor, pathos, and pugnacity intertwine throughout. Incidentally this reviewer finds many helpful points which make for more useful and pleasant contacts with writers. Well worth reading by anyone who has editorial contacts.—\$2.60 postpaid.

MY FIGHT FOR BIRTH CONTROL

By *Margaret Sanger*

MARGARET SANGER not only knew how to plan and organize and carry on a fight which has all but succeeded, but she knows how to dramatize it most readably in type. This book is a colorful autobiography of the central figure in that long fight. It is a book that fairly pulls the reader along toward the final page, whatever his or her views with regard to birth control itself. A good background knowledge of this movement, concerning which there is an ever growing public opinion, will incidentally be gleaned from this vivid account. As Mrs. Sanger says, the opposition can object all it wishes but, in all except technicality, birth control is a fact today—"they cannot push the chick back into the shell."—\$3.20 postpaid.—*A. G. I.*

THE GREAT PHYSICIAN—A Short Life of Sir William Osler

By *Edith Gittings Reid*

EVERYBODY knows Osler was the man who is alleged to have said we all ought to be chloroformed at 60, but few know the fascinating story of his remarkable life and career. The author of this biography had the advantage of a day-to-day acquaintance with the great physician and throws much bright light on the real nature of this superman.—\$3.70 postpaid.—*A. G. I.*

IVORY, SCOURGE OF AFRICA

By *Ernst D. Moore*

THE sordid and murderous tale of Arab dominance in the ivory and slave trade which stopped at nothing to accomplish its ends. Told by one whose forebears as well as himself had purchased the ivory obtained at such fearful cost in human misery. One would have no idea previous to reading this

book, what a terrible epoch this was in African history; one's blood fairly chills yet the interest will hold to every page of this narrative, though it is not at all sensationally written. It is a calm exposition of the facts learned first-hand. Interestingly illustrated, pleasing format.—\$4.20 postpaid.

MODERN CIVILIZATION ON TRIAL

By *C. Delisle Burns*

FOR a judicial and impartial summing up of the good and the bad which distinguishes our modern civilization, this book is recommended to the thoughtful reader. The analysis or contrasts between the various groups which make up the modern world and the interests which make them interdependent are developed in logical and sequential form. Government, War and Peace, Production, Taste, Education, Sciences and Arts as outlined against the background of history, are some of the divisions which make up this cultural study.—\$2.65 postpaid.

SNAKES OF THE WORLD

By *Raymond L. Ditmars, Litt. D.*

THE writer has had 30 years' experience as curator of reptiles and in this period has answered thousands of questions, such as "Do the boas and pythons break the bones of animals?"; "What is the greatest size attained by serpents?" All these questions are fully answered. We learn that there are slightly over 2000 different kinds of snakes. A large majority of this number is composed of non-venomous kinds, in great variety of form and size. The extent of this majority is far greater than is ordinarily surmised. The plates, 84 in number, are all printed at the back of the book, thus enabling the text to be printed on antique paper so as to be readable. This is the book on snakes that explorers have been waiting for, as the poisonous snakes are minutely described.—\$6.30 postpaid.—*A. A. H.*

SCIENTIFIC SELF-DEFENCE

By *W. E. Fairbairn*

TRAINED for many years in the practice of jiu-jitsu, the author has evolved a means of defense for the non-active civilian who wishes to be able to protect himself from assault by thugs or other malicious persons. All the holds are fully described and illustrated so that one can readily practice them without further instruction. Douglas Fairbanks, who has somewhat of a reputation for efficiency in jiu-jitsu, writes the preface in which he heartily commends the book as well as the wrestling art of the author.—\$3.65 postpaid.

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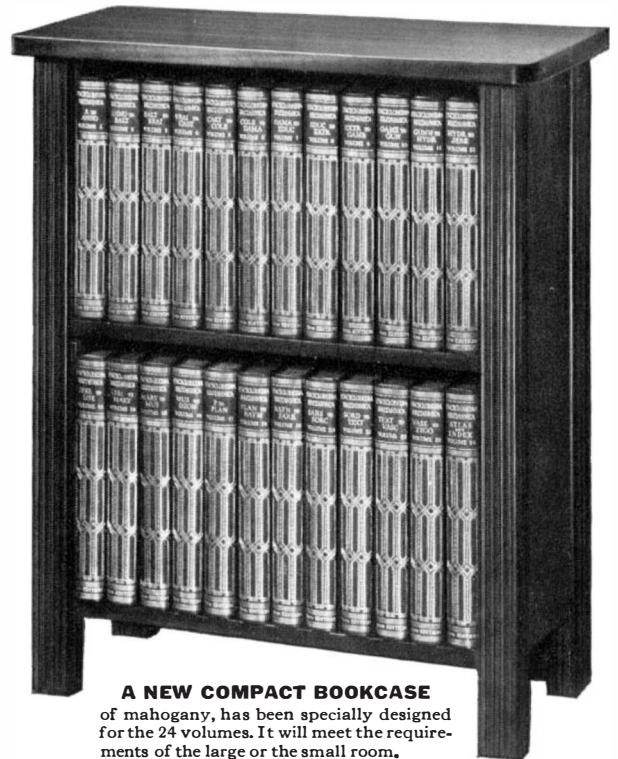
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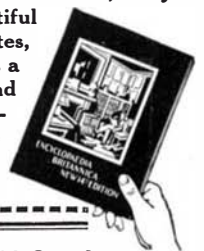
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