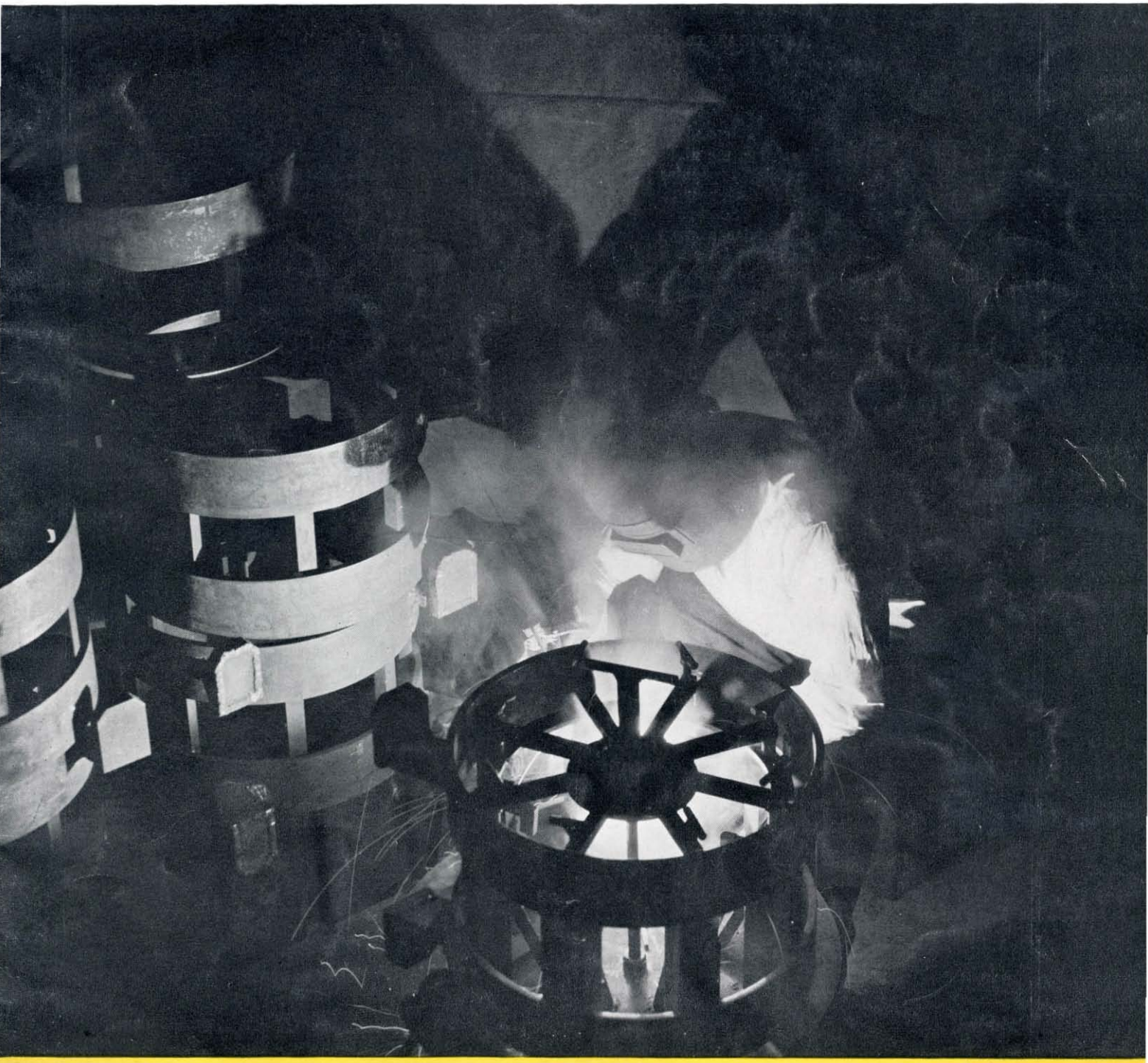
1 in 100 CAN UNDERSTAND Einstein

By JOSEPH B. NICHOLS

SCIENTIFIC AMERICAN

Vol. 150 No. 2 FEBRUARY, 1934 35c a Copy



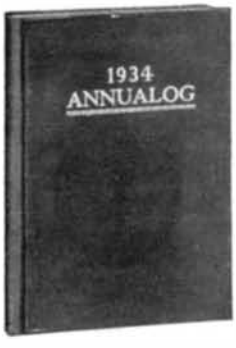
A Flash, A Sizzling Hiss. . . . (See page 57)

You won't find the

1934 ANNUALOG

in any bookstore

Because it has been prepared by us for SCIENTIFIC AMERICAN readers and reserved exclusively for them.



This little volume, the ninth of an increasingly popular series prepared each year by the editors of SCIENTIFIC AMERICAN, contains a great wealth of scientific facts and figures from authoritative sources. It discusses the progress of the past year in pure science, industry, aviation, engineering, archeology, astronomy, chemistry; interprets developments in these and other familiar and out-of-the-way corners of science; explains their significance, economic and sociological. Judging by the present demand for the older volumes, it is a book to be treasured as a mine of information and as a reference. Contains upwards of 200 articles. No; you can not get it at a bookstore.

But
It's yours for 25c
extra

with a one-year subscription or a two-year subscription to SCIENTIFIC AMERICAN at regular rates.

When sending in your subscription, simply make your check out for $4.25 for a one-year subscription or $7.25 for a two-year subscription and ask us to send:

The SCIENTIFIC AMERICAN Annualog for 1934

SCIENTIFIC AMERICAN

Owned and published by Munn & Company, Inc.; Orson D. Munn, President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

NINETIETH YEAR • ORSON D. MUNN, Editor

CONTENTS · FEBRUARY · 1934

Across the Editor's Desk 58

Frontispiece—Attractive Mount Wilson Observatory 60

Blister Busters—*By Charles Lathrop Pack* 61
How the C. C. C. is Fighting an Enemy of the White Pine Forests

Our Second Test for Telepathy 64
The Final Verdict in Our Tests—"Not Proved"

Our Point of View—*Editorials* 65
The Mail Goes Through; Streamlined Motor Cars; Absent-Minded Professors; A Magnificent Flight

A Doctor Looks at Smoke and Dust—*By W. W. McFarland, M.D.* 66
Doctors and Industrialists Can Combine to Combat Air Impurities That Threaten General Health

The Revised Food and Drugs Bill—*By T. Swann Harding* 68
What this Bill Will Mean to YOU if it Becomes Law

Elongating Legs by Surgery 71
A New Technique Which Actually Lengthens Bones

You Have One Chance in a Hundred to Understand Einstein —*By Joseph B. Nichols* 72
The Traditional Dozen Understanders is Proved Too Small

"Malnutrition" in the British Navy 74
Two Pages of Drawings Presenting Britain's Side of Naval Construction

Streamlining and Your Automobile—*By Alexander Klemin* 76
Proper Streamlining Presents Great Possibilities for Economy

The New Telescope Mirrors—*By Henry Norris Russell, Ph.D.* 80
Aluminum, Deposited on Glass in a Vacuum, Appears to Approach the Long-Sought Perfect Surface for Telescope Mirrors

Scheduled Atlantic Flying—*By Reginald M. Cleveland* 82
By What Route, and When, May We Expect Regular Transatlantic Air Service?

Sundials and Their Construction—I —*By R. Newton Mayall and Margaret Walton Mayall, M.A.* 84
Planning Simple Equatorial and Horizontal Dials

The Amateur and His Microscope—VIII —*By K. Bernice Fick, B.S.* 86
The Detection of Food Adulterations and Spoilage—II

Cover

A GIGANTIC shadow—like a hovering spirit of industrial progress—attends the manufacture of motor frames by arc welding. In a few short years this has become a major process for joining metals, largely through the outstanding development work of The Lincoln Electric Company, by courtesy of whom our cover picture is used.

SCIENTIFIC AMERICAN DIGEST

Of General Interest

Motor Cars for 1934 88
Physiological Effects of Alcoholic Drinks 89
Gasoline More Powerful Than TNT 92
Winter in Summer 93
New Ship Drive Uses Feathering Blades 93
New Joist-and-Plywood Floor Panel 94
Golf at Home 94
Chemical Flower Gardens 95
A Versatile Fire Alarm 95
Glass Wool "Shot from Guns" 95
Auto Telescope Mounting 95
Man-Made Lightning for Research 96
White Buffalo, "Big Medicine" 96
A Modern Desert Coach 98
Permanent Floor Covering 98
Battery Tester 99
High Compression—High Efficiency 103
Moonlight Indoors 104
Opens All Bottles and Jars 105
Frozen Rum Punches 106

Aviation

Photographing a State From the Air 90
Anti-Aircraft Searchlights 91
Australia's Air Trophy 91
Testing in the Tides 91
Baby Planes 91
A Flying Fortress 92
Flying Stewardesses 92

Chemistry in Industry

Research Makes Little Failure a Big Success 89
Purity Increases Usefulness of Iron 93
Phosphorescent Pigments 94
Perfuming Rubber 98
Thermoplastic Cements 99
Waste Products Improve Cadmium 105
Industrial Uses of Ultra-Violet 107

Health Science

Too Much Medicine 89
Nose is Gateway of Invasion 93
New Antidote for Mercury Bichloride 94
Reducing Medicines 95
Dangerous Eyelash Dye 98
Lung Ventilation Measured 103

The Amateur Astronomer 100

Current Bulletin Briefs 102

Book Review 110

Commercial Property News

The "Chipso" Trade Mark 111
Important Points Concerning Italian Patents 111
Patentability 111

SCIENTIFIC AMERICAN, February, 1934. Vol. No. 150, No. 2, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City. Subscription price $4.00 per year. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

ACROSS THE EDITOR'S DESK

"STATIC electricity may be eventually harnessed for driving motors and this prospect is attractive on account of the enormous power output of such a machine at very high voltages. The efficient generation and control of these is the chief impediment in this direction." With these sentences Dr. Nikola Tesla closes a most interesting and informative discussion of the possibilities of electrostatic generators. This article, prompted by the nation-wide interest in Dr. Van de Graaff's high-voltage direct-current generator described on page 96 of this issue, was prepared especially for SCIENTIFIC AMERICAN by Dr. Tesla. It is, in our opinion, the clearest and most concise explanation of these electrical generators that has ever appeared in print. As Dr. Tesla says: "Knowledge of static electricity dates back to the earliest dawn of civilization but for ages it remained merely an interesting and mystifying phenomenon." We are all familiar with the small static machines of the high-school laboratory but most of us have thought of them as nothing more than interesting playthings. Now, apparently, they are growing up and hold a world of promise for the future.

●

Newspapers throughout the country have aroused great interest in the subject of artificial impregnation performed by a physician, by their reports on a specific case of this type. Although the practice of artificial impregnation is not by any means widespread, it has certain highly interesting scientific, moral, and legal aspects. No social menace appears to be involved and so far as is known it is not illegal. John Harvey Caldwell has made an extensive survey of a number of doctors situated in widely separated cities and has obtained from them expressions of opinion regarding artificial impregnation. These opinions have been used as a basis of an article which will be published soon, and which discusses this subject in an informative, logical, and unprejudiced manner.

●

Air conditioning as an aid to industrial and business working conditions has obtained a firm foot hold in this country. It is not, however, in very wide use as yet in the home. One reason for this, perhaps, is because research work has not progressed sufficiently to enable engineers to make efficient installations under the widely varying conditions found in homes. In an attempt to remedy this condition and to provide a working basis for future operations, a research laboratory for air conditioning in the home has been established. An article to be published soon tells of this laboratory, its equipment, and methods of operation. The knowledge which will be obtained as a result of the experimental work now going on, may have a very definite effect on both comfort and health.

It may seem to be a far cry from air conditioning equipment in the home to the construction of Boulder Dam in the Grand Canyon of the Colorado River. There is, however, a definite linkage. Refrigerating equipment has been installed on the Boulder Dam site for no other reason than to cool concrete. It has been known for some time that the chemical reactions which accompany the setting of Portland cement in concrete releases a considerable quantity of heat which in the case of some of the work at Boulder Dam may be expected to raise the temperature of the concrete mass on an average of about 40 degrees, Fahrenheit, above the temperature at which it is cast. In order to insure proper setting and curing of the concrete over an extended period of time it is desirable to reduce this temperature rise as much as possible. This is now being done by means of the refrigerating plant at the dam site. How the work is carried on and the results that are being obtained will be told in an article scheduled to appear in an early number.

●

"There is not much energy concentrated in half a peanut, in a gram of cane sugar, in one and one half grams of white bread, or in four grams of the edible part of a banana, yet, little as there is, there is enough in each of these portions to supply the surplusage of energy that an hour of intense mental effort requires." Thus is introduced an article to appear in SCIENTIFIC AMERICAN in the near future, which tells some surprising things about the effects on the human body of the consumption of foods. The article, prepared by Carnegie Institution of Washington, and based upon a recent experimental investigation by Dr. Francis G. Benedict, Director of the Nutrition Laboratory of the Institution, brings the great work that physiologists are doing in their field of investigation once again to general attention. When you finish reading this article you will have obtained a broad and comprehensive idea of nutrition and its effect on working and thinking.

●

Most people, if they give the subject any thought at all, would probably be inclined to dismiss "blimps" as being "those funny looking little balloons that apparently have no practical use whatsoever." The many applications of these small airships are not generally known and for this reason we are pleased to announce that in our March issue we will present an article which will not only clear up many misconceptions about blimps but will tell of the multitude of uses to which they can be put both in times of peace and in war. This article was specially written for us by John T. Rowland, late Lieutenant U.S.N.R.F.

Orson D. Munn

Editor and Publisher

BUT IT'S FAIR AND WARM BY TELEPHONE!

Outside, hurrying feet plod on against the winds and swirling snow of winter. On such a day, it is good to be indoors where all is snug and warm.

• • •

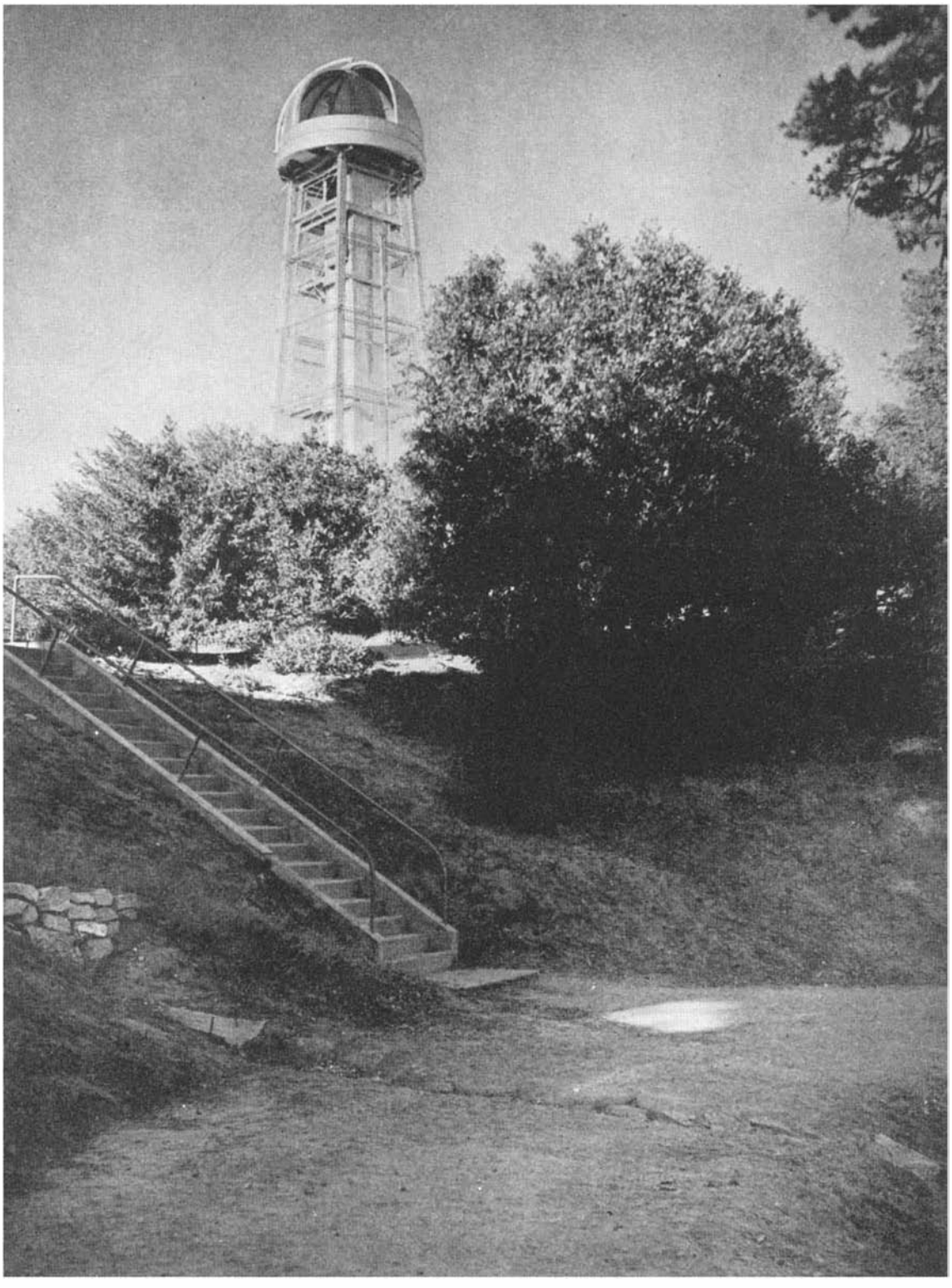
ALL outdoors may be frowning, the thermometer close to zero, street travel an exhausting task. Yet to your telephone it is as clear and fair as a day in June.

Without moving from your chair at home or in your office, you can send your voice across the snow-swept miles. Wind and weather need not delay the necessary tasks of business or break the ties between friends and relatives. Through all the days of the year, the telephone is your contact with the world beyond your door. It knows no season—no letting up when the going gets hard. Through storm and flood, an army of trained employees works ceaselessly along the highways of speech.

This very day, as you talk so easily from the warmth and comfort of your home, a lineman may be scaling a pole far out on a frozen mountainside—so that the service may go on. So that you may talk to almost anyone, anywhere, at any time.

Make someone happy these winter days through a voice visit by telephone. A boy or girl at school, a mother or father in another city, or a good friend away on a visit. To most places 175 miles away, for example, the rate for a station-to-station call is 95c in the daytime, 85c after 7 P. M., and 55c after 8:30 P. M.

BELL TELEPHONE SYSTEM



ATTRACTIVE MOUNT WILSON OBSERVATORY

THE 60-foot vertical or tower telescope at the Mount Wilson Observatory, amid its attractive surroundings. The trees are canyon oaks. An unusual photograph with excellent artistic composition, made by Mr. Malcolm K. Parkhurst of New York, from whom originals may be obtained for framing. The tower telescope is intended solely for use in connection with the sun. The solar rays are caught on a movable plane mirror at the top of the tower, are reflected to a fixed plane mirror nearby and pass through a 12-inch objective which focuses them on the slit of a spectrograph 60 feet below.

The "blister busters" often have to use toxic chemicals to destroy the germinating places of the highly active blister rust spores. Here a pack train is transporting 100-pound kegs of chemicals

BLISTER BUSTERS

By CHARLES LATHROP PACK

President of the American Tree Association

THERE is an enemy advancing on the forests of the United States. Not only is it threatening the three million acres of white pine in the inland empire of western Montana, northern Idaho, and eastern Washington, but vast acreage elsewhere. Whether or not this invader is successful means much to the carpenter in Maine, the builder in Kentucky, and the furniture manufacturer in Grand Rapids.

This invader is a modernist in methods of warfare. He disdains the weapons of yesterday and uses those of tomorrow. He employs that most vicious and subtle tool of death—germ warfare. Opposing his advance has been a small and valiant detachment of shock troops fighting against great odds. These have now been greatly reinforced, but the battle continues to rage. The enemy goes by the name of Blister Rust; the shock troops are the Federal blister rust control workers; the reinforcements are the young and numerous recruits from the Civilian Conservation Corps who are getting their first baptism of fire in the eternal war of Nature.

This is not a new conflict. Yet, despite stubborn defense by the professional soldiers in the field, the spring of 1933 found a discouraging condition. By the effective stratagem of infiltration the enemy was rapidly occupying new areas. Faced with this situation, the intelligence service of the conservation forces reported that nothing short of a major offensive would be effective. The standing force of trained troops was pitifully small, they declared, and their service of supply woefully inadequate. It was, indeed, a Marne in the conservation war. But reinforcements were forthcoming. New troops were rushed to the front and the battle is now going forward with good reason to hope for ultimate victory.

LEST we become too involved, perhaps we had best drop the military metaphor. At the same time, however, we re-emphasize the fact that the threat of the white pine blister rust concerns every American who uses wood, whether it be matches or matched timbers. Yet, unknown to the majority, the Division of Blister Rust Control of the United States Department of Agriculture has been fighting their battle. (There we go, getting military again!) The work has been done by insufficient numbers backed by inadequate funds. Much has been accomplished in the face of these handicaps. Now, men are available from the Civilian Conservation Corps and more money is set aside from the public works fund.

A word about the C. C. C. Many people have had and, perhaps, still have the idea that these three hundred thousand young men were enrolled, divided up into groups, and told to go out and plant trees. Conservation, however, is a large word. It means more than just putting loafing acres to work growing trees, important as that may be. It means the protection of existing trees from fire and disease. It means the cutting of fire lines and the building of roads and trails so that forest fire destruction may be reduced. It means the development of areas, such as National Forests and National Parks, that have been conserved for the use of all of the people. It even includes the improvement of certain large areas set aside as refuges for migratory birds. And, certainly, the preservation of immensely valuable and important forests of white pine comes under the head of conservation.

So, joined in the offensive against the enemy of the white pine are members of 208 of the conservation camps located in 22 states. By mid-August more than twelve thousand of the boys were battling. At that time their drive had accounted for more than twelve million currant and gooseberry bushes, which the scientists

Happy C. C. C. boys with a pile of pulled-up Ribes, representing 300 feet of live stem

call "Ribes," and they had turned 150,000 acres of pine lands into No-Ribes Land. Although charged merely with the task of organization, the Army men in charge of the camps have come to regard this work in the light of national defense. They have extended the most whole-hearted co-operation and this has been reflected in the spirit of the men working in the woods.

Commercial white pine forests at present occupy approximately twenty million acres in the United States, about half in the east and half in the west. The Federal Government owns one third of the total stand of seventy billion board feet of white pine saw timber, and the total value of all timber of this species is estimated at 420,000,000 dollars. An immense economic stake is involved. A definite campaign has been mapped out and the Conservation Corps boys have swung into line.

HERE is the way in which one of the boys, whose name, incidentally, is Forrest, writes home to the folks about what he is doing:

"Down in the jungle of swamp-willow and alder brush grow the gooseberry and currant, technically known as Ribes. Some are big and some are small. Almost all of them are full of thorns.

"From foreign shores has come the disease known as blister rust. It kills the white pines, which are rather valuable. The spores, or germs, develop on the Ribes and go from there to the pine. Which, as you see, completes its life cycle. So, if the Ribes are destroyed, the pine is saved.

"This germ can travel a distance of 900 feet and still do its work. Therefore the Ribes must be done away with within an area of 900 feet of the white pine stand.

"In the spring five of us were picked out, or picked on, by the technical man in charge and shown how it goes. This is it:

"The men line up, about five or six feet apart. Number one has a line to follow through the woods. A string or line of papers hung on the bushes extends from end to end of the area to be worked. The man on the opposite end of the line-up lays another line as he goes along, thus making it possible to cover every inch of the ground.

"When the mosquitos, May flies, June bugs, deer flies, and what-nots are busy, in a temperature of about a hundred, more or less, and swamp water is up to your knees, life is not always a bowl of cherries. Perhaps the sight of 20 more or less grown men following a string through the woods is laughable. At times I get the laugh on the laughers, however. I have been chosen foreman of the crew. If we lose a man through K. P. duty or illness or plain laziness, then one of the humorous ones is chosen and becomes a Blister Buster himself."

Which, after all, is a rather good though sketchy picture of what is being done by about seven thousand members of the C. C. C., boys from the sidewalks of the cities who are gaining health and experience in the outdoors. The manner in which the blister rust goes about its destructive activity merits, however, a somewhat more complete description than Forrest gives it.

THE interesting thing about this disease, and the key to its control, lies in the fact that it must use an intermediary or secondary host to complete its life cycle. The rust is a fungus. It appears first in the spring as a blister-like white sac on the bark of the white pine. These sacs burst open and give to the wind millions of tiny, seed-like bodies known as spores. They can travel long distances with the aid of a stiff breeze. When, in their voyaging, they light on the leaves of certain species of currant and gooseberry—lumped together as Ribes in control terminology—they are happy little spores. They stay right there and set about to germinate, infecting the leaves and, by early summer, forming orange-colored pustules on the under-leaf surfaces.

The rust knows no summer holiday, but spends that season spreading locally over leaf after leaf and bush after bush. It uses a different kind of spore for this ubiquitous activity. When fall comes along hair-like bodies appear on the rusted leaves. These bear spores and the wind again helps to carry these back to the pines. They make relatively short trips at this time but they get amazing results. They infect the pines only through the needles. From these fingertips of the tree the fungus sends its tiny microscopic threads back through the needle into the twig and thence to the branch or the bole of the tree. First evidence that the tree is stricken is an orange discloration on branch and bole. Then, in a year or so, the blisters form, let loose their spores and the life cycle goes on. The pine is doomed.

Within the bark a canker develops. This grows both vertically and horizontally. If it continues its horizontal path around the pine it is just as fatal as though its host had been girdled with an axe. Usually the canker takes the top of the tree, causing starvation of the rest or death through the attacks of secondary fungi. A more recent mode of rust killing has been found in the west. In these cases, the full significance of which is not yet known, the rust has not reached the trunk but has infected so many twigs as to remove all foliage and rapidly kill the tree.

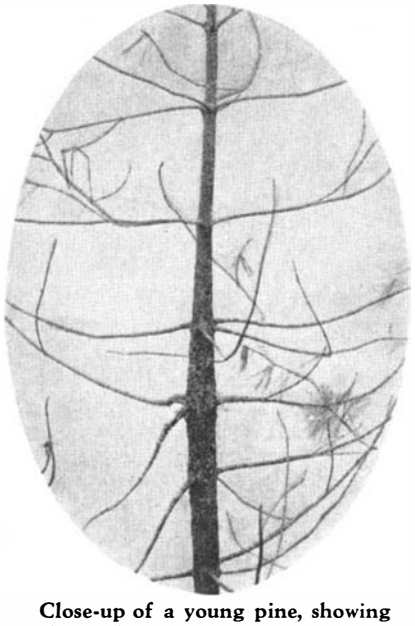
A young white pine that has been killed by insidious blister rust

Since only Ribes bushes can nurture and spread the fungus, the method of control is obvious. It's out damned Ribes and spare none. These pestiferous Ribes, of which there are 62 different kinds growing wild in the woods, effect various methods and locales of growth and have to be attacked in different ways. A whole battle plan has been worked out based on exhaustive research and study of their habits. The sticky currant, for example, likes wooded slopes back from streams and has a way of springing up in burned over areas. The white-stemmed gooseberry and the wild black currant inhabit moist and swampy spots. The prickly currant is abundant in stream

bottoms, although often found also on wooded slopes.

Control of the blister rust is not a year-around job. It must be done during the few months of the year when currant and gooseberry bushes are in leaf. Frost or severe drought causes the leaves to fall in mid-season and retards the work. Eradication also calls for work of high quality, thus demanding specialized and highly-trained supervision to a degree greater than almost any other forest management operation for which common labor is employed.

Study has shown that the white-stemmed gooseberry and the wild black currant are Public Enemies One and Two in the western white pine region. They are the most eager hosts to the spores. Since they grow in profusion along stream banks they are called "stream type Ribes," and assault upon them comes first on the control list. They concentrate so thickly, however, often partly under water, that pulling them up by hand was found next to impossible. A solution of water and sodium chlorate—and, later, the less hazardous calcium chlorate—was tried on the wild black currant. It died under



Close-up of a young pine, showing the girdling growth of rust canker

this treatment, and wild black currants have been getting generous baths of it ever since. The white-stemmed gooseberry proved to be less easily killed by this chemical but its destruction is being effectively accomplished by improved chemical sprays supplemented by hand pulling where necessary. In California sugar pine forests these bushes have been effectively cleared out where most numerous by spraying Diesel engine oil on them.

Once an area has been surveyed and the chemical needs estimated, areas are laid off as described earlier by our friend Forrest. Usually spraying equipment carried on the back like a knapsack is used. In places where it is practicable, "bulldozers"—trail-building tractors with toothed instead of solid blades—are sent snorting about tearing up the offending bushes by the roots and piling them up to dry. These are later burned and the region sowed to grass. The Ribes seedlings have a hard time establishing themselves in sod. Thus, worthless brush land is converted into valuable pasturage and the Ribes are no more. Experimental work to increase effectiveness of control work and to cut its costs is continually being conducted along with the task of eradication.

Studies of the upland species of Ribes found them somewhat temperamental. They react to different conditions of light and moisture, and are exacting as to conditions under which the seeds germinate and the seedlings survive. The seeds have a faculty of lying dormant in the duff of the forest until conditions suit them and then appearing in great numbers. With such knowledge, control of their activities has been materially aided and workers know what to look for.

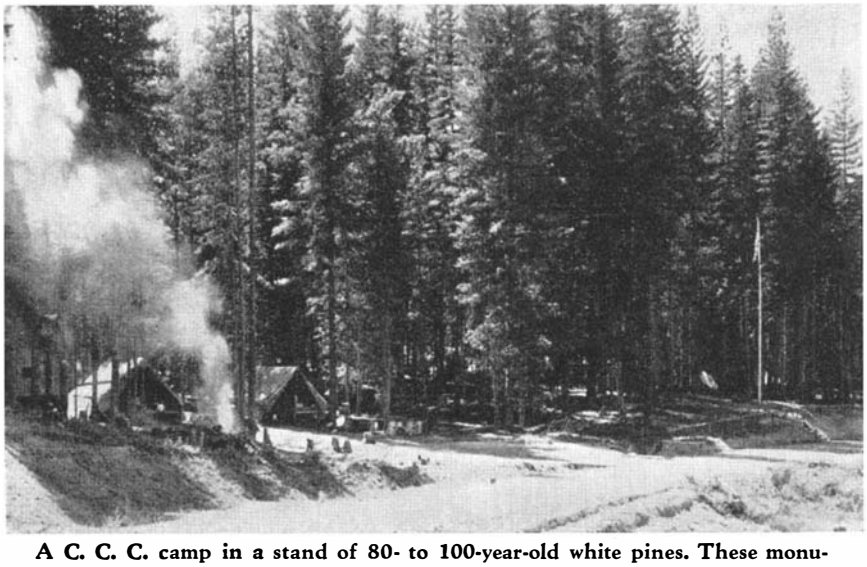
An immigrant from Europe, the white pine disease first made its appearance in eastern white pine forests about 30 years ago. Its devastation has been considerable, but the wide extent over which control has already been applied in the east assures continuation of these forests.

THE blister rust was introduced into western North America in 1910 on a shipment of small pines from France. Since then it has spread east and southeast from Vancouver, B. C., to the southern end of the Idaho white pine belt, 400 miles away, and to Port Orford, Oregon, 450 miles south.

The emergency due to the rust is greatest in Idaho where white pine lumber forms a large part of the economic foundation of the region. Western white pine, also, has been found highly susceptible to the rust, and the largest trees will be killed rapidly in areas which are not protected by 1936. Worse, the magnificent sugar pine of California is even more susceptible to blister rust attacks than is the western white pine. However, the rust is not yet known to be in California, where millions of acres of sugar pines would be affected. As a preventive measure, five hundred Conservation Corps men are eradicating Ribes at strategic California points before it is too late. The notable sugar pine forests of Yosemite National Park are included in the California protection program.

In drawing upon the C. C. C. for the much-needed reinforcements, it was first necessary to train leaders. Men were chosen at various camps and put through a course of intensive training. They learned how to track the festive Ribes to its lair and to know what it looked like in its various forms. They practiced methods of crew organization and took an elementary course in the technical phases of the job. They were then equipped to serve as superintendents, foremen, or checkers under the technically-trained men from the Division of Blister Rust Control and the Forest Service.

BY last fall, protective work had been completed on more than 100,000 acres in the west alone. Results of past work conducted on a smaller scale by the workers of the Blister Rust Control Division provide a rule by which the immense value of this additional manpower may be measured. With additional funds now available from the public works fund, and with the prospect of continued C. C. C. help, the Division of Blister Rust Control is looking hopefully into the future.



A C. C. C. camp in a stand of 80- to 100-year-old white pines. These monumental trees ever impress the camp personnel with the importance of their work

TEST FOR TELEPATHY

Brought Forth Little Data Which Could Not Be Ascribed to the Operation of Chance

THE rules for conduct of SCIENTIFIC AMERICAN'S second test for telepathy were published in our June, 1933, issue. The collected results received from our readers have been carefully studied and a complete report made by Dr. Walter Franklin Prince. Since no startling evidences for telepathy were revealed, we record here only some of the difficulties of the test and a few of the results obtained.

It is self evident that any conclusive series of tests for telepathy must be conducted in rigid conformity to a carefully prepared set of rules. In answer to the question of how far the experimenters followed the directions laid down, Dr. Prince notes the following: One couple did not send in the percipient's papers, but the agent copied them in his own handwriting. In another case, where several groups of test sheets were sent in, some of the original papers of the percipient were returned, but the greater part of the records omit all the original sheets and were simply copied in typewriting.

So much for such deviations from the necessary mechanical requirements of the test; those noted are typical of many others that were made. More important was the direction that the agent should select "the name of some simple and familiar object which he can readily visualize." Many of the agents observed this rule, but others selected such words as "pain," "music," "free love," "wind," and so on. It is obvious that, in a test of this kind, results cannot be expected if the agent cannot vividly visualize the object to be "transmitted."

We now come to the actual analyses of the various lists of words. Space will not permit a full report, and we will therefore omit those which may be listed as total failures. As in our first telepathy test (for results of this see July, 1933, issue) we received a perfect (?) result from the man who claims: "I was born with telepathy . . . these things are easy for me and I know that there is no one else in the world who can do it." From the nature of the report, it can be dismissed as being the work of a paranoiac or, at least, a hopeless crank.

ONE group of 30 experiments—10 between the correspondent and his wife, 10 between the wife and, presumably, her son, and 10 between the correspondent and another lady appear, upon first examination, to hold some promise. But ruthless analysis must be applied. In spite of directions to the contrary, 17 and possibly 21 of the 30 objects named by the agent were probably either visible or audible at the time of the test. The word "tree," third in each list, may have been suggested to the agent by glancing out of the window and to the percipient by following the glance. "Automobile" is number 8 on agent's list and 7 on the percipient's; the latter may have first glanced at a car through the window, unconsciously suggesting to the agent the selection of that word for his next number. In concluding his analysis of this group of tests, Dr. Prince says: "There may be some grain of telepathy in this series but it furnishes not a grain of proof."

In another set, the agent attempted his own analysis and called attention to the fact that similar words appeared in the agent's list for one test and in the percipient's for a later one. This can hardly be held to be evidence, as we cannot go back of the record. If we could, we would allow chance to play such a part as to vitiate all results.

THE following comment is quoted from Dr. Prince's analysis of another set of 50 experiments: "Agent's number 7 and percipient's 8 are, respectively, 'bicycle' and 'motorcycle.' We are accustomed to look with leniency upon a correspondence which occurs on the part of the percipient one number after the agent's. Even a correspondence two numbers later might be deferred telepathy, although the weight of such an instance is comparatively small. A's 34 ('steamboat rainbow') is a little ambiguous but probably he had in mind a steamboat named *Rainbow*. P's 34 was 'sailboat.' A's 40 is 'pistol' and P's 40 'cannon,' which makes one think a bit.

"The correspondences 'bicycle' and 'motorcycle,' 'steamboat' and 'sailboat,' 'pistol' and 'cannon' are statistically, as proved by experiments in guessing, really much beyond expectation. There is not enough in this series to demonstrate telepathy—nothing like what the Sinclairs would get in a series of only 10 to 14 objects—yet the results are sufficient to make it worth while for these subjects, exercising every possible care as to conditions, to experiment further."

There are other tests in our files which show rather far-fetched apparent coincidences, but the above suffice as representative of them all. When the bright light of impartial analysis is applied, and every conceivable loophole is closed to the operation of something other than telepathy, they all reduce to the same level, and the final verdict to be given in our tests must read "Not Proved."

WITH this issue *Scientific American* brings to a close its active participation in research for telepathy. When we started our telepathy tests early in 1933, we consulted several of the best minds in psychology regarding the then proposed procedure. There was a general agreement that any series of tests which would add to the data regarding telepathy would be of value for further study. Since, in scientific research, any avenue which offers a possibility of results is worth following, we have devoted considerable time and space to the subject of telepathy. The report of our first test (July, 1933) showed a slight tendency toward the operation of something other than chance; results of our second test appear on this page. It now appears that further tests, to be of the greatest value, must be conducted under controlled laboratory conditions.

We wish to thank those of our readers who have been good enough to take part in our tests, and also those who have offered suggestions for further investigations. Those who have written to us regarding apparent telepathic experiences have also done a great service to science, and their recorded statements will be of great value to psychology. These records will be kept in absolute confidence, and no names will be divulged in print without permission.

—The Editor.

OUR POINT OF VIEW

The Mail Goes Through

DURING a recent spell of bad weather, two airmail planes crashed in the wildest part of the Allegheny Mountains in Pennsylvania. All scheduled passenger air-transports had been grounded by flying conditions but, true to the traditions of the service, the mail went through. Both pilots of the doomed planes were in constant radio communication with Newark Airport up to the minute when they decided that the coating of ice and snow gathering on the wings would make further progress impossible. "I'm falling 500 feet a minute," radioed one of the pilots. "Guess I'll go over the side. So long."

Parachutes saved the lives of the airmen, Harold Gay Andrews and Dean Burford, both veterans of the service, but their planes crashed in the snow-covered mountains. Through the storm they struggled to their planes, extricated the registered mail pouches, and made their respective ways to the nearest villages.

Thus, briefly, is written a short chapter of the history of aviation and the airmail. A useless waste of planes? A risk of human lives that was unwarranted? We think not. The tradition of the mail is one on which rests a large part of the economic structure of this country. It must be preserved at almost any cost. The fact that these two pilots came through with their lives and that they reclaimed the mail points to several things. First, they knew their ships and their business and were equipped with efficient parachutes. Secondly, they were in constant communication with the airport so that in case of trouble, rescue parties could be dispatched immediately. Thirdly, there was no fire to destroy the mails, due to the presence of mind of the pilots in shutting off the ignition before bailing out.

The airmail in the United States has a record of which we may well be proud. It cannot fail to grow when the ships are in the hands of such pilots as Andrews and Burford.

Streamlined Motor Cars

WRITING of motor car design in general, and streamlining in particular, a correspondent to the *New York Herald Tribune* makes the following remark: "Streamlining, of course, in automobile design is the bunk. No motor should be driven fast enough to have wind resistance make any appreciable difference." Since this appears to be a more or less general impression, we hasten to correct it. The essential reason for streamline design is not to obtain more speed, but to achieve practical speeds with a minimum of horsepower and hence a minimum of gasoline consumption. Above 30 miles per hour, wind resistence is an increasingly important factor in power consumption. Since the average motor car speed today, as pointed out in the article starting on page 76 of this issue, is in excess of 40 miles per hour, it will be seen that streamlining can and will have a direct and important effect on the motorist's pocketbook.

We hope that automobile manufacturers will take to heart the teachings of the science of aerodynamics, and that soon there will be available cars in which the gasoline we have to pay for will be used to get us over the ground at a reasonable speed without sacrificing a large proportion of the power developed to overcoming wind resistence.

Absent-Minded Professors

POPULARLY a scientist is supposed to be a tall, gaunt figure clad in a long white smock. He wears whiskers, a pair of Oxford glasses on a black ribbon, and he spends his life gazing at the contents of a test tube. His surroundings seem to consist of a microscope—if more surroundings are needed, two microscopes.

Go to any gathering of scientific men, whether physicists or chemists, biologists or anthropologists, and take a census of whiskers, Oxford glasses, and other scenic effects. Today not two men of science in a hundred sport the traditional hirsute adornment, while the scientific man who dared appear in the stilted Oxford glasses and ribbon of the traditional concept would be an object of amusement among his colleagues.

Your man of science is today a plain unaffected fellow, dressed about as you are. He speaks about as you do and he is as human as you are. He enjoys a good time as well as you do and he isn't above raising Cain a little now and then for the good of his soul. In short, he is just a plain average man.

Gone, too, is the typical absent-minded professor of the comic cartoon—at least professors are not more absent in mind than most of us, and aren't we all absent-minded at times? One of the most absent-minded men was Painlevé, a noted mathematician. It is said that he would take a taxi home when his own car was waiting for him. When the taxi driver asked for his address he often gave his telephone number. Once, expecting a friend, he pinned a note on his own door: "Painlevé will return in 15 minutes." On returning he saw his own note and sat down on the step and waited for himself. But Painlevé was also a politician—thrice premier of France. Perhaps he was absent-minded as a mathematician and present-minded as a politician—if not the reverse.

Scientists, after all, are "just folks." It is time the traditional concept of them should be chloroformed.

A Magnificent Flight

KINGS and queens, prime ministers, and presidents have rendered homage once more to aviation's "Royal Family," Colonel and Mrs. Lindbergh, on their remarkable air jaunt across the North Atlantic; back and forth across Europe, the British Isles, and Africa; and across the South Atlantic to Brazil. As this is being written they have landed in Florida on their way from South America for Christmas at home.

In flying as they have, to all outward appearances casually and as whim led them—like carefree adventurers—they have shown again, in true Lindbergh fashion, that the airplane, in competent hands, is as safe as the automobile. Leaving the United States July 9, they explored the North Atlantic as it never before has been explored. Extraordinarily dangerous flights, such as crossing the Greenland ice cap twice, were taken as all in the day's work; and the crossing of the South Atlantic with hardly more fanfare than obtained when the Colonel took off from New York for Paris one spring day in 1927.

The record of this flight is perhaps the greatest testimonial to aviation ever written—to American aviation. We extend to the Colonel and his expert assistant, Anne, our sincere congratulations. We have, however, one friendly suggestion to make:

Colonel Lindbergh is the symbol of American aviation; he is the personification of its progress and its triumphs. We hope, therefore, that on completion of the present trip, he will be content to leave more of the future pioneering to others, will himself live less dangerously, at the same time giving of his wide knowledge to the furtherance of aviation.

A Doctor Looks at Smoke and Dust

By W. W. McFARLAND, M. D.
Director of the Department of Public Health, City of Pittsburgh, Pennsylvania

THIRTY years ago an Allegheny County judge, sitting in Pittsburgh and ruling on the application of a litigant for relief from ore dust, declared that if the people could not stand the consequences incident to a manufacturing district they could move out of town. He very probably was sincere in believing at that time that nothing could be done in the way of curbing air pollution.

It is a matter of record, however, that eight years later Mellon Institute of Industrial Research was launched upon the nation's first comprehensive survey of municipal atmospheric contamination, and that, on the basis of facts uncovered in its 1911 to 1913 surveys, something did begin to happen about smoke and dust in Pittsburgh, and things have been happening ever since.

People did not have to move to get relief. Under the program of gradual improvement adopted by the city, the air of Pittsburgh slowly but steadily has progressed toward a condition of hygienic purity. That program will continue to be pressed until the city's atmosphere has been restored to as near its pristine state as is practically attainable. It has yet a considerable distance to go, but it is on its way and will not be turned aside.

This brief historical statement is given as a means of assisting an intelligent understanding of Mellon Institute's latest contribution in the struggle which all cities must continue to carry on against the pollution of their air supply.

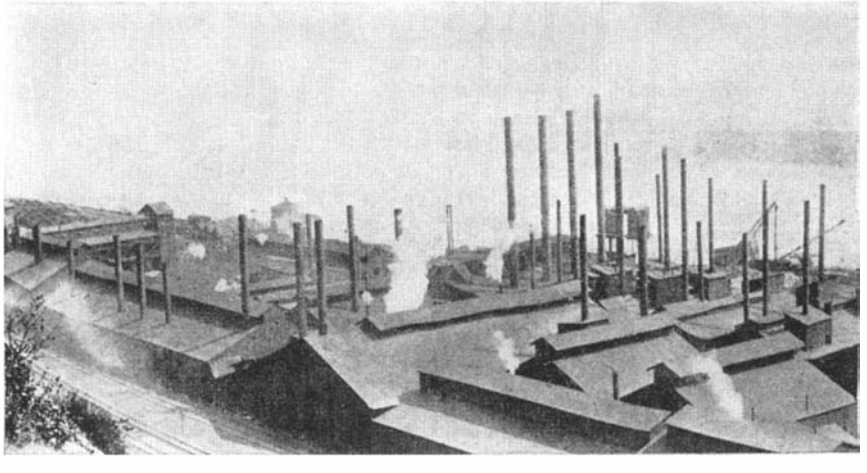
Under the supervision of H. B. Meller, the head of its Air Pollution Investigation, Mellon Institute has prepared a practical "Modern Plan for Community Campaign Against Air Pollution." Initial suggestion that such a plan be drawn up came from the College of Physicians in Philadelphia. A program of action is being developed there by a special committee appointed by the College. A lengthy abstract of the plan, as published in the *American Journal of the Medical Sciences*, is being widely studied and favorably commented on by physicians. Meantime, the New York Academy of Medicine's committee on Public Health Relations has scheduled a session where the plan will be discussed by its author, with special reference to application in the New York area.

MELLON INSTITUTE'S election to present its pure air campaign plans to medical societies is consistent with its handling of the problem from the very start of its investigation. It is a matter of record that campaigns against smoke and dust get satisfactory results only in cities where physicians take a leading hand. There is also the oft-repeated Institute declaration that since pure air is primarily a medical consideration, the necessity for medical leadership cannot safely be disregarded.

Along with the promulgation of the modern campaign plan, the Institute has expressed the opinion that an unusual opportunity exists to make progress in the restoration of hygienically pure air to the cities, and it urges medical societies to assert their leadership. It is pointed out that the scientific research workers, engineers, and others who would be entrusted with the execution of a municipal program want to know what substances, now present in city air, must come out to make that air conform to the necessities of human comfort and health. They wish to have the physicians set the limit for smokelessness and dustlessness.

For the benefit of the layman who might be constrained to think the physicians have been unduly hesitant or dilatory in asserting their leadership in this important matter, it should be explained that only recently have leading combustion engineers and other related specialists fully demonstrated their ability to fill a prescription for the smokeless and dustless operation of small as well as large fuel-burning plants, to be done practically and at reasonable cost. In these demonstrations, of course, they are employing appliances, processed fuels, and firing methods brought to perfection in the last few years. Under these altered circumstances, it can now be said with assurance that, if the physicians will write a prescription setting up reasonable standards of dustlessness and smokelessness, the engineers can fill it without committing fuel consumers to costly, experimental ventures. Always heretofore there has been the objection from some quarters that while pure air

Air hygiene studies are carried on in laboratories on a comprehensive scale



A steel plant in operation. The principal fuel is bituminous coal that is being properly used in the furnaces

is a city asset of fundamental value, its attainment could not be secured save at undue expense. Thanks to the efforts of inventors, research workers, manufacturers, and progressive fuel producers, that objection no longer holds good. Eighty percent of the solid particles now emitted by stacks where solid fuel or refuse is burned can be kept out of the air by tested appliances and processes that are not burdensomely expensive. In many cases, a large percentage of the cost would be returned as direct savings.

IN this connection, the engineers point out other interesting facts. The percentage of inefficient heating and power plants has increased greatly, due to slow rate of replacement during the depression period and to the fact that advantage to the full extent has not been taken of improvements in equipment and fuels developed by science. Given favorable credit conditions and expanding volume of business, heat and power makers may wish to move quickly to the purchase and installation of modern, economical equipment and harmonious fuels. A development of this sort should be anticipated. Where standards of smokelessness and dustlessness are to be set up by municipalities, early action to that effect is desirable. This would give fuel users advance notice and let them take advantage of the fact that the installation of equipment designed to control smoke and dust costs least when put in as a part of a general alteration or replacement job.

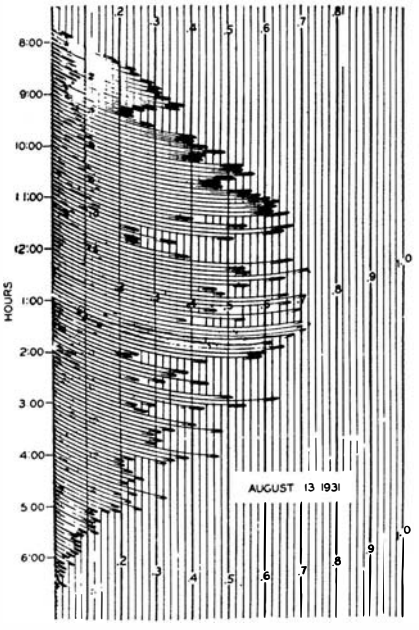
These are some of the considerations underlying the assertion that physicians, public health workers, and others interested in restoring pure air to cities are confronted with the opportunity of a generation for scoring substantial gains.

As a physician and health department executive, my primary concern with air pollution has to do with its medical aspects. There can hardly be any disagreement with Meller's statement as given in the preface to his plan: "Pure air is primarily a medical consideration and its maintenance is a municipal health department responsibility, just as are pure food and pure water."

IT has been reported that certain derivatives of tar will, through repeated irritation, cause cancer of the skin. These derivatives are among the constituents of soft coal and oil smoke, and may also enter the air from other industrial sources. Dr. Jerome Meyers, of the New York Department of Health, made a very interesting partial survey in this field a few years ago, in which he called attention to the apparent parallelism of high smoke content of the air and incidence of cancer. This study should be resumed in the light of most recent information and the improvement in the gathering and compiling of cancer statistics in New York City.

Other reported experiences and investigations include other harm done to health by dust, gases, or unburned (atomized) oil coming from stacks, and various metallic oxides and chemical substances thrown off by domestic and commercial incinerators and industrial plants.

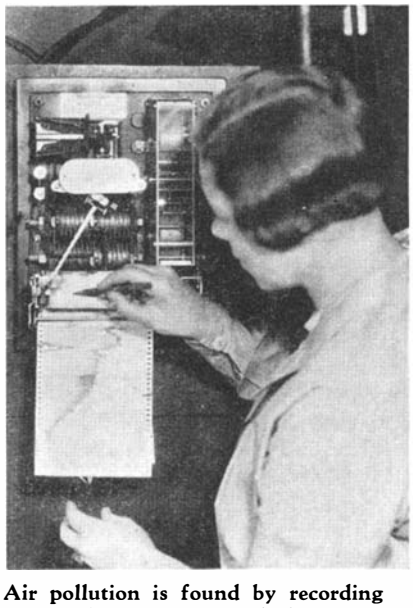
Space does not permit a detailed account of the physiological effects of the various contaminants usually found in city air. A general observation will suffice: It is easier for the average man to keep up his bodily resistance to disease and to maintain vigor when he is making direct contact with strong sunshine and is breathing air of little dust content. Under such conditions the health hazards are fewest. Actually,



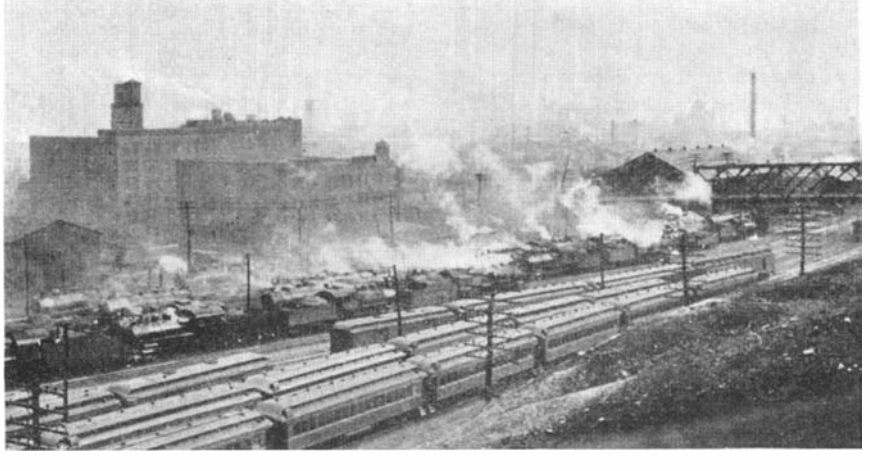
Graph showing effect of clouds and smoke in blocking ultra-violet

man can exist wholly without sunlight and can endure considerable concentrations of some kinds of dusts. But the broad interests of medical science do not lie in the direction of encouraging such difficulties or of increasing the complications and artificialities of city life. Since it is easier, cheaper, and safer to live in intimate contact with unfiltered sunshine and air free of harmful pollutants, preventive medicine is properly concerned with a movement toward restoration of natural conditions. Preventable smoke and dust clouds that obstruct solar radiation and fill the nose, throat and lungs with irritants are perilous.

Over and beyond the physiological effects of atmospheric contamination are psychological aspects to which investigators have called attention. There is also an economic angle. All these are touched on in Mellon Institute's plan and will be studied by inventors, chemists, physicists, and others who must have a hand in filling any pure air prescription the physicians write.



Air pollution is found by recording ultra-violet rays received from sun



Smokeless firing of locomotives. Engines in the Pennsylvania yards in Pittsburgh ready for rail service

THE REVISED FOOD AND DRUGS BILL— WHAT IT MEANS TO YOU

By T. SWANN HARDING

IN the days of the Restoration there lived in London a "Gentlewoman." She abode at "the Surgeon's Sign, just at the corner of Coventry-Court in the Haymarket, near Pickadilly," and she issued a Bill (or advertisement) in which she first praised God for making woman beautiful, and then offered to all and sundry "a highly approved 'Balsamick Essence,' with several other Incomparable Cosmeticks, *faithfully prepared without Mercury*" (*n.b.*) to keep her so in case she backslid from pulchritude. This Essence would remove all freckles, wrinkles, tan, sunburn, yellowness, and "morphew" in 30 days, and render "the skin plump, soft, fair, bright, smooth and of a lovely colour."

That just about covers the possibilities of a complete cosmetic and it is interesting to observe that they had not one, but many, way back there when Pepys kept his sly diary and Cromwell had not long been in his grave. It is even more interesting to know that at least one "Gentlewoman" cosmetician was so scrupulous about her wares that she scorned the use of the violent poison, mercury, in their preparation. It is therefore somewhat humiliating to reflect that within the past five years (and even today) American ladies have used and been poisoned by cosmetic preparations containing not only mercury, but lead, arsenic, thallium acetate (the rodent exterminator), and toxic organic compounds with astonishing names that would only confuse us if mentioned here.

IN the London of Restoration times it was known that mercury was a dangerous substance to put in cosmetics. Today the market of America is replete with hair tonics, ointments, freckle removers, beauty lotions, whitening creams, and other beautifiers containing this metal. The prolonged use of such cosmetics may cause severe skin irritation or even systematic poisoning, because the skin so readily absorbs mercury. The kidneys may be damaged irreparably, the teeth ulcerated, and the jaw bones may decay. Even death can ultimately result, for many individuals are highly susceptible to mercury poisoning. Arsenic occurs in many hair tonics and dandruff remedies. Lead appears in hair dyes and tonics and in scalp lotions. Thallium acetate was the active ingredient of a cream advertised to remove excess hair harmlessly, but which sent numerous ladies to hospitals, they having lost every hair on their bodies and been desperately ill besides. A dye to lend lure to eyelashes has produced many cases of severe dermatosis and, in several instances, has permanently impaired the vision of the users.

It is natural to ask: "How can such things be? Don't we have a Food and Drugs Law? Why don't the rascals down in Washington enforce it, protect the ladies from these poisonous cosmetics,

Testing digitalis in U. S. Food and Drug Administration Laboratory

render their kissproof lipsticks actually kissproof, and keep women, as one Middle Age quack described them, 'The Admirablest Creatures that ever God created under the Canopy of Heaven?' If mercurial cosmetic preparations were known to be dangerous in the 16th or 17th Century, what possible excuse can there be for their sale in America in the 20th Century? What is the matter with those impotent dodoes who make out they are enforcing the law?"

At this point it is well to read the present Food and Drugs Act. That act defines a drug as an agent used in the treatment of disease. Freckles, excess hair, wrinkles, enlarged pores, falling hair, obesity, and dandruff are not diseases; they may be blemishes or botherations, but they no more classify as diseases than do irregularly architectured noses and shortness of stature. Hence cosmetics are not drugs, unless they make some specific claim to cure disease on their labels—which, generally speaking, they never do. Cosmetics are surely not foods. Gadgets to straighten noses are not drugs, and neither are mechanical chiropractors intended to stretch the short men to great height so that they may avoid the failures and humiliations those of small stature (like Napoleon) undergo.

THEREFORE the present Food and Drugs Act does not cover cosmetics. It does not cover therapeutic gadgets and contraptions, some of them selling for 10 dollars and costing 75 cents to make, and all of them as astonishingly magical in their claimed powers as the miraculous necklace some firm got out to cure goiter. The present law does not cover advertising, other than statements which appear on the labels of food and drug products or those made in booklets or folders that form an integral part of the package as sold. For that reason a common remedy advertised widely as good for all ills to which womanly flesh is heir, and really an innocuous mixture of useless herb extracts, bears on its label the mere statement that it is "Recommended as a vegetable tonic in conditions for which this preparation is adapted," meaning nothing at all and being true to fact!

In consequence of these deficiencies which have made Dr. Harvey W. Wiley's Food and Drugs Act obsolete, a revision of that act has been prepared to supersede the old statute. It was written by legal and scientific experts in the Department of Agriculture, gained the blessing of the Administration, and was introduced in the Senate by Senator Copeland in June 1933 as S. 1944. That bill does specifically cover cosmetics. It covers gadgets and contrivances. It covers advertising, applying the same standard of accuracy to it that the present law applies to food and drug labels. It sets up food standards and it establishes minimum tolerances for the poison content of foods.

What will be the status of a cosmetic under that bill? Just two or three years ago a remedy for superfluous hair, in

the form of a cream, was advertised to ladies. They were to apply it freely, as they would a cold cream. It was said not only to be harmless but to be beneficial to the skin. Yet it contained 7 percent of the deadly poison thallium acetate, whereas the leading dermatologists in the world used never more than a 1 percent thallium acetate cream in their work, and this was applied with the utmost caution. Many skin experts would not prescribe the use of such creams at all. The revised Food and Drugs Bill will declare that a cosmetic (also a household remedy or proprietary medicine) must be harmless to the consumer when used as directed on the label. Secondly, it will say that no false or misleading statements can be made about any cosmetic, food, or drug product in magazine, newspaper, bill board, handbill, radio, or other advertising.

After all, no one knows better than the scrupulous manufacturer of cosmetics that unwarranted claims have injured this business severely. For that reason the cosmetic industry, except for its underworld elements, is behind the bill. Cosmetics cannot feed the skin, reduce flesh, eliminate wrinkles, remove enlarged pores, or perform magic. The true foundation of beauty is health, which depends largely on proper food, sleep, and exercise. Cosmetics have a legitimate function in enhancing natural beauty, but they do not need to contain poisons in order to perform that function. Claims for special merit due to incorporating turtle oil, strawberry juice, hormones, vitamins, buttermilk, milkweed, cucumber extract, lemon or other rare, precious, difficultly obtained, or mystical ingredients are not justifiable, while wrinkle and muscle oils, in beautiful bottles, with attractive labels, selling for one dollar an ounce, often contain only castor oil and a little color and perfume!

THE better makers of cosmetics know these things. They have in some cases been forced, or at least have felt compelled, to make unwarranted claims for their products because of the manifestly unfair competition of gentlemen of the cosmetic underworld who made the business a racket, and whose activities will be curbed by the revised Food and Drugs Act. It is for this reason that the industry as a whole backs the bill. True, there are occasional excited protests, like that of the half-hysterical speaker who recently declared that the new bill compelled cosmetic manufacturers to put vitamins in lipsticks. He had half heard a talk on the bill and had later scrambled allusions to nutrition with statements about cosmetics. The bill actually combines increased consumer with increased producer protection, the former being protected from poison and the latter from unscrupulous and unfair competitors.

Koremlu was only one of a number of hair removers which contained thallium acetate and caused very serious trouble

Turning to drugs: Just what reason is there that Glauber's salts, the purgative usually given to horses, should be exploited under a trade name as a remedy for kidney trouble, rheumatism, indigestion, high blood pressure, arthritis, faulty elimination, acidosis, and all the ills of increasing age? What further reason is there that the public should purchase a pound package of these magic salts for $1.50 when they can go to the drug store and get Glauber's salts for 40 cents a pound or, better still for humans, Epsom salts at 9 cents? There just is no sense to that.

Why should unfortunate sufferers from diabetes be permitted to waste their substance to the extent of 12 dollars a pint bottle for an extracted concoction of a common weed, horsetail, that grows along railroad tracks, which, in spite of its jocular name, is known to scientists as containing no medicinally active ingredients? Why should the victims of tuberculosis of the lungs be additionally victimized by a heartless corporation which recommends to them as a cure for their ailment a common horse liniment composed of well known and quite ordinary ingredients? Why should the obese be persuaded to buy a fat reducer guaranteed to be harmless but which contains actively dangerous thyroid substance as well as portions of a certain seaweed long used in Ireland to fatten hogs?

Under the present law these are all remedies for disease, except the anti-fat preparation—for excess fat is not legally a disease; it is simply a social handicap. The labels of these preparations are blameless. Not one label makes extravagant claims. But their general advertising is quite another thing, especially over the radio. In other instances a properly labeled box of Epsom salts may be shipped in interstate commerce quite legally labeled, but when it arrives at the druggist's it is placed in a holder, shipped separately, on which there are printed curative claims from anemia to zoomorphism and from cancer to club-foot. There is no scientific justification for that. It is not ethical business. Why tolerate it? What reputable manufacturer would want it tolerated?

IT is true that some reputable manufacturers appear to be opposed to the Copeland Bill. This is not to be wondered at when one considers the fairy tales they have been told about it by those to whose interest it is to have the bill defeated. They have been told seriously that the bill is designed absolutely to prohibit self-medication. This is absurd on its face. As long ago as 1913 the *Journal of the American Medical Association* itself affirmed the right of laymen to treat themselves with home remedies for minor ailments, and Dr. Arthur J. Cramp of that Association reaffirmed this in a magazine article in 1933. You cannot stop people from trying to treat their own ailments, but you can go far towards making that self-treatment foolproof.

Anyone who reads the Copeland Bill will find that it goes into great detail about the labels for proprietary remedies. These labels must be fully informative. They must state that the remedy is a palliative and not a cure, when it is not a cure. They must carry warning statements about hypnotics and habit-forming agents. They must list all dangerous drugs. The manufacturers of proprietary remedies must not advertise them for the treatment of a long list of diseases for which science knows that it is dangerous to have laymen treat themselves. No false or misleading curative claims can be made on labels. It is quite obvious that all this discus-

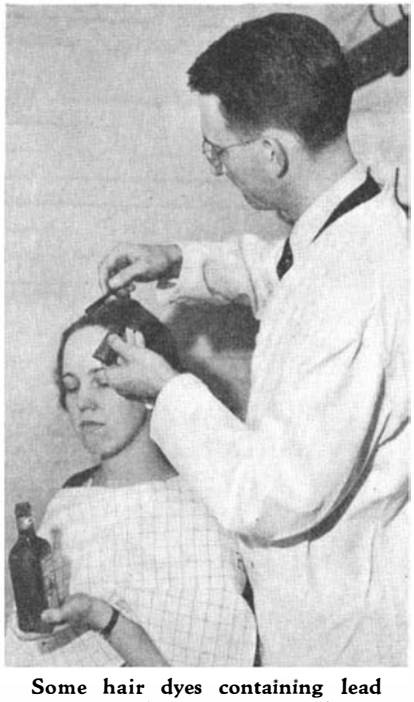
sion is in the bill not because doctors need such information about proprietary remedies.

The whole bill is predicated upon a continuation of self-medication but it tries to make self-medication foolproof by giving the ordinary lay consumer the same information about the remedy that a doctor would have. If science knows that saline laxatives are not remedies for the diseases of old age, that horsetail is not a remedy for diabetes or a common liniment for tuberculosis, and if a mixture containing thyroid or thallium acetate is not "safe and harmless" to use for obesity or excess hair, why should not the layman have the benefit of that scientific information? The Copeland Bill will, if passed, merely make the fruits of scientific knowledge so accessible that laymen can use them almost automatically.

TODAY the horsetail diabetes remedy is freely sold because the Government, in bringing its case, could not prove that the therapeutic claims made on the label were "false and fraudulent." There was no shadow of doubt but what the claims were false. That was proved. Horsetail was not a remedy for diabetes. But fraud could not be proved because it could not be shown that the manufacturer knew he lied when he affixed such labels to his product. Under the Copeland Bill it will not be necessary to prove intent to defraud in such instances. The mere fact that a curative claim is false and misleading will be sufficient and, in the name of scientific research and the boons it has given us, why should that not be sufficient?

In the matter of foods the Copeland Bill will establish standards. Today there are no legal food standards except for butter and a few canned products, the latter having been enacted at the demand of the canning industry itself. Tomato paste may contain 12 or 22 percent solids; "maple flavored" sirup may contain less than 2 percent maple sirup, only a trace of ordinary sugar, and about 98 percent corn sugar; jam may contain 22 in lieu of 45 percent of fresh fruit, and the same holds for preserves; oysters may be soaked till they contain an inordinate quantity of water, and ice cream whipped until it is little more than well threshed atmosphere. These practices cannot be stopped today because we have no legal food standards.

The Copeland Bill will remedy that by establishing standards for foods. It will go far toward protecting public health by demanding that health foods really be health foods, or else quit claiming that they are, and also by establishing poison tolerances. Under the present law the Government must, each time it prosecutes, bring expert testimony to show that some specific lot of food may be injurious to health because it contains an added (not a naturally occurring) poisonous or other deleterious ingredient. Under the Copeland Bill the minimum (harmless) tolerances of various poisons in foods will be established by taking a poll of poison experts of the country, and violation of that standard will be illegal *per se*. In some cases, of course, the presence of poison will be totally prohibited; there will be no tolerance. In



Some hair dyes containing lead have caused users intense suffering

other cases, if it becomes necessary in order to protect the public health, the Government can force certain industries to operate under a license and permit system.

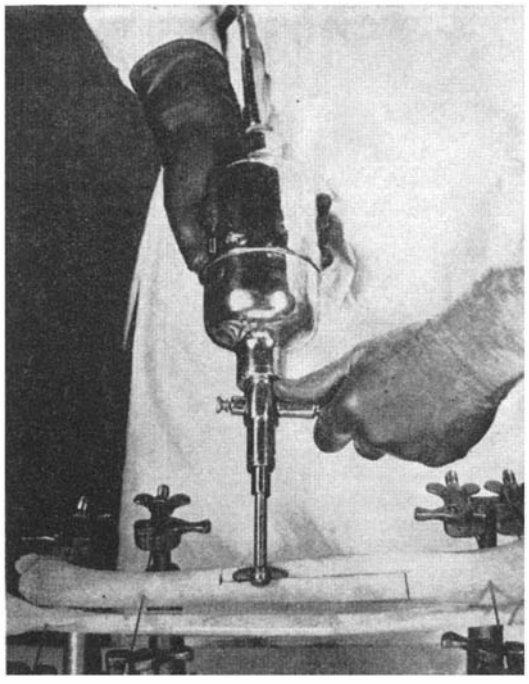
"But this is autocracy. It gives the Secretary of Agriculture and certain bureaucratic underlings absolutely dictatorial powers!" Your exclamation has been made before. It has actually been said that under the bill the food, drug, and cosmetic industries would have no recourse at all to the courts in questioning the decisions of Department officials, and that the word of such officials "becomes the law of the land." This is ludicrously absurd. Any such bill would be unconstitutional forthwith. Court review will occur if the bill is passed, just as it does now, for the interpretation of our laws is made by the courts, not by Government officials or even by scientists. In many cases the bill would merely enact into law what are common procedures today; in others it would tighten loopholes in the old law, many of which have appeared because of the inevitable progress of science during the past 27 years.

Suppose the bill became law. A manufacturer desires to market a common horse liniment as a cure for tuberculosis, a horsetail concoction for diabetes, or a food containing too much of some poison. He can go ahead and make a try at it. But, since the scientists who have studied tuberculosis, diabetes, and poisons all their lives know that these products are worthless or harmful, and since these expert opinions are on record, why do so? Appeal may be had to the courts, of course. The scientists would be called as witnesses. But if that happened today you would find no scientists willing to testify in favor of such remedies. Yet court review is perfectly possible under the new bill. But no Department of Agriculture czar would dictatorially make the law. The truth that science had already ascertained would be the real criterion of final judgment.

NATURALLY this bill has enemies. Many of them are sincere. Some of these have been misinformed by hysterical objectors whose disregard for fact is notorious. Others have positive reason for objecting to certain provisions of the bill and, in their excitement, attack the whole thing rather than seek to have the particular defect remedied. Doubtless, as the hearings on the bill proceed, the hostility of many of these objectors will be mollified. Others still object because they hold that they have themselves been anointed of the Lord to represent the consumer and, as missionaries to the lowly guinea pigs, they alone should be permitted to write and to dictate the enforcement of the law. However, the law can no more be turned over to them than it could be turned over to the American Medical Association.

All in all this is a good bill representing a sincere effort on the part of broad-minded idealists to protect consumers from fraud and harm, and reputable manufacturers from unfair competition, while interfering with legitimate business as little as possible in order to accomplish the desired ends. Years ago Dr. Harvey W. Wiley held hearings on enforcement policies for the then new Food and Drugs Act. That was in 1906, and he then made it plain in New York City that enforcement policies would be designed to protect consumers effectively with as little disturbance to business as possible. In 1908 he reported that he was more than pleased with the sympathetic co-operation of business men and manufacturers in their compliance with the bill. Dr. Wiley's policies have never been changed, and it can be said without fear of contradiction that no reputable and scrupulous manufacturer has a thing to fear from the Copeland Bill. Indeed he has a great deal to gain from its passage. To say that its passage would greatly benefit consumers is simply to state the obvious.

ELONGATING LEGS BY SURGERY

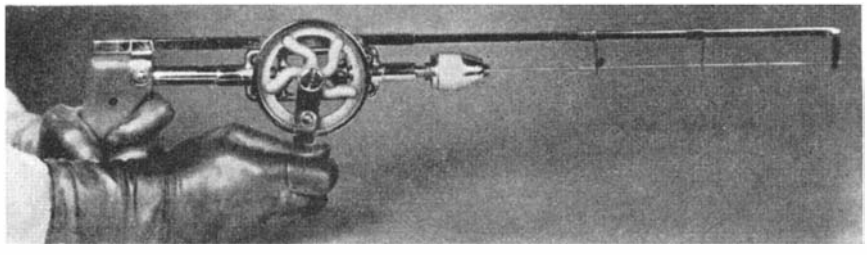


A demonstration set-up showing how high-speed rotary saw cuts bones after drilling

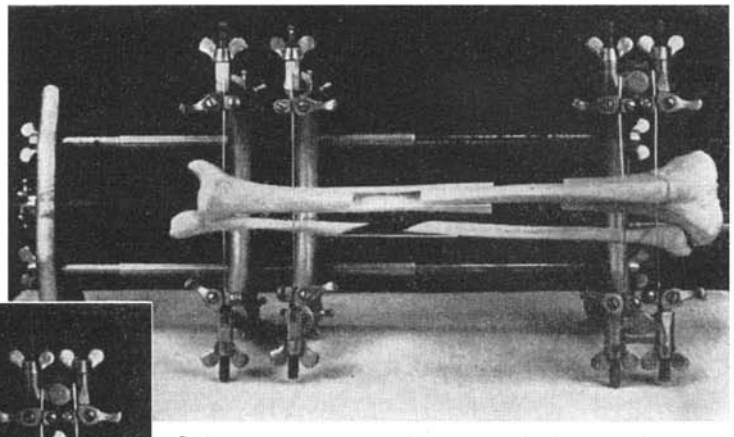
THE advances in orthopedic surgery in the last 25 years, and even in the last decade, have been very great. These operations are highly interesting and are not chronicled as freely as they should be in the public interest. It is now no longer necessary to go through life with one leg shorter than the other. It seems that a short leg is one of the greatest terrors to most people, who have a great horror anyway of "becoming crippled." There are many causes for crippling disabilities, among them being infantile paralysis, tuberculosis, or any serious fractures or accidents which might result in the shortening of a limb. Is there a real remedy? Fortunately there is a good one, when practised by skilled surgeons who make orthopedic operations their specialty.

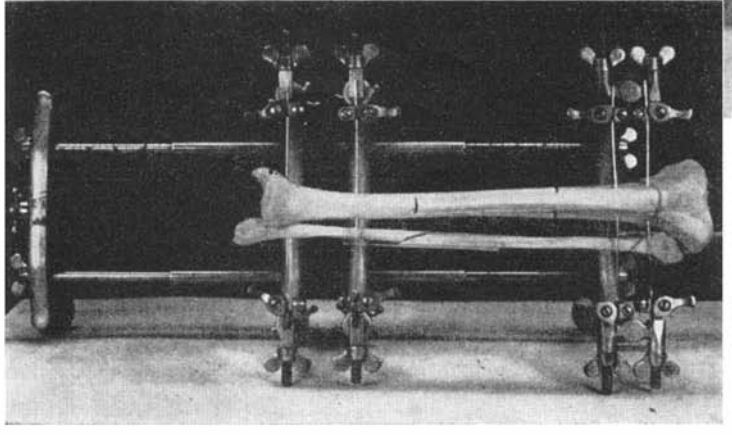
Several years ago Dr. Leroy Abbott, at present a resident of San Francisco, began experimenting with a process of surgical lengthening of the bones. The reason that such an operation had not been attempted previously was that bone, of all tissues of the body, is the most highly specialized and is therefore most damaged by any infection. This fear of infection, inherited from the pre-Listerian days, prevented progress until advances in aseptic surgery, particularly since the war, became so great that the percentage of infection has been immeasurably reduced and operative procedures of great complexity may be undertaken with full confidence of success.

The patient, fully anesthetized, is wheeled into the operating room where surgeons with their masks and gloves and nurses in similar garb stand guard against infection. The skin is cut away to the bone. The lining membrane of the bone is completely stripped away, together with all the attached muscles. The bone drill bores holes with wires which are left in place and held in adjustable clamps. Then with a rapidly rotated power saw the large bone, the femur, is divided in the fashion of an elongated Z or tongue and groove. The small bone —the fibula—is cut diagonally. The wound is then closed, the clamps remaining in place until the patient recovers. Wing nuts serve to elongate the clamps gradually after the first day. Usually about one sixteenth of an inch a day can be gained without causing the patient undue discomfort. Nature fills in the gap as it is gradually opened by the clamps. The gain in length may be as much as two to three inches. We are indebted to the Hospital for Ruptured and Crippled, New York City, which we illustrated in our issue of September, 1930, and to Dr. Armitage Whitman of the surgical staff for the above information and the accompanying photographs.



Hand drill for inserting wires in bones to be lengthened, developed by Dr. W. W. Burbank. The steel wires used for stretching are provided with drill points





Left: **Demonstration of bones ready for stretching**
Above: **How the adjustable clamp lengthens bones**

You Have

ONE CHANCE IN A HUNDRED

to Understand EINSTEIN

By JOSEPH B. NICHOLS

Editor's Note: After preparing the accompanying article the author submitted it to Professor Einstein, with the following note:

"The enclosed article was written for publication in a magazine. If you find time to read it, I hope you will not find too much to object to. We have a maxim: that a cat may look at a king, so perhaps I can write concerning the renowned Doctor Einstein. At least you can smile at my 'cat-German.'"

Professor Einstein's reply, which he has given permission to translate and quote, was as follows:

"Thank God I am not a king, on the other hand you are quite an efficient cat. What you say against the legend of the unattainableness of the theory of relativity is as correct as it is useful. I believe that your figures give a good idea and contribute towards removing that detrimental and false faith in authority against which I have always fought to the best of my ability."

THE man whose wife doesn't understand him is too common to be of interest. A man whom nobody understands is, perhaps, a tragic case. (We couldn't know for sure, not being able to understand him.) But a man who is reputed to be understood by only a dozen men has captured the imagination of the world.

Everybody agrees that Albert Einstein is one of the great geniuses of all time. His researches in mathematical physics have revolutionized science. Their effect has not been on science alone; ultimately they will cause radical changes in many other fields of thought. However, when we try to find out what it is all about—just what changes are taking place in the theories of science and philosophy—most of us, after more or less reading, give it up and content ourselves with wondering about the simpler, but more insoluble problem . . . how Professor Einstein managed to get and retain such a wonderful head of hair.

Everyone who has mentioned Doctor Einstein or the theory of relativity has asked the question, "Is it true that only 12 people are able to understand the theory?" This estimate is usually attributed to Einstein himself. The last time this question came to my attention the number had fallen to six. There has not been any recent holocaust of the master minds of physics, so the decrease must indicate that six of the original group have decided that they didn't understand, after all.

The question, how many people can understand Einstein, is very interesting. It would seem that an answer (of a sort) can be arrived at. An exact result, whether six, or twelve, or twelve thousand, would be open to question, but at least we should be able to come to an approximate conclusion. As the scientists like to say, we can approach the proper order of magnitude. However, the matter is not too simple. We must first define just what we mean by "understanding Einstein."

THERE seems to be some fatality connected with popular explanations of relativity, leading its exponents to unbounded coining of paradoxes. This may be a reaction from the rigor of technical mathematics. Whatever the reason, the blight should not extend to a mere attempt to determine how many people are able to understand the subject. Still, according to the definition we choose, we may anticipate the answer to be, (*a*) at least 700,000; (*b*) perhaps 2000; (*c*) the dozen or so of the contemporary legend; and (*d*) none.

If, by an understanding of relativity, we mean such a complete knowledge of the subject that all its implications and effects are explicitly in mind, the fourth answer is correct. I am sure that Professor Einstein would be the first to agree with this conclusion. If such complete comprehension were possible, it would imply that relativity, as a branch of science, is complete, finished, and sterile for any future purpose. It would have no more worlds to conquer. Who would then care to study it? Let us pray that the doom of perfection may never descend on such a promising subject.

However, if such comprehensive knowledge were attained, by a single master mind or by thousands, there would be no way of proving the fact. Even much simpler conceptions, apparently set out on unassailable foundations, have ultimately gone to ruin. For example, consider the position held for centuries by the geometry of Euclid, based on axioms so self-evident that to ask for proof would be considered a sign of a vanishingly small I.Q. Relativity has risen on the wreck of the axiom of parallels.

Evidently there is a relativity of knowledge, as well as a knowledge of relativity. Perfect understanding is unattainable; therefore, a definition must be a matter of degree.

Suppose we take a definition which will lie within the range of the human mind, and estimate, if we can, how many may perhaps understand almost as much of relativity as Einstein himself. The number of men included in this group would be very small; perhaps, at the lowest, the mighty six, whoever they may be, and at the most liberal estimate, not more than two or three dozen. They would be men of surpassing ability, who have given a lifetime to the study of mathematical physics. Had there been no Einstein, it is possible that one or two of these men might be capable of that last stroke of synthesis which resulted in the doctrine of relativity. Einstein does not work in a mental vacuum; the problems which he studies are also being probed by others, and the findings of all are pooled in the general fund of knowledge. Besides, though an illuminating idea may wait for generations for some genius to discover it; after that genius has once announced it, it appears to those who are prepared as very understandable. Our group was ready to accept and appreciate relativity as soon as it was formulated.

WE might even feel some confidence in naming a few candidates. Surely Lorentz, Weyl, Eddington, de Sitter, and at least a dozen others who have made contributions directly in this field, as well as men like de Broglie, Dirac, and Heisenberg, who are working along other lines of physics requiring fully as advanced mathematical equipment and scientific knowledge. And we have said nothing of the group at the California Institute of Technology, whom Einstein has recently visited, nor of the scientists at Mount Wilson.

These are the men who form the basis

of the "dozen" legend. To them, relativity is of direct professional interest. Had the doctrine of relativity no implications, by reason of its novel treatment of space and time, for the philosopher and the philosophically minded layman; that is, if Einstein had put his system forth merely as the theory of tensors applied to certain phenomena of electrodynamics, these men would still have been interested.

HOWEVER, these are the men who *do* understand Einstein, in the fullest sense possible in this imperfect world. Our question was: "How many can understand?" How many, we may say, given the same training as these men have received, would be in the same position? The number of mathematical physicists is limited by the all-pervading law of supply and demand. The world can support only a certain number of research specialists. While great mathematical ability is essential, it is not the sole factor determining who these men shall be. We can speculate that the leaders in other fields of science—chemistry, geology, pure mathematics, or engineering—might, if their interests and opportunities had taken a slightly different trend, have been among the group considered above.

Now, let us limit the question a little more. The small group we have just enumerated should be expected to be at the forefront of all the latest developments; to be able to assimilate each new advance as soon as it is announced, as well as to contribute a share. But it would be unfair to say that no one can understand relativity unless he gives a whole lifetime to its study.

In 1916 Professor Einstein published a paper entitled "The Foundation of the General Theory of Relativity." This was the epoch-making document which, after the close of the World War, brought the author to the attention of the general public. In it tensors are applied to the formulation of natural laws; the new law of gravitation, which includes Newton's law as a first approximation, is deduced; the abnormal behavior of the orbit of Mercury was explained; and the bending of rays of light passing near the sun, to confirm which scientists have gone on expeditions to observe recent eclipses, was predicted. If a student can read this paper, can follow the reasoning and understand what it is all about, surely he can be enrolled among those who understand Einstein; as of the date 1917 at least, if not perhaps as of 1933. At any rate, he will know more than most of us do.

The graduate departments of the leading universities offer courses in relativity, and it is possible that many of the students who take these courses obtain a good understanding of the subject. It is very improbable that all do. Strange as it may seem, to people who are not well acquainted with universities, it is even not impossible that some of these courses may be presented by professors who do not themselves understand the subject. However, there is a high degree of probability that the professors do know what they are talking about, and that quite a number of the students manage to gain that understanding. Since 1920, it is inconceivable that a large percentage of graduate students have been able to obtain the degree of Doctor of Philosophy in either physics or mathematics, without being conversant with the general theory of relativity.

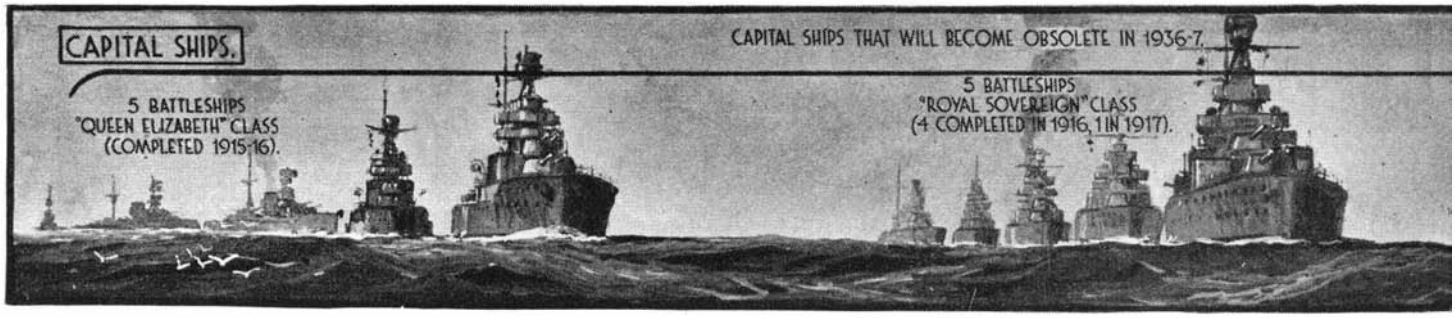
IN the period between 1920 and 1930, according to statistics compiled by the National Research Council, the various universities of the United States conferred the degree of Doctor of Philosophy on 603 candidates in the field of physics, and 392 in mathematics. Practically 100 per year. Let us be conservative and estimate that not more than 500 of these erudite doctors studied relativity. There would still be quite a number of graduate students who have failed to take the degree, but who may have mastered the mathematical theory of relativity. And it is possible that a few of the crop of Ph.Ds prior to 1920, and not included in any of our lists heretofore, may have mustered up enough energy to study the subject. And these figures are for the United States alone. There are scientists and graduate students of science in England, in France, in Italy, in Holland, in Norway, in Japan. And, of course, there may be a few in Germany. It would be sad to think that the untranslated papers of Einstein can be read understandingly only by those who have acquired German as a second language in order to be able to read the works of Einstein and a few others who are included in the group of mighty men we discussed at the beginning. When we say that at least 2000 understand relativity, our estimate is really too modest.

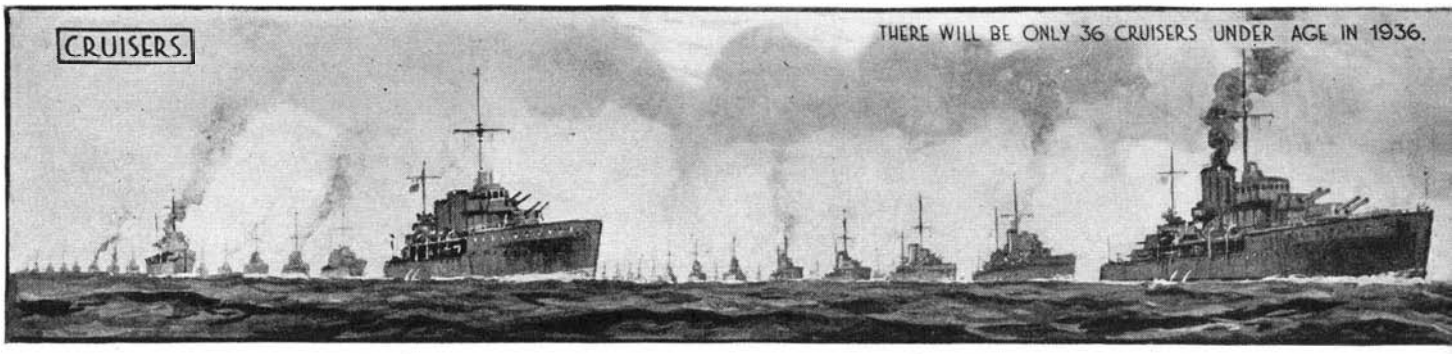
The impression that one receives, on hearing that perhaps only a dozen men are able to understand relativity, is that the material is so recondite, so difficult, that only a very few persons possess the intelligence necessary to grasp it. It is not a matter of acquired training and education, but of hereditary mental power. There is a certain degree of truth in this point of view, but it is not the whole truth. If we agree with the majority of psychologists that intelligence is, in the individual, a fixed quantity, we should expect that not everybody would possess a sufficient amount. In fact, a great many persons, even some who are fairly successful in many ways, are unable to master the abstract reasoning required for ordinary high-school mathematics. However, the adepts of relativity have no monopoly of intellect. The publicity given to the subject and the interest aroused have been due to its implications for philosophy, and also to a large extent to the personality of its founder. Fully as difficult to understand, and as significant to science, are the quantum theory, wave mechanics, statistical mechanics, chemical thermodynamics, colloidal chemistry, and a host of other subjects. Perhaps only a handful, a couple of dozen, will become experts in any of these branches. The highly learned will be only a select few, but we cannot justly single out the votaries of any one branch for special honor.

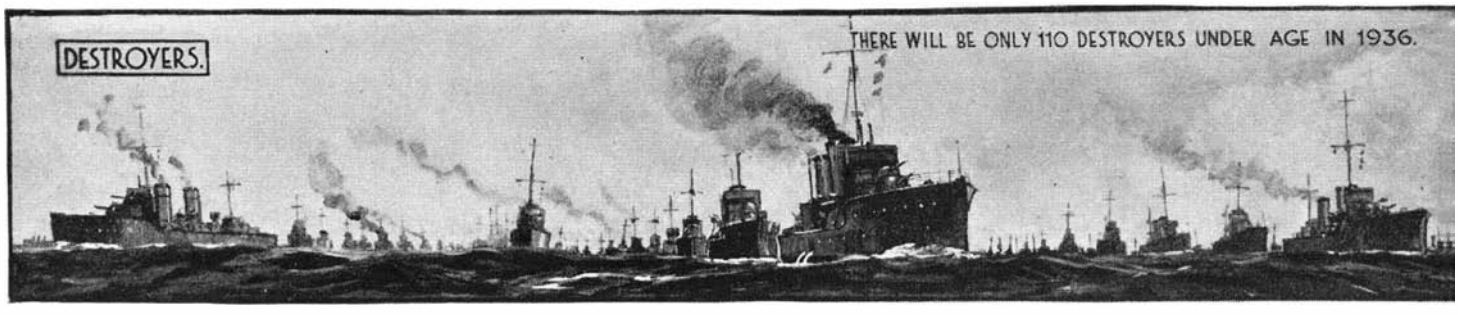
So, in considering how many have such native intelligence that, given the special training, they would be able to swell the ranks of, say, the 2000 plus, if not of the two or three dozen, we have, to begin with, those who belong to the similar throngs who are versed to an equal extent in these other subjects. There would be some overlapping, but we should be able to include at least another 2000 plus from each of the other major branches of science. In the last decade, while approximately 1000 doctorates were conferred in physics and mathematics, the total number of doctorates in science was over 7000. We should be safe, then, for this last estimate, in using the same proportion and saying that at least 14,000 could qualify. But this is just a beginning.

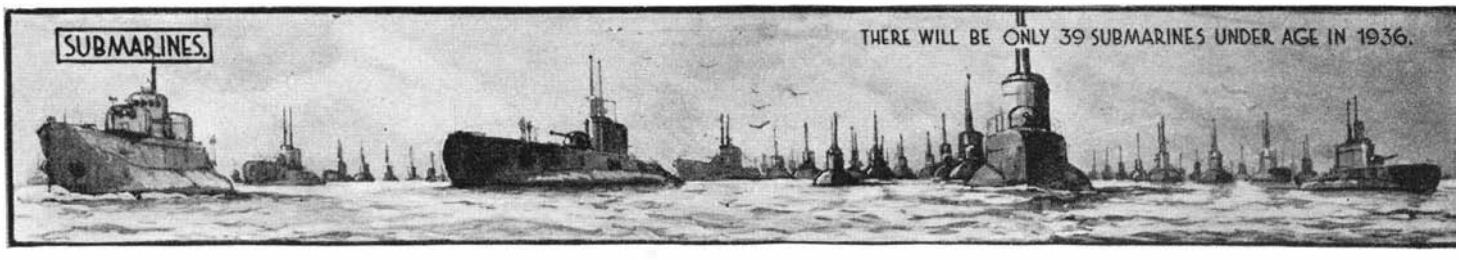
IF our social system were such that every individual received the education which he is capable of mastering, the matter would be very simple. We could assume that every graduate student of science would be of the necessary caliber. However, we know that many students manage to get admitted to graduate schools without being overburdened with intelligence. In fact, I would even venture the sacrilegious statement that some such have emerged with the precious doctor's degree. On the other hand, the factors which may debar intellectually qualified individuals from pursuing graduate work, or even from attending college, are numerous and varied. For example, there are financial reasons. At any rate, there is a lack of opportunity for many—how many, we can only guess. Consider that in 1930 the universities of the United States conferred 1055 doctor's degrees in science. In 1900, the number was 102. No one would claim that the number of people with the raw intelligence presumably necessary for a prospective doctor has increased tenfold in 30 years, nor, seriously, that the intellect required of a candidate has been reduced. The in-

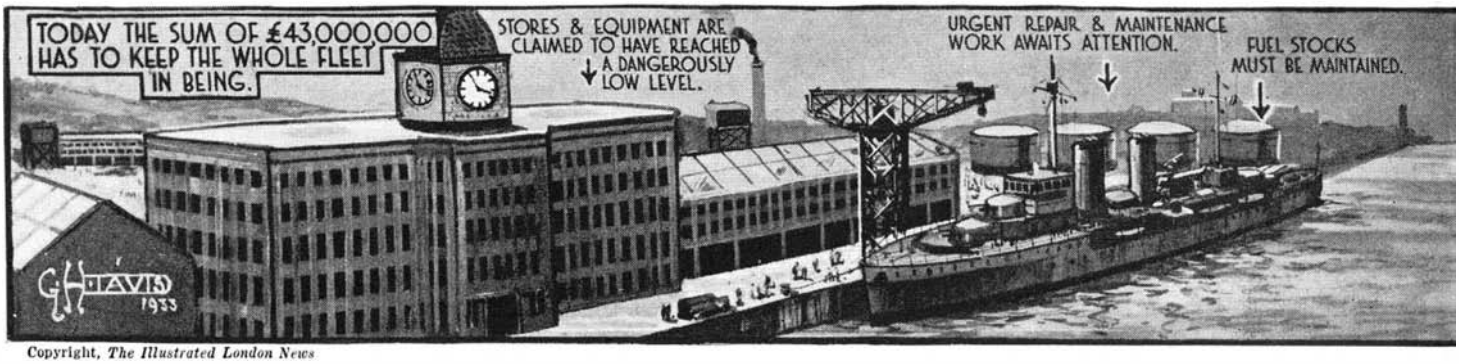
(*Please turn to page* 107)





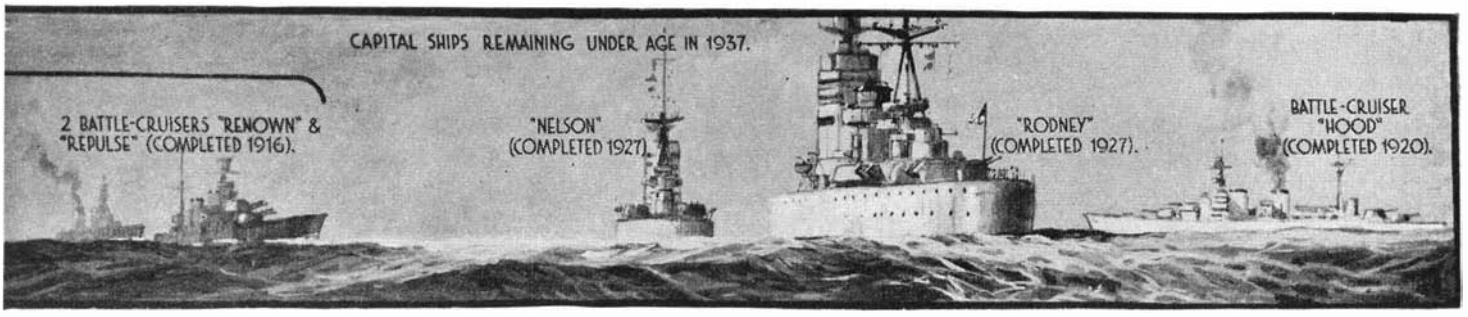


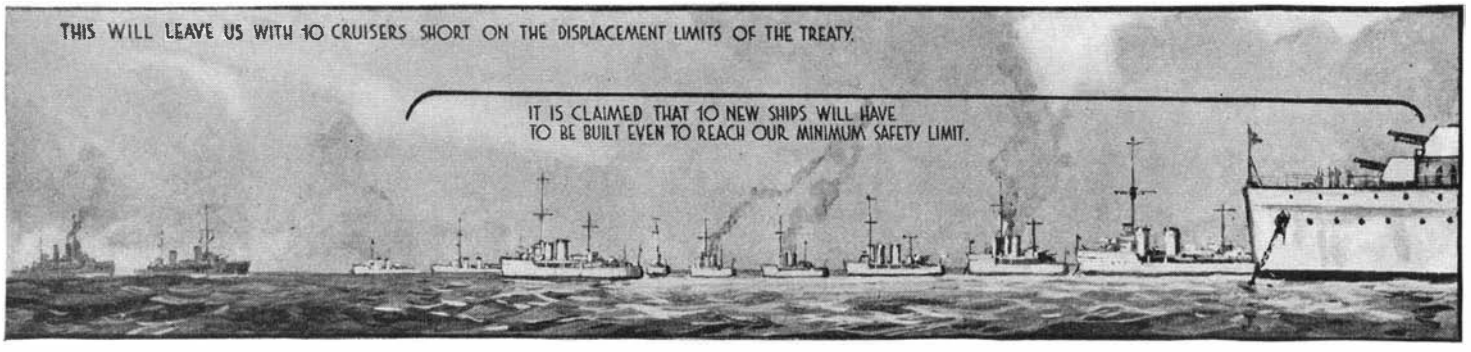


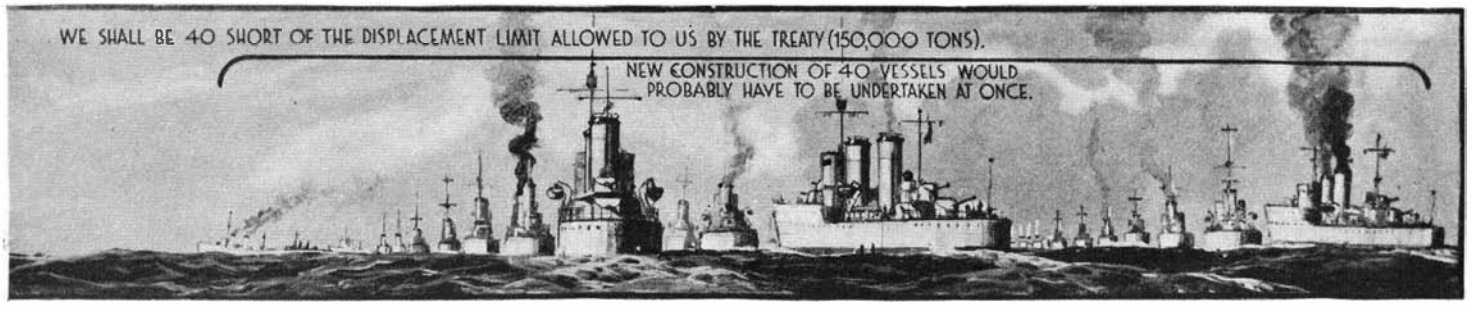


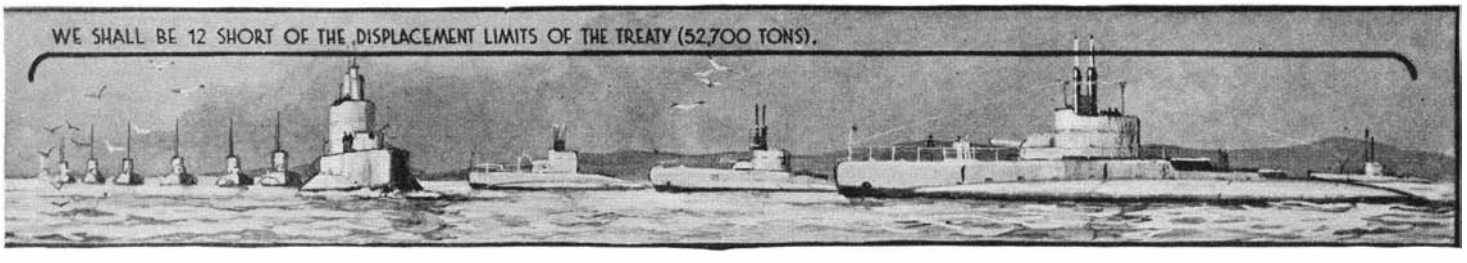
"Malnutrition" in the British Navy

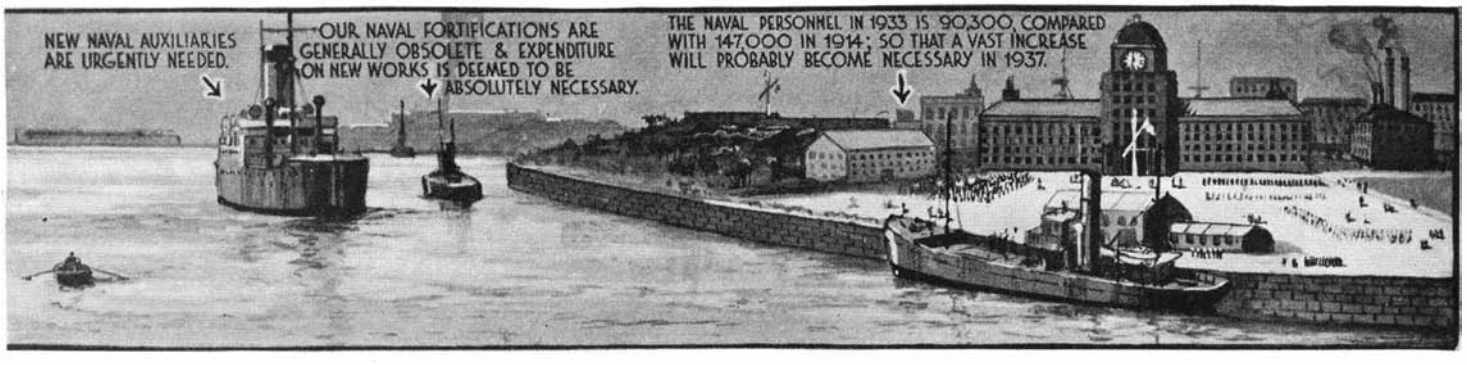
IN view of the naval building program recently begun by the United States as a method of relieving unemployment, and because this country is far behind the allowable quota of ships under the naval treaties, the above illustrations are of interest in showing the deep concern with which the British Empire views the question of fleet strength. Like ourselves, the British feel that many of their ships are out of date. We are inclined to agree that, if the claims are fully substantiated, the British Empire will be faced with the problem of finding vast sums of money for new construction at the expiration of the present





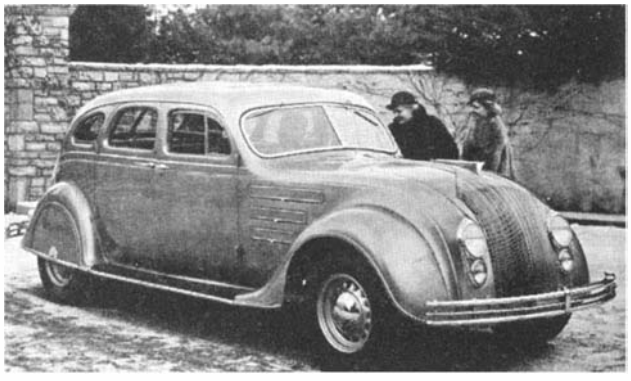






treaties on December 31, 1936. It must be noted, however, that the British fleet at present exceeds in tonnage that of the United States, while the question of relative obsolescence of the two fleets is open to some argument. Japan's fleet has been built to within a few thousand tons of the allowable limit; and since the majority of her vessels are of recent construction, her fleet is in excellent condition. From our knowledge of our own fleet's deficiency and judging by the British claims depicted above, there is no question that much naval building and organizing of auxiliary services will be necessary before the expiration of the present treaties if there is to be any serious consideration of an extension of treaties. It is sincerely believed that such an extension is necessary in order to prevent competition in naval building and the mistrust of motives which so often has led to war.

STREAMLINING AND YOUR AUTOMOBILE



An experimental model of a streamlined car (see also Figure 10) produced by a well-known manufacturer

By ALEXANDER KLEMIN
Daniel Guggenheim School of Aeronautics
New York University

Much Greater Gasoline Economy May be Expected When Motor Cars Are Really Streamlined. The Facts of the Matter, in Non-Technical Language, Are Presented in the Accompanying Article. Will Motor Car Manufacturers Meet the Demand for Greater Efficiency by Producing Automobiles Planned by Airplane Designers?

THE familiar automobile, when moving at today's normal speeds, exerts more power to overcome air resistance than to conquer ground friction. Yet motor car streamlining has hitherto been almost neglected by manufacturers. Speed has been achieved by mere application of brute power—and tremendous wastage of gasoline.

Of course we have had with us, all during 1933, cars labeled "streamlined" for advertising purposes. To tilt the windshield a little more rakishly, to give the radiator a push and the rear end a pull, did not make a 1933 streamlined car out of a 1932 model. One should, of course, feel somewhat lenient toward the manufacturers. To produce a real streamlined car commercially would mean scrapping an enormous investment in dies and machinery. And to dare so far would require perfect confidence that buyers would take kindly to the new shape when they saw it. Manufacturers have had good reasons for going

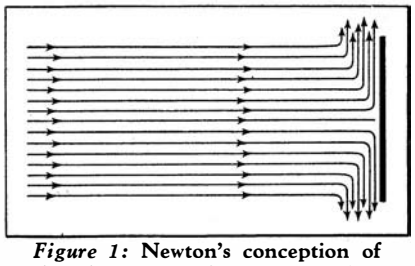


Figure 1: Newton's conception of the deflection of air "particles"

at the thing slowly—for playing safe—for trying out public acceptance by degrees. Such questions of policy are for business men to settle. The engineers are quite certain that vast improvements in efficiency and speed are possible by streamlining the automobile, but maintain that real departures from present forms are necessary.

Man has long known, of course, that the air—though invisible and thin—nevertheless has definite weight, and the ability to resist the motion of any body moving through it. But the explanation of this air resistance or drag has not been so plain; it has occupied some of the greatest minds of the last two centuries.

Sir Isaac Newton, who propounded so many mechanical laws that stand to this day, considered the air as being composed of many individual particles which behaved like little bullets or pellets. When particles of wind struck a flat plate held at right angles to the wind's direction, they were then (said Newton) deflected at right angles to their own direction of motion. (See Figure 1.)

FOR once Newton, the discoverer of the laws of gravity, was wrong; his conception was erroneous, and the values he gave for the resistance of various objects were too high. Partially, however, he was right: he showed that air dislikes abrupt deviations and sharp corners.

It is not an accident in nature that fishes which move fast in pursuit, or in avoidance of pursuit, are all of the shape which we have learned recently to call streamline. Nor can evolution have been blind in giving bodies of similar outline to the fastest flying insects and birds. When a fluid parts to make way for such a streamlined shape, this fluid (whether air or water) meets with no sharp corners, and follows the curved contours without any sharp changes in direction or motion.

It is true that the air which comes in actual contact with the very surface of a moving body is brought to rest, and also that the fluid which is at a little distance from the body is somewhat slowed down. (The result is the same whether we visualize the air moving and the body at rest, or the reverse.) Naturally this produces some little drag on a moving body, for slowing up the air-flow means expenditure of energy. This phenomenon, known as "skin friction," is unavoidable no matter how smooth and polished the surface. It is, however, of small practical importance.

The important fact is that the air flows smoothly almost to the very tail or stern of the streamlined body. (See Figure 2.) It is only at the very tail that a few eddies or whirls are produced.

Next to this natural stream-lined form, which has been adopted exactly for airships, comes an oval shape. Here the air-flow is rather more disturbed. The swirls at the rear set up a partial vacuum which acts as a definite brake on the forward movement. To meet the same slight air resistance as that of a completely streamlined body of a certain size, an oval object would need to be much smaller.

The third, or egg-shaped form, with its longer axis at right angles to the wind, has to be still smaller if it is to offer no more resistance when in motion than the streamlined shape. The air eddies quite roughly in back of the body.

The last of the four bodies to be con-

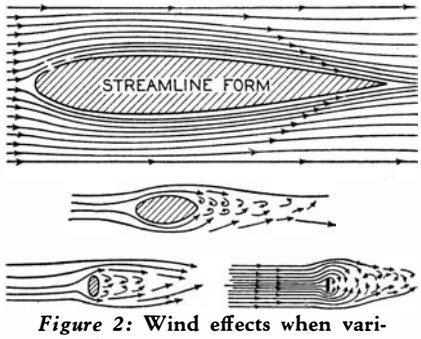


Figure 2: Wind effects when various shapes are in an air stream

sidered, and the one offering the maximum of resistance, is the flat plate. Here the flowing air encounters two sharp corners. On the windward side the air-flow is fairly smooth. But on the lee-ward side eddies and whirls continuously form and reform, and a constant expenditure of energy is needed to overcome their action. The flat plate has to be very tiny indeed if it is to be propelled through the air with the same amount of force as is required to move the streamlined object.

THOUGH air is relatively light in weight (a 28-inch cube of air weighs only a pound, while the same volume of water would weigh 100 pounds, and of steel 784 pounds) the force of air in motion may be enormous. We all know the power of the wind when it rises to cyclone velocity. We may even take a more homely example: A man is holding an umbrella in a 60-mile gale. (Figure 3.) The umbrella creates even more resistance than a flat plate, for not only does the air swirl in back, but it also piles up and swirls on the umbrella's windward side. With an umbrella 3 feet in diameter, the man actually has to exercise a pull of 85 pounds. Other simple tests of wind power can be made by opening the door of an automobile that is moving very rapidly, or by swinging out a garage door in the face of a storm. An Atlantic liner in a gale may be slowed down from some 25 miles an hour to as little as 10 or 12, and a large portion of this retardation will be chargeable to the power of the wind on the superstructure of the ship.

Lord Kelvin, great British scientist, has rightly said that "to know, one has to measure." Without becoming too involved a reader untrained in mathematical mysteries can understand how resistance is gaged in aerodynamics.

If, for example, our flat plate is held square against the wind—*i.e.*, facing the

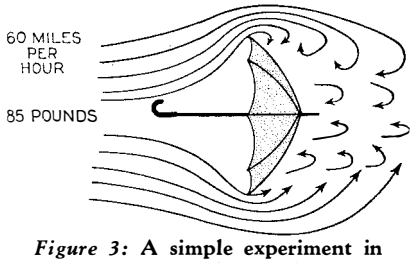


Figure 3: **A simple experiment in wind resistance, described in text**

wind—on what factors will the resistance depend? And how will this resistance vary with speed and areas?

First, we find it simple common sense to say that the resistance will vary directly as the area; as the area of the plate is increased, it is obvious that the resistance will be greater.

Second, we find resistance depending on the speed of the wind; the faster the wind, the more air will strike the plate in a given time. Likewise, the faster the flow of the air, the more velocity it will lose in striking the plate. Here we have a double effect, due to only one cause. Hence this drag will be proportional, not to the speed alone, but to speed times speed. We can say, therefore, that the resistance varies with the square of the speed. Note here, in passing, that

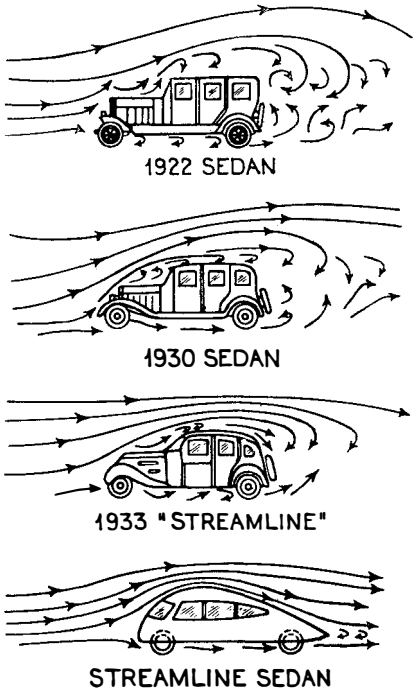


Figure 4: **A comparative study in air currents around auto bodies**

it is because resistance varies with the *square* of the speed that the streamlining of automobiles becomes of such vital interest and importance when higher speeds are considered.

Third, and finally, resistance will depend upon a factor which we may call K, which is a *constant* representing the shape of the body. This always has to be experimentally determined.

We are now ready to make an equation:

Resistance=*K* times (*Area in Square Feet*) times (*Speed in Miles per Hour*)^2.

For a flat plate, K equals .0032. We are now ready to do an example in arithmetic. Problem: What is the resistance of a flat plate which is ten square feet in area, in a wind 100 miles an hour?

We take our constant K of .0032; we multiply it by 10 for the area; we multiply again by 100 squared for the speed; and we find the answer is the enormous value of 320 pounds. This is the force exerted against the flat plate.

We shall study presently the corresponding coefficient for the automobile. The equation for the plate shows, however, that we can reduce the resistance of a given body in a given airspeed only by changing one of two factors: either K, representing the shape, or the area.

Now in an automobile it is hardly practicable to reduce the area. The frontal or projected area of the car is largely determined by factors outside of the designer's control: just so much space, headroom, and comfort must be provided for the passengers.

Aerodynamic streamlining of the automobile means, therefore, a changing of the shape—giving the car such a form that K is reduced in value. If K goes down, the resistance goes down, and the power expended to overcome air resistance decreases likewise.

It is to aviation that we owe our greatest debt for present-day advance in our knowledge of aerodynamic engineering. The automobile, of course, was hitched directly on to a horse-and-carriage age; no one ever gave a thought to getting through the air when the obvious problem was to get over the ground. That the first automobiles were designed like carriages was no more remarkable than the fact that they still are like them.

Aviation, on the other hand, started off with the problem of designing a new vehicle for travel in an entirely new element; it had no precedents of design to follow; and even the first airplanes

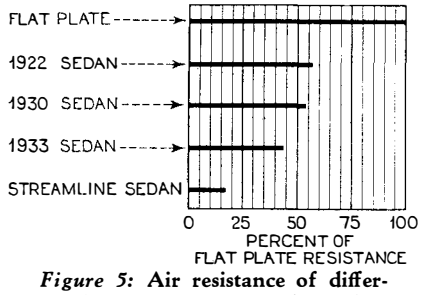


Figure 5: **Air resistance of different bodies compared with a plate**

incorporated certain elements of aerodynamic design—understandable when we remember that the Wrights made all their calculations from wind-tunnel tests.

The research in wind tunnels has continued ever since. Compare the early Wright biplane, seen through its many exposed struts and wires, with a modern transport ship having retracted landing gear, complete absence of exposed wires or struts, and a close approximation to a flying wing.

In the year 1915 the Schneider Trophy race was won by a seaplane having 160 horsepower at a speed of 60 miles an hour. In 1931 the race was won by a seaplane at a speed of 340 miles an hour. If there had meanwhile been no change in the art of streamlining and designing planes, the horsepower required by the 1931 ship would have been proportional to the cube of the ratio of the speeds. The horsepower would have been $(340/60)^3 \times 160$, or

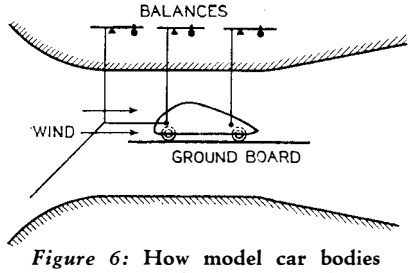


Figure 6: **How model car bodies are suspended for wind tunnel tests**

29,200 horsepower,* but the actual horsepower used by the 1931 racer was only 2300, or about one thirteenth of the preceding figure.

One very important fact discovered in aviation is certainly not utilized even by the makers of these recent "streamlined" cars with ornate headlamps and fenders. It is a curious thing that minor projections or excrescencies on a moving body may cause two and two to become seven. If, for example, we take a perfect airship form, and then mount upon it a small projection of comparatively minor resistance value by itself, the combination resistance may be more than doubled. This is caused by the interplay of the two groups of disturbed air currents. Of this factor the designers of recent automobiles seem to have taken little cognizance. Though the basic shape of the car might indeed seem slightly improved, the flow of air is impeded just as much as ever by fenders, mudguards, headlights, spare tires, and misplaced radiators and driving gear under the car.

ALL of this is easily demonstrated by wind-tunnel tests. A wind tunnel (Figure 6) is, in effect, a huge wasp-like tube, with windows in the sides. through which air is drawn by a giant propeller placed at one end. A board is placed in this tunnel to simulate the ground. On this is placed the automobile model, which in turn is connected by wires to the ceiling. The forces exerted are measured through these wires on very delicate balances mounted above the roof of the tunnel.

The result of tunnel tests on four different types of cars is interesting. Of these one was an early 1922 model, one a typical 1930 sedan, one a so-called streamlined car of early 1933, and the fourth an automobile actually streamlined in accord with aerodynamic principles. (Figure 4.) It is true that the air flow around the 1933 model proved slightly less disturbed than around the 1922 model—but only slightly. Below are the results listed in tabular form; in graph form, they are shown in Figure 5. The first column gives the value of K, which it is so important to reduce if we are to avoid great power wastage. The second column compares this value of K, in percentage form, with the same value for the flat plate previously discussed. Note that a 1922 sedan had 56 percent as much air resistance as if it had been a flat plate! Furthermore, the 1933 sedan was only 11 percent better!

Description	*Value of K*	*Percent of K for flat plate*
A flat plate	.0032	100
Typical 1922 sedan	.0018	56
Typical 1930 sedan	.0017	53
"Streamlined" 1933 sedan	.0014	44
A scientifically streamlined automobile	.0005	16

These values, let us repeat, are not mere estimates; they are derived from careful experimentation in the wind tunnel, where very accurately scaled models of the automobiles are used. The figures are therefore based on the very best data that modern science can supply. Nothing remains but to admit that in 1933 the applied science of automobile streamlining was still in its infancy.

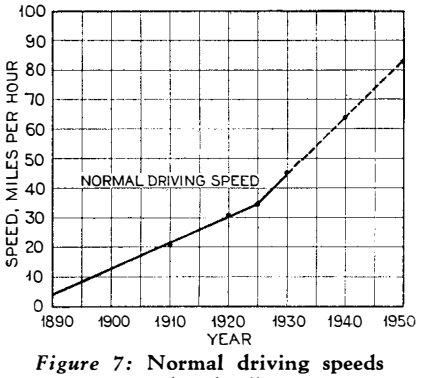


Figure 7: **Normal driving speeds have increased and will continue up**

If we are going to estimate the operating cost in fuel, and in dollars, of these automobiles that are only 50 percent better than flat square plates, we must know something about normal speeds. We are not concerned with the top speed of a car. It is the speed on the open road in ordinary driving, the speed which the driver—after more or less experimentation—finds best suited for his purpose. How this normal driving speed has varied with the years is hard to estimate; we may at least be sure that it has steadily increased. Figure 7 is the result of a wide inquiry on the subject made by a prominent automotive engineer whose researches can be regarded as quite reliable. It indicates that the normal driving speed for the year 1933 was 50 miles an hour. With better roads and additional "super" highways, it seems only reasonable to assume that speeds will continue to increase, and that by the year 1940 the average driving speed on the open road will be 64 miles an hour. How are the automobile designers going to meet this high-speed challenge? Merely with more powerful engines?

On a level road there are two major resistances to be overcome. One is the rolling resistance; the other, the air resistance. The air resistance we have already calculated for a conventional car of today. The rolling resistance is even more easily ascertained.

The rolling resistance is due to such factors as friction in the wheel bearings; friction in the tire walls; deformation of the road surface; loss in the transmission, and in the final drive. It may be very accurately determined on a chassis dynanometer, an instrument known to all automobile engineers. Here the car is mounted on an endless belt, to simulate rolling over the ground; the draw bar pull and the engine power are simultaneously measured.

WE HAVE already seen that horsepower required to overcome air resistance increases as the cube of the speed. Horsepower needed to overcome rolling resistance increases directly in single ratio as the speed. Total horsepower required would be a combination of these two factors, and increases very rapidly as speeds increase. (The curves reproduced here apply only to high-gear conditions.) The engine of the car at full throttle can deliver, at any speed up to top speed, a power much greater than the total horsepower required. But, when the curve of maximum available power and of total resistance power meet, we then reach the top speed, which cannot possibly be exceeded. Up to this point the excess power available may be used for overcoming a grade, or the effect of a powerful headwind.

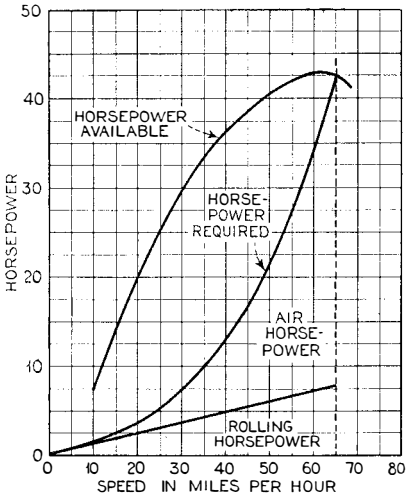


Figure 8: **Power required to overcome air resistance in a 1933 sedan**

*Author's Note: It was previously shown that air resistance varies with the *square* of the speed. Power, however, is not only a function of the force exerted, but also of the speed at which the pull or push is being exerted. Thus, to estimate the horsepower of the work done, the air drag has to be multiplied again by the speed. Now, if we multiply the speed by the square of the speed, we get speed cubed. In short, horsepower required increases as the cube of the speed—still more rapidly than resistance, and still more forcefully so far as its argument for streamlining is concerned.

(See Figure 8 on the opposite page.)

Reduction of power expenditure needed for rolling resistance is largely a problem in reducing friction—never to be completely solved this side of perpetual motion. It is in reduction of power spent in combating wind resistance that the real opportunity for triumph lies. How much of the motorist's dollar is today being spent to make horsepower that will overcome air resistance? To average 50 miles an hour, he will apparently need 26 horsepower, of this amount 18.2 horsepower being devoted solely to overcoming air resistance. With the average engine, such total expended horsepower would mean a fuel consumption of 3.81 gallons an hour. Of this amount the air horsepower would be responsible for 2.66 gallons. At 20 cents a gallon this means a driver would spend, in an hour's traveling, 23 cents to overcome rolling resistance, and 53.1 cents to conquer air resistance. In other words, at only 50 miles an hour the average driver burns up 70 percent of his gasoline just to get through the air.

If, by 1940, true streamlining of cars has not been adopted, and if average speeds, as projected by present trends, reach 64 miles per hour, the total horsepower expenditure will then be 54. Trusting that gasoline remains at about 20 cents a gallon, the cost of transportation would become $1.62 per hour; of this amount only 31 cents would be devoted to getting over the ground. The rest would be expended on invisible air.

TRUE streamlining would save about 30 percent of our gasoline at 30 miles an hour (see Figure 9), and over one half of it at 60 miles an hour. Four or five years from now, with average speeds increased, the relative saving to the average driver will be even more striking.

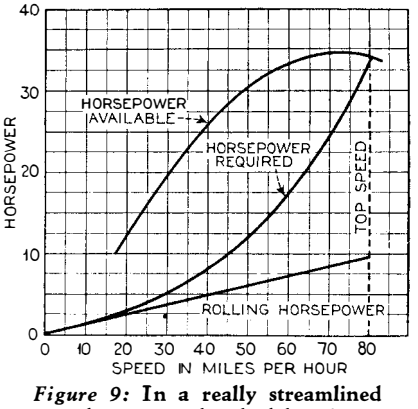


Figure 9: **In a really streamlined car, the power absorbed by air resistance is reduced. (See Figure 8)**

of aerodynamic knowledge to create the car outlined in Figures 10 and 11. (At the time of going to press with this number, it appears quite likely that at least one or more manufacturers will bring out in 1934 cars that approach the form shown in Figure 10. In fact, models of this design have already been produced. *The Editor.)*

In Figure 10 is the laboratory conception of the ultimate in streamlined cars if present basic construction is maintained: that is, if the motor is kept in the front, the front wheels steer, and the rear wheels drive. As will be seen from the sketch, all sharp corners would be eliminated. There would be no fenders or running boards. The cooling radiator would be smoothly faired into the rounded nose, with air outlet ducts forcing the air to flow smoothly out of louvres underneath.

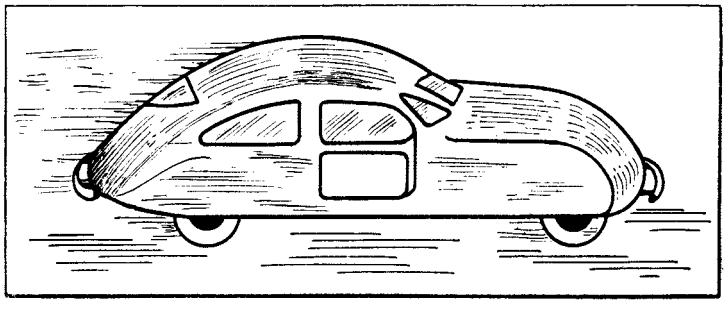
The hood would completely cover the front wheels and the engine. The nose would be rounded and shortened, permitting (on the same chassis length) an extending of the body in the rear and the inclosure there of the spare tires, trunk, and so on. The body would be wide in front, and taper to the rear; there would certainly be room for three front passengers. Projecting accessories such as lights, horns, license plates, radiator caps, and so forth, would all be flush with the surface of the body. The only projections that seem absolutely necessary to maintain would be bumpers, front and rear.

In Figure 11 is outlined what seems to be the ultimate in streamlining. Here the conventional body construction is no longer followed. The motor will be in the rear, and the passengers ahead of the motor. There may be either three or four wheels, depending on whether a single or double wheel is used in the rear. If a single wheel is used there, the steering will be by this wheel. This three-wheeled arrangement will have certain maneuvering advantages over the other type.

From a purely aerodynamic standpoint this latter is the more efficient shape, but from other viewpoints it appears less practical than the car shown in Figure 10. The fragmentary data available indicate that the car of Figure 10 should have only 45 percent of the air resistance of the 1933 sedan. The car shown in Figure 11 will have about 36 percent of the same value.

IT may well be argued that buyers would not immediately accept this completely streamlined car; that they would not like its appearance, and that in general public aversion to change is too great. On the other hand, the public would very soon realize the saving in gasoline. And, since eddies and whirls would be eliminated, a great deal of air buffeting and vibration would also disappear, markedly increasing riding comfort.

The eye soon becomes adjusted to radical changes of the objects surrounding us. The car of 1922 probably appeared quite beautiful to the eye of its owner. The new completely streamlined car may, in a very short time, be quite as pleasing to the eye. It certainly will give more economy and more comfort. It remains to be seen how American designers will meet the challenge.



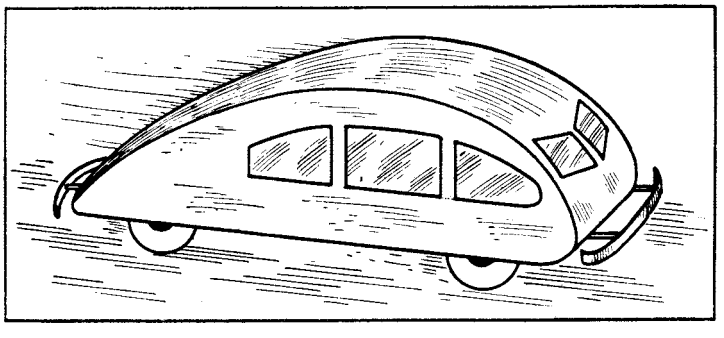


Figure 10, left: **The ultimate in streamlining with present basic construction.** ***Figure 11, below:*** **A more efficient streamlined design with the engine in the rear**

It is possible that motor-car designers will still pursue the beaten tracks for customers, making minor modifications here or there, bringing out each new model with just a little change and a great burst of publicity.

It is also possible, on the other hand, that some pioneer will make a really determined effort to bridge with one leap all the unnecessary intervening steps, will scorn to put a few more horns on the horse, and will use our present store

THE NEW TELESCOPE MIRRORS

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
President of the American Association for the Advancement of Science

A LITERARY-MINDED student of the writer's once answered an examination question in the words, "Telescopes are of two kinds, refractory and reflective." Every one of the many astronomers who have chuckled over the story admits that the telescopes of his acquaintance have sometimes been decidedly refractory, quite independent of their optical systems; and an instrument which allows the astronomer to reflect is deeply welcome, though it may form its image by refraction.

Speaking more seriously, it would be hard to say whether the lens or the mirror is of the greater usefulness to the astronomer. In the long history of telescope making they have alternated in precedence. Newton's invention of the reflecting telescope furnished the first means by which sharp achromatic images of the heavenly bodies could be secured, and the refractor could not compete until Dolland designed the achromatic lens. The resources of 18th Century glassmakers, however, were unequal to the production of large homogeneous blocks, so that the first great telescopes were Herschel's reflectors. In the 19th Century the refractor forged ahead again and the reflector was neglected for a generation. Toward the close of the century modern resources of engineering and technique were for the first time applied to the construction of reflecting telescopes, with the results now known to all men, and there is no probability that refractors can ever be made which can compete in light-grasp with the great modern reflectors—though both types are sure to remain of permanent value. The reflector, owing to its smaller cost and more modest demands for housing room (for equal power), has become the favorite of the amateur observer.

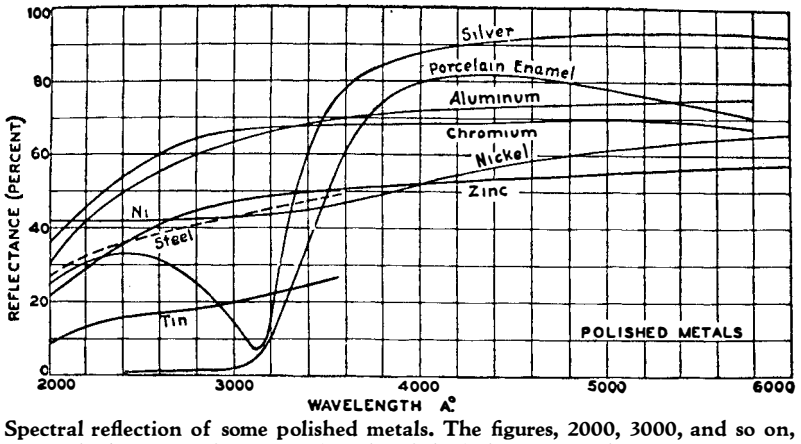
THE heart of a reflector telescope is the mirror and it is here that troubles begin, for no ideal substance for the construction of optical mirrors has yet been found or is in sight. The perfect material, which Dr. Anderson in an imaginative mood has called "mirrorite," must be rigid and permanent but not brittle or too heavy; must have a vanishingly small coefficient of expansion and conduct heat freely so that it shall not be distorted by temperature changes; must have a very high reflecting power for all wavelengths from the extreme ultra-violet to the infra-red; must be capable of being worked to an exceedingly accurate figure and retaining it for years without distortion or after-effects; and must take a high polish and retain it free from tarnish or stain under all the vicissitudes of the observatory or the laboratory. Such a miraculous combination of virtues is too much to hope for; we must be content with an approximation.

When it comes to metal mirrors, nothing is yet available that is much better than the speculum metal used by Herschel, an alloy of tin which takes and retains a fine polish but unfortunately is almost as brittle as glass. It is still generally employed for diffraction gratings and some other purposes, but for telescopic use it has the great disadvantage that any tarnish on the surface cannot be removed without re-polishing, with the accompanying danger of spoiling the accurate figure of the surface. Modern practice therefore tends almost exclusively toward glass mirrors.

Properly annealed glass is admirably rigid and permanent and can be cast in large masses. Its coefficient of expansion is lower than for metals and may be much reduced by the use of special glasses of the Pyrex type, and it takes and retains an excellent polish. Fused quartz is still better, but has not yet been successfully obtained in really large disks.

But the reflecting power of a bare glass surface is ridiculously low, so that it is of no use till it has been coated with a metallic film so thin that its presence does not spoil the shape of the surface. For many years the standard coating has been of silver. This can be easily deposited on a clean surface by chemical means. The amateur in his first trial may think the process complicated, messy, and anything but easy, but in expert hands it is all in the day's work. An imperfect coating can be dissolved off in a moment with nitric acid and resilvering begun.

When the silvering solution has been washed off with distilled water the sur-



Spectral reflection of some polished metals. The figures, 2000, 3000, and so on, across the bottom, refer to wavelengths of the light, expressed in angstrom units (ten millionths of a millimeter). The visible spectrum begins at about 3900, at the end of the violet, and extends through the various colors as follows: violet as far as about 4300, blue to 4900, green to 5500, yellow to 5900, orange to 6200, and red to 7700, the latter extending off the present diagram to the right and the infra-red lying beyond that. The same diagram extends to the left beyond the limit of the visible spectrum (at 3900) as far as 2000 but, since the earth's atmosphere cuts off the ultra-violet waves shorter than about 3000 angstroms in length, the part to the left of 3000 may be ignored in connection with astronomical work; it is used in laboratories, where it can be created artificially The figures on the left side refer to the percentages of incident light reflected by the different metals—that is, the reflectivity or reflectance. Note how high the curve for silver stands throughout the visible spectrum but how rapidly it tumbles after the end of it at 3900. As Professor Russell states, silver films are actually transparent to waves of this length and silver mirrors are virtually useless for capturing the ultra-violet end of the spectrum of a star. The curve for aluminum pertains to ordinary aluminum freshly polished, not the vacuum-deposited kind discussed in the article. Even it, however, shows high ultra-violet reflectivity

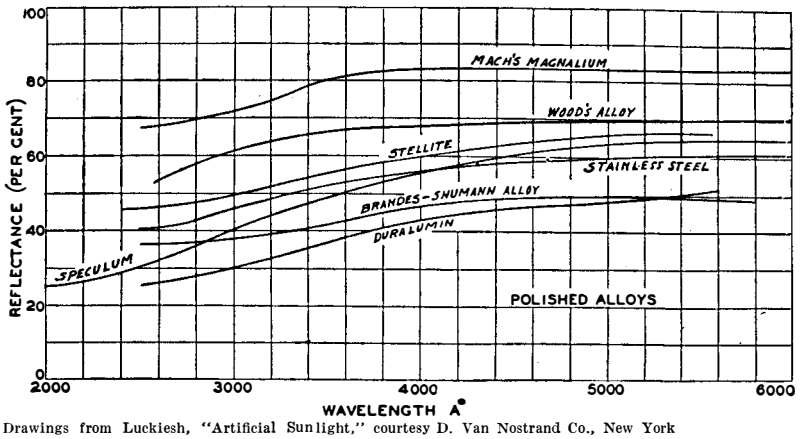
face is dim with more or less of a "bloom," but this is removable by ordinary polishing.

A fresh silver surface has a very high reflecting power for visible light—fully 90 percent—but it has serious disadvantages. First, it is soft and easily scratched. Even polishing with the finest jeweler's rouge produces microscopic scratches which scatter light and make it hard to observe faint stars near bright ones. Secondly, it is very liable to tarnish. Even in the best atmosphere a silver coat deteriorates badly and has to be replaced in from six months to a year, and there is an important loss in reflectivity before this. Third, and most serious of all for the spectroscopist, the reflecting power of silver falls off very rapidly in the ultra-violet. Near 3100 angstroms it is only 5 percent—hardly more than for bare glass. Indeed, a silver film is almost transparent for such light and serves as an excellent color filter. For shorter waves the reflecting power gradually increases but is still low. On this account it is practically impossible to photograph the spectrum of a star with silver mirrors in the region below 3400 angstroms, and much detail of great interest lying between this and the limit set by atmospheric ozone at 3000 angstroms is inaccessible.

A BETTER metallic film is much to be desired, and one with almost ideal properties has recently been found. It is of a familiar but most unexpected composition—aluminum!

We ordinarily think of aluminum as a greyish metal, and few of us have ever seen a highly polished surface—for if prepared in the ordinary way it tarnishes very rapidly. Aluminum, indeed, is one of the most active, chemically, of all the metals and no one would have expected it to give permanent mirror surfaces.

Success of course depends on finding the right way to put the aluminum on the glass. It is done by evaporation in a vacuum. The metal has a rather low boiling point under reduced pressure and there is no great trouble in volatilizing it, but the form in which it comes down depends enormously upon the vacuum conditions. In a partial vacuum, at a pressure of about 12 millimeters, Dr. Pettit finds that it invariably deposits in a finely divided form which makes a dead black coating. Many other metals—as different as gold and zinc—do just the same, and the process is useful to *blacken* small pieces of apparatus. At lower pressures—say 1 millimeter—aluminum deposits as a fine white powder. But if the pressure is kept exceedingly low, so that the separate atoms of metal which evaporate from the heated filament fly clear across the vacuum chamber without hitting any gas molecules on the way, they condense on any *clean* surface in the form of a brilliant, lustrous, polished mirror.



Drawings from Luckiesh, "Artificial Sunlight," courtesy D. Van Nostrand Co., New York

Spectral reflection curves for polished alloys, after Hurlburt. Mach's magnalium has 69 parts aluminum and 31 parts magnesium in 100 (see "Amateur Telescope Making," page 317). Wood's alloy consists of bismuth, lead, tin, and cadmium. Stellite consists of chromium, cobalt, and tungsten. Stainless steel is usually 18 parts chromium, 8 parts nickel, the remainder iron. Brandes-Shumann alloy has copper 41, nickel 26, tin 25, iron 8, antimony 1. Duralumin has aluminum 94, copper 4, manganese 1, magnesium 1. Speculum metal has copper 68, tin 32, and is a very brittle, cantankerous alloy to deal with

One might fear that when air was admitted, this coating would oxidize and be spoiled, but it covers itself with a uniform, transparent, and almost infinitesimally thin film of oxide and suffers no further change. This film is what makes the process valuable. Aluminum oxide is one of the hardest known substances, appearing in nature as corundum (emery) or in its precious forms as ruby or sapphire, and the tenacious coating which automatically forms on the surface has extraordinary protective powers. The film can be washed with soap and water—ordinary soap and water—without damage. Indeed, this suffices to clean off any dust or faint bloom, and no polishing is necessary. Its chemical and mechanical resistance is amazing. A few days ago the writer saw a young physicist take a brilliant aluminum-on-glass mirror and pour concentrated nitric acid over it. A silver mirror would have vanished in the twinkling of an eye, but this one was utterly unaffected and, when washed under the tap and dried with a soft paper handkerchief, was a little brighter than before. Then came a still more amazing test—a strip of sticking plaster was laid on the mirror, rubbed down and pulled off from one end, leaving no trace of injury! These films can, however, be dissolved by caustic alkali solutions, which is convenient for removal of an imperfect attempt.

No one knows yet how long the film will last without tarnish under good conditions—the process has not been invented long enough—but no serious trouble has appeared in a year's service.

The reflecting power for visible light is about 85 percent—slightly less than for new silver but better than silver even slightly tarnished. In the ultra-violet it remains above 80 percent as far as 2500 angstroms. With aluminized mirrors and quartz prisms and lenses, the stellar spectrum between 3400 and 3000 angstroms should now be easily observable.

No one who has seen the new mirrors doubts that the future is theirs. At the Mount Wilson Observatory, for example, all the auxiliary mirrors of the great telescopes—some of them 30 inches in diameter—are being treated by this new process, by co-operation with the California Institute of Technology in whose laboratories a special vacuum apparatus has been developed, capable of taking things up to this size. The troublesome problem of getting the glass surface perfectly clean has been solved and the process is "in production."

THE amateur telescope makers—of whom many, it is hoped, may read this—will naturally inquire: What chance have we at this great improvement? The individual amateur would probably find the process impracticable. The construction of an aluminizing apparatus big enough to hold a good-sized mirror, vacuum-tight up to the requirements of an X-ray tube, and provided with the necessary devices for exhausting the air and volatilizing the aluminum, involves considerable time and cost, and its operation demands a skilled technique acquired only after a good deal of laboratory experience. The average telescope maker can hardly hope to set up so elaborate an outfit, but there seems to be no reason why a co-operative effort might not succeed. Someone with special interest in the problem might tackle it and, if successful, might be in a position to supply his brother astronomers—amateur or even professional—with this new and admirable advantage.—*Mount Wilson Observatory, Nov.* 30, 1933.

SCHEDULED ATLANTIC FLYING

By REGINALD M. CLEVELAND

HOW?

LARGE projects, especially those which stimulate the imagination, commonly evoke no little foolish speculation and theorizing in the public prints. This notably has been the case in the discussion of an air line or air lines linking the new world with the old across the Atlantic Ocean. It is pardonable, in view of the rapid flux of aviation development, that guesses concerning equipment to be used for such service have sometimes been wide of the mark. Some of the pronouncements, however, especially some of those emanating from the other side of the big pond, have been little short of ridiculous.

Atlantic air service—leaving out of account for the purposes of this article scheduled service by dirigible, which is already a fact as regards the Southern route, and seems to be peeking happily around the corner as regards the Northern—divides itself into two very distinct spheres. These are the North Atlantic and the South Atlantic. For the purposes of heavier-than-air travel they are in rather strong contrast with each other.

The South Atlantic is an arena for a trade struggle in which European nations, notably France and Germany, are contending with the United States for speed of communication, primarily for the mails, between the great Latin American cities and their home capitals. The advantage seems likely to remain with the United States, for in this case our air-borne mails, passengers, and express, already being carried with splendid efficiency which has reached 99 percent plus of scheduled flights completed, through Pan-American Airways' highly developed system, do not need to cross any major ocean to reach their goals.

Both the French and the Germans, however, are attacking the problem of the South Atlantic project with vigor. The Germans have shown how efficiently the Reich and the Republic of Brazil can be joined by airship service.

GERMANY is now conducting an interesting experiment with heavier-than-air transport, sending mails down the West African coast to Bathhurst in British Gambia, and thence, in Dornier Wal flying boats, across the stretch of sea amounting to nearly 1900 miles between the African and Brazilian coasts, in two hops. The flight is broken near mid-ocean by the use of a mother ship which serves at once as receiving and sending air field; the converted steamer *Westfalen* cruises about a limited area and gives the on-coming plane her location by radio. As the flying boat approaches, the *Westfalen* proceeds under slow way in the same direction as the plane's flight, creating with a drag sail a "slick" in her wake. The plane lands in this smooth area, and

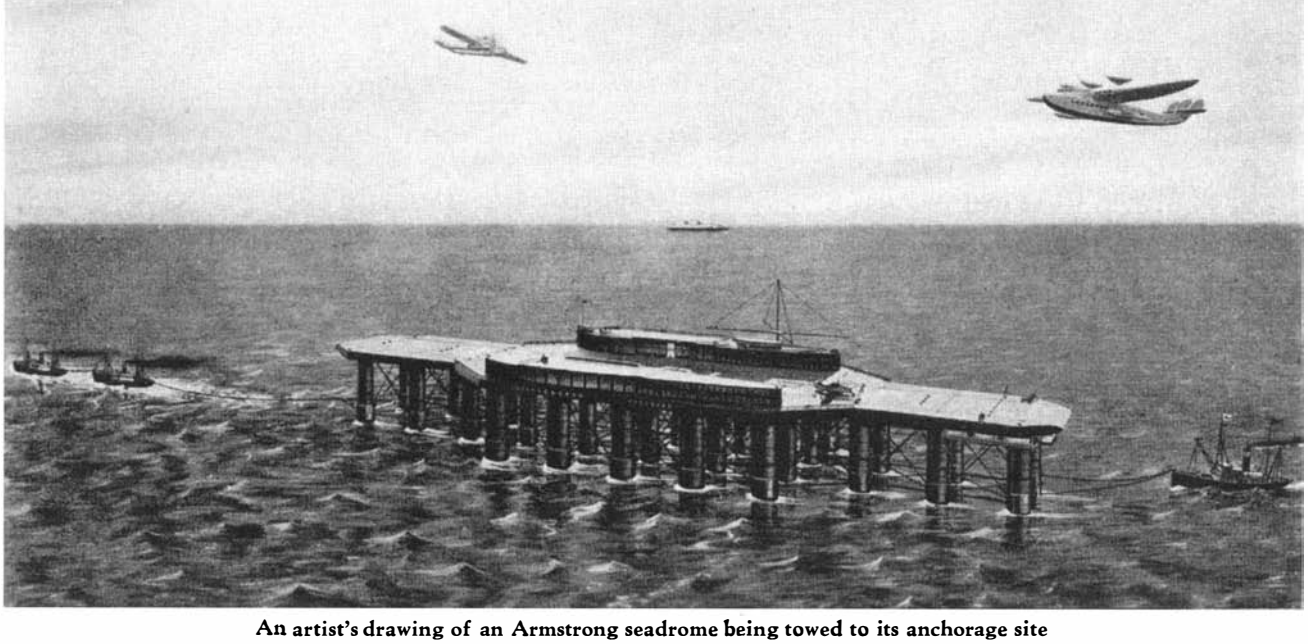
WHEN?

the vessel, gathering speed, draws the sail up closer to the surface of the water, so that in effect it becomes a slightly submerged ramp. The plane taxies thereon and is lifted over the stern by booms. Then the same plane can either be serviced and refueled, and catapulted from the deck for the second stage of the journey, or the load can be transferred to a second waiting plane as desired.

The French seem committed to the single hop method, and have made test flights between Dakar in Senegal and Natal, Brazil, with flying boats carrying mail. Several French designers have produced long-range load-carrying boats which are intended for this service. Should they prove successful, they will substitute wings for the fast dispatch boats or "avisos" which have heretofore been used to carry across the stretch of sea the mails which are flown from France to her African colony and again flown from the easternmost point of Brazil down the coast to Rio and Buenos Aires.

The North Atlantic presents a different problem, and it is about this problem which most of the unjustifiable speculation has centered.

In the first place, in the nature of things, service by airplane across the North Atlantic must be a co-operative and international undertaking, rather



An artist's drawing of an Armstrong seadrome being towed to its anchorage site

than a strictly competitive one. Harbors which must be used by flying boats, whatever route or routes be selected, are under the sovereignty of different nations. For example, the ports of the United States coast are under our own jurisdiction; Bermuda and the Canadian outposts are under that of the British Empire; Greenland and Iceland—where concessions have already been granted to Pan-American Airways—owe Danish allegiance; and the French have long-term concessions in the Azores which, even should they be abandoned, as has lately been rumored, would revert to Portugal.

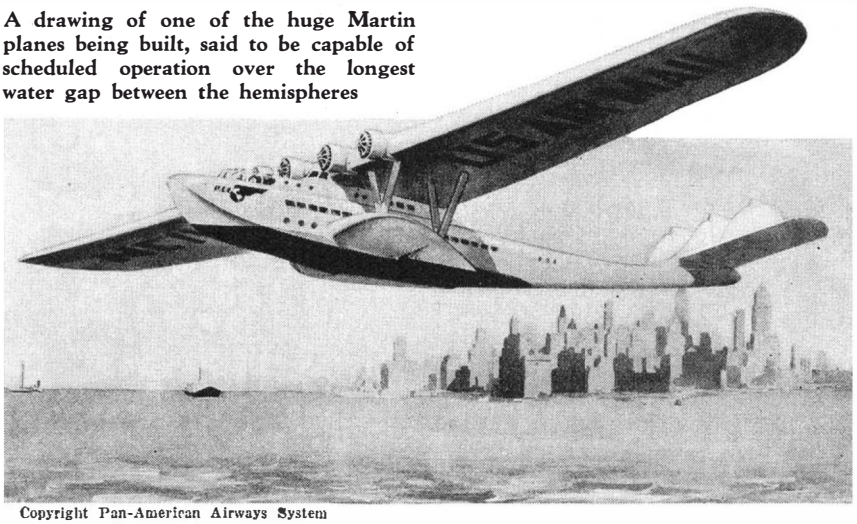
The British, the Germans, and the Danes, as well as American interests, have conducted and in some cases still are conducting, careful surveys, both geographical and aerological, of the route by way of the northern islands. Portions of this route have also been surveyed from the air during recent months by Col. Charles A. Lindbergh and his wife, the Colonel flying in his capacity as technical adviser of Pan-American.

IT is obvious that the North Atlantic field is still a subject for study and survey. Those who profess to say that a specific route of scheduled airplane service will be flown at a specific date are drawing on imagination rather than fact. Nevertheless, there can be no real doubt that such a service will be instituted, and little question that Imperial Airways, Air France, and Pan-American Airways, with the last named the operating unit, will all play parts in the perfected drama.

It has been announced by the Secretary of Commerce that 1,500,000 dollars will be appropriated from the recovery funds by the Government for the construction of a quarter-section of one of the seadrome landing fields long advocated by Edward R. Armstrong. The implication that, should this section prove its case, the Government would construct a chain of five such seadromes across the North Atlantic at a cost of about 30,000,000 dollars, has injected another element of intense interest into the Atlantic airline question.

Basically, the seadrome is a landing platform 1200 feet long and 350 feet wide, supported by streamlined, telescopic columns which extend far below the surface of the sea. Utilizing the known fact that below a comparatively trivial depth there is no wave motion in the ocean, no matter how tumultuous the surface billows, Mr. Armstrong has placed his ballasting chambers deep in this zone of perpetual calm. At the same time he has raised the platform out of the water far above the highest recorded wave level. By reason of both these factors, and the open character of the columnar supports of the platform, it remains level and unmoved in calm and storm.

A drawing of one of the huge Martin planes being built, said to be capable of scheduled operation over the longest water gap between the hemispheres



Copyright Pan-American Airways System

Critics of the seadrome plan—and they have been not a few, including fliers of as much experience as Clarence D. Chamberlin—allege:

That before a chain of seadromes could be constructed, flying boats will be in the air capable of making the North Atlantic crossing by way of Bermuda and the Azores, for example, with pay loads.

That, while from an engineering standpoint, the landing fields may well do what their designer contends they will do, their maintenance cost would prove prohibitively high.

That they necessitate the use of land planes over stretches of water 500 or 600 miles long, or of amphibians which, in large sizes, are too heavy to be economically practical.

That, if it is desired to break the Atlantic stretch into shorter segments than those provided by natural islands on either northern or southern route, mother ships of the *Westfalen* order could provide such intermediate points at a fraction of the cost.

The advocates of the seadrome idea contend, however:

That even when planes of sufficient range for the Atlantic journey, say by way of Bermuda and the Azores, are flying, their pay load could be multiplied by four by refueling them in the air or at sea from the seadrome bases.

That reliability of airplane performance has reached the point where 500 mile stretches are not to be considered hazardous, and that even if land planes were to be used over such stretches, they could be provided with flotation gear, as are carrier fighting craft, so that, in emergency, swift power cruisers based at the seadrome could rapidly effect rescue of crew and cargo.

That such a chain through the medium of tolls, would be a swiftly self-liquidating investment, and of as great importance to the nation as the Panama Canal.

That the steady, ample landing fields, provided with every sort of comfort, from hotel to swimming pool, would serve as the surest haven which could be provided for aircraft, having fixed position and dependable stability, regardless of weather.

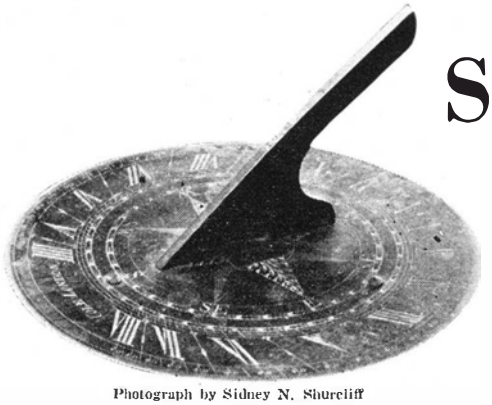
WHETHER or not a seadrome chain, with its many intriguing possibilities, is forged to join us by a series of giant links with the Old World, there can be no question that heavier-than-air equipment, fit to make the journey, will soon be in the air.

The first of the giant flying boats under order for Pan-American may have emerged from the Sikorsky plant at Bridgeport ere this issue reaches its readers. It will have a range of 2500 miles against a 30-mile head wind, with a mail load of at least 500 pounds. It will have a 1200-mile range, with 32 passengers, and at least a 600-mile range with 50 passengers. These specifications apply also to its two sister ships under order. The three flying boats for the same line being constructed at Glenn Martin's Baltimore plant will apparently have even larger range and capacity. (See also page 166, March 1933 SCIENTIFIC AMERICAN.)

Conquest of the North Atlantic for scheduled flight does not mean that argosies of airplanes will carry the bulk of tourist travel to Europe this year or next. It does not mean that fast ocean liners must rust at their anchorage. Only those whose zeal outruns their judgment think of it as a threat to the steamship business.

It does mean a magnificent speeding up of that small percentage of the mails which is really urgent—that a vital document can probably be delivered from San Francisco to London by air in 48 hours or less, and that where time is really of the essence of things, statesmen can be whisked from the shadow of the Washington Monument to Downing Street in perhaps two nights and a day.

The dream forged in the splendor of the *Spirit of St. Louis* is coming true.



Photograph by Sidney N. Shurcliff

SUNDIALS AND THEIR CONSTRUCTION—I

Planning Simple Equatorial and Horizontal Dials

By R. NEWTON MAYALL
Landscape Architect
and MARGARET WALTON MAYALL, M.A.
Research Assistant, Harvard College Observatory

A SUNDIAL shows apparent solar time; but, because of the variation in the length of its days and hours, this is not satisfactory for scientific purposes. Therefore, man has made use of a fictitious "sun," which moves uniformly in the celestial equator. By means of this fictitious sun, mean solar time (watch time) is obtained.

The difference between mean time and apparent time is called the equation of time, which never amounts to more than a quarter of an hour. By using the equation of time a sundial can be constructed which will be an accurate timekeeper, the accuracy depending upon how carefully the hour lines are laid out, the size of the dial, and the division of the hours. It is not impossible to construct a dial that will show the time accurately to the nearest minute.

The hour lines for a sundial may be described upon almost any surface, in any position. Rarely, however, does occasion arise for constructing a dial on any but a plane surface and in either a horizontal, vertical, or reclining position.

There are many different ways of computing the hour lines for each type of dial, all of which are good. The geometric method will be described, because of its simplicity; also because only the most common materials are necessary for the construction of the hour lines by this method, such as pencil, paper, straight-edge, compasses, and protractor.

There are also many ways of laying out the hour lines by the geometric method, but only the simplest and most accurate constructions will be illustrated. For their use no knowledge of mathematics or astronomy is necessary. The accuracy of this method is determined by the care used in drawing the elemental lines. The ease and quickness with which the hour lines may be laid out make it very practical.

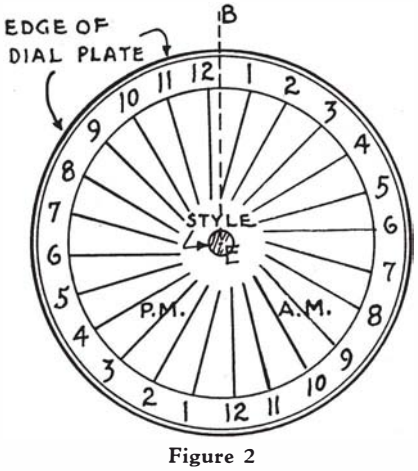


Figure 2

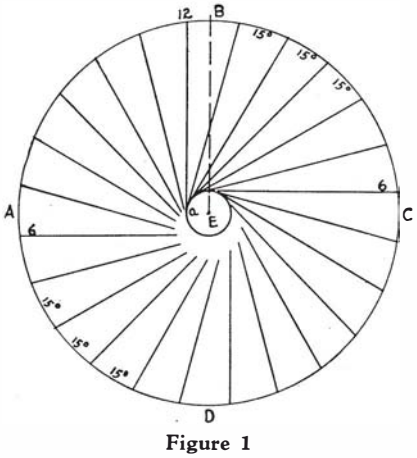


Figure 1

Before the hour lines for a dial can be computed, certain facts must be known. These are: 1—The plane in which the dial will lie. (Horizontal, vertical, or otherwise.) 2—The latitude of the place where the dial is to be used. (The latitude may be obtained from any good map. If greater accuracy is desired use the United States Geological Survey maps.)

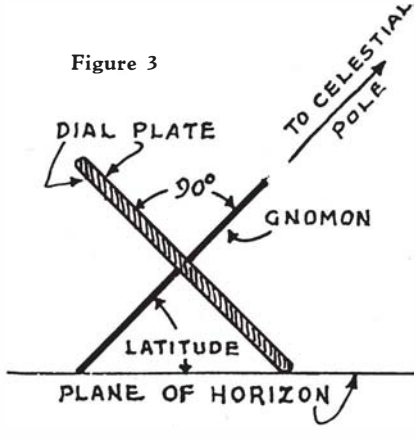
IT is also well to remember that the style should lie parallel to the axis of the earth and point to the celestial pole, and that the style and 12 o'clock line should lie in the plane of the meridian of the place. For those who are not familiar with the names applied to the various parts of a sundial, and as an aid to a proper understanding of the text, the following is a list of parts with a description of each:

Meridian: A great circle of the celestial sphere, passing through its poles and the zenith of a given place. A line on the earth, the plane of which, if produced, would cut the celestial sphere at its pole. This line must be determined before the dial can be placed in position to tell time. A simple and easy method for determining the meridian line at any given place will be described in a later article.

Hour angle: The hour angle of the sun is that angle or arc measured by the time which has elapsed since it was last on the meridian. Since this angle depends upon time, it is usually measured in hours and minutes, instead of degrees. The hour is equal to 1/24 of a circumference, and since there are 360 degrees in a circumference, one hour is equal to 15 degrees, two hours equal 30 degrees, and so on.

Hour lines: The lines described on any surface for the purpose of telling time.

Figure 3



Dial plate: The surface upon which the hour lines are described.

Gnomon: Any object which, by its shadow, serves as an indicator.

Style: That edge of the gnomon, elevated above the dial plate, which casts a shadow when the sun shines upon it.

Substyle: The line upon which the style is erected, perpendicular to the plane of the dial. The base of the gnomon.

Height of the style: The angular or

linear distance of the style above the substyle.

Substyle distance: The angle which the substyle makes with the meridian or 12 o'clock line.

Center of dial: In sundials, the point where all the hour lines meet.

Declination of the dial: The angle measured between the meridian passing through the dial, and a plane perpendicular to the plane of the dial. This angle is always measured from the south or north toward the east or west.

THE equatorial dial is the simplest form of the sundial and the easiest to construct. The plane of the dial lies parallel to the plane of the equator and it can be used at any place on the earth, provided the style is inclined at an angle above the horizon equal to the latitude of the place in which it is to be used.

The style is a round rod, which passes through the dial plate and is perpendicular to it, and it should point to the celestial pole. The substyle is at the center of the dial, at the point *E*, Figure 1. The height of the style is determined by the size of the dial plate and is usually made from 6 to 8 inches.

The construction is as follows:

With *E*, Figure 1, as a center, describe a small circle whose diameter is equal to the diameter of the style.

Also, with *E* as a center, describe the circle *ABCD*.

Draw *EB*, for the meridian; then draw the line 12*a*, for the 12 o'clock line, parallel to *EB* and tangent to the small circle representing the diameter of the style.

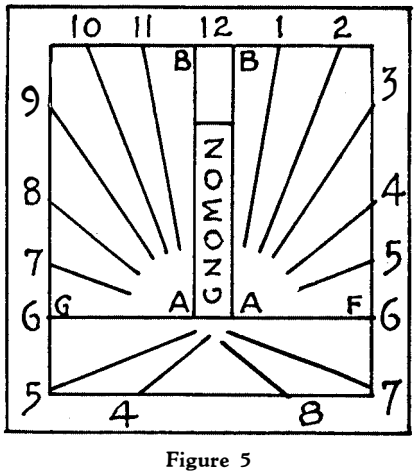


Figure 5

Now divide the circle into 24 equal parts, beginning at the point 12; and from the points thus found draw lines tangent to the small circle and on the same side with 12*a*. These lines will be the required hour lines.

When the style has been erected perpendicular to the dial plate the hour will be shown by the left-hand edge of the shadow. (*Note:* If the style is less than 1/8 inch in diameter, or if the rod tapers to a point at the top, all the hour lines will be drawn from the center, at *E;* and the division of the hours will begin at the point *B.*)

Figure 4

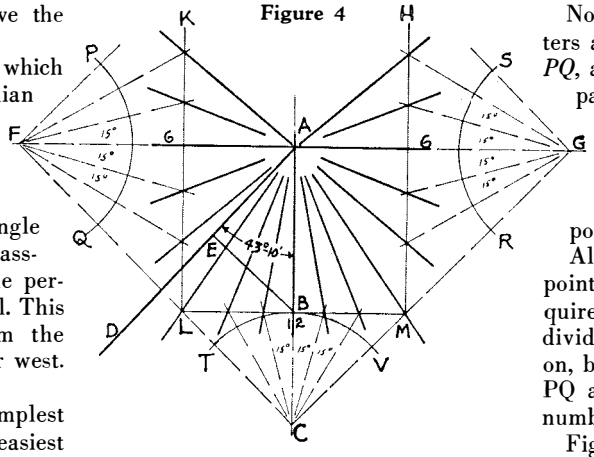


Figure 2 shows the hour lines transferred to the dial plate, and the method of numbering them, on the upper or north face.

Figure 3 shows the position of the dial when in use.

This dial will show the time from sunrise to sunset throughout the year, if the hour lines are inscribed on both faces of the plate. Otherwise the dial would show only the time during the six months of summer, between the equinoxes.

An equatorial dial must be so placed that the style points to the celestial pole, which will be at an angle above the horizon equal to the latitude of the place. The plane of the dial must be perpendicular to the style, and the 12 o'clock line must lie in the plane of the meridian.

THE horizontal dial is the most common type of dial. Its plane lies parallel to the plane of the horizon. Figure 4 shows the construction of the hour lines for the latitude of 43°10′.

The style points to the celestial pole. The substyle is the 12 o'clock line and lies in the plane of the meridian. The height of the style is equal to the latitude of the place (43°10′ in the instance chosen for an example).

The construction is as follows:

Draw the horizontal line *FAG*, Figure 4. (This will be the 6 o'clock line.)

At *A*, draw *AC* perpendicular to *FAG*. (This will be the 12 o'clock line.)

Draw *AD* so that the angle *DAC* is equal to the latitude of the place. (In this case 43°10′.)

From *B*, on *AC*, draw *BE* perpendicular to *DA*.

Make *BC* equal to *BE;* then make *AG* and *AF* equal to *AC*.

Draw lines *FC* and *CG*. Through *B* draw a line parallel to *FG*, cutting *CG* at *M*, and *FC* at *L*. Through the points *L* and *M* draw the lines *LK* and *MH* parallel to *AC*.

Now, with the radius *BC*, and centers at *C*, *F*, and *G*, draw the arcs *TV*, *PQ*, and *SR*. Divide these arcs into equal parts of 15 degrees each. Draw lines from *F*, *C*, and *G*, through the points thus found, until they cut the lines *KL*, *LM*, and *MH*. Draw lines from *A* through the points found on *KL*, *LM*, and *MH*. Also draw lines from *A* through the points *L* and *M*. These will be the required hour lines. The hours may be divided into halves, quarters, and so on, by further subdividing the arcs TV, PQ and SR, Figure 4, into the desired number of parts.

Figure 5 shows the hour lines transferred to the dial plate, and the way in which they should be numbered.

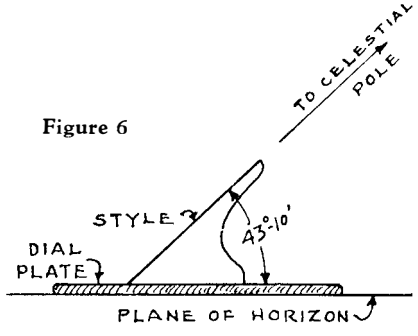
Figure 6 shows the position of the dial when in use.

This dial will show the time, in the latitude for which it is constructed, from sunrise to sunset, throughout the year.

To set the dial, first place it in position and carefully level it. Then orient it, so that the style points to the pole and the 12 o'clock line lies in the plane of the meridian.

(*Note:* When the hour lines are transferred to the dial plate, allowance *must* be made for the width of the gnomon. In Figure 5 this has been exaggerated. Thus *BB* and *AA* represent the width of the style. Also note that the 7 and 8 hour lines in the evening do not converge in the same point as the afternoon hours, but on the opposite side of the gnomon where the morning hours converge, because they are the prolongation of the same hours in the morning. The same is true of the 4 and 5 hour lines in the morning.)

Figure 6



THE horizontal and equatorial dials are often used as accents or focal points in the garden or on the lawn. They should be placed where there is little or no interference from the surrounding buildings and trees.

●

The next article will describe methods for determining a meridian line, the declination of a plane, and the construction of the south vertical dial.

THE AMATEUR AND HIS MICROSCOPE—VIII

THE DETECTION OF FOOD ADULTERATIONS AND SPOILAGE—II

By K. BERNICE FICK, B. S.
Kroger Food Foundation, Cincinnati, Ohio

(*Continued from January*)

FINELY ground woody substances added to coffee and spices are more difficult to detect than are starch granules, but by constant examination of the pure and unadulterated product the microscopist can quite readily find and identify such substances as sawdust, ground bark, ground cocoanut hulls, bran, hulls, and weed seeds. Products of this type are examined unstained, either in a water or glycerine mount.

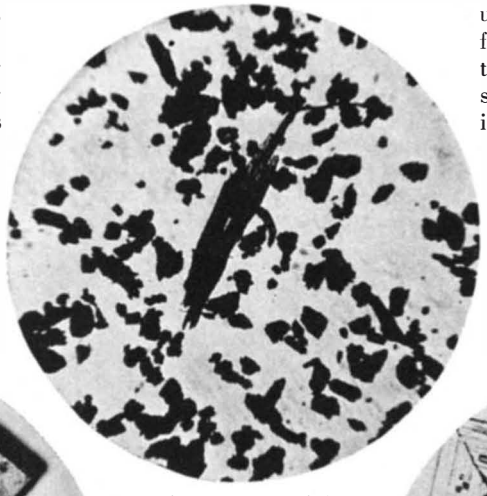
Tea sometimes is treated with a very small quantity of certain coloring materials to give it a bright color or a gloss, in order to make a poor grade of tea appear to be of a higher quality. But if the dust sifted from such a product is examined under a microscope, the solid particles of the coloring material can readily be found. Other leaves are seldom added to tea as an adulterant, but in such a case the foreign leaves are easily detected after the tea has been soaked in hot water for a few minutes to allow the leaves to uncurl, and carefully spread out on a piece of glass, because the true tea leaf is very characteristic in shape and structure, and is easily distinguished from other leaves.

Of course there are some types of food adulterations that cannot be found with a microscope, but must be found by chemical analysis. Although the detection of preservatives and dyes is chiefly accomplished by chemical analysis, some can be found by a careful microscopic examination of the material for certain crystalline and unusual structures which readily can be identified.

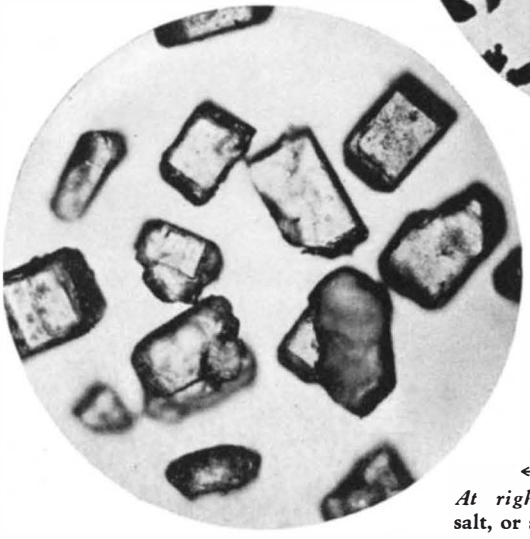
Some crystalline structures are beautiful under the microscope, and here again the amateur microscopist can find numerous crystalline substances right in his own kitchen. Salt, sugar, borax, and Epsom salts are all beautiful under the microscope. The most perfect crystals are obtained by dissolving some of the material in a little water, and allowing a drop of the solution to dry on slides, and then examining the slides without cover glasses under the microscope. This should be adjusted to give about 100 diameters magnification.

The use of artificial dyestuffs in cheaper varieties of jellies, jams, catsups, and sauces gives these products a very desirable color, and tends to mislead the public and to create the wrong idea of the true color of the pure food. Many food colors are harmless and unobjectionable when used in confections and desserts, but when used to cover inferior quality, they are properly considered as adulterants. In detecting some dyes, a microscopic examination reveals small particles of pigments which are not soluble in water, or which have been crystallized out by chemical treatment.

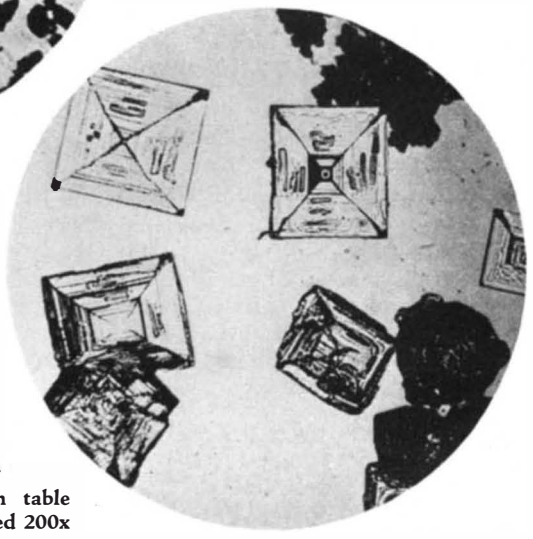
SOMETIMES coloring materials are added to tomato products to cover up the use of sub-standard or unripe fruit. Even though the product appears to be of excellent quality, the microscopist examines it just as carefully as if it were brownish or off-color. He can soon tell whether the manufacturer used wholesome ripe tomatoes, green tomatoes, or tomatoes which were over-ripe and spoiled. He examines the particles of the fruit to determine its degree of maturity, and also searches for the yeasts, molds, and



White pepper adulterated with ground cocoanut hulls (note one showing in center). x200



Left: **Grains of cane sugar, magnified about 50 times**



← Courtesy Bausch and Lomb →

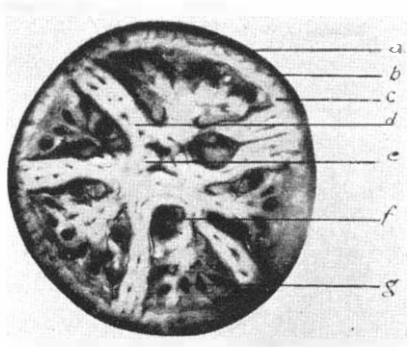
At right: **Crystals of common table salt, or sodium chloride, magnified 200x**

bacteria, which, although killed by sterilization, are present in the product. The number of these organisms reflects the quality of the raw material used; and, by finding the percentage of the fields containing mold, by using a specially designed slide, the microscopist can determine the percentage of spoiled material put into the product when it was manufactured. He can tell, by the type of organisms present, whether the tomatoes were too ripe, improperly trimmed, or whether the equipment used in the preparation of the product was unclean and improperly sterilized.

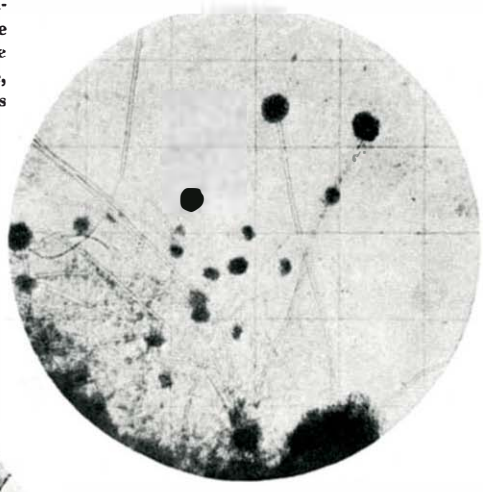
Although the amateur cannot expect to count the molds in tomato products accurately, he can familiarize himself with the general structure of the tomato and of the various types of molds that he would expect to find in finished tomato products, and in that way prepare himself later to approximate the results of the skilled microscopist.

His first duty is to collect several sound tomatoes, and a few with decayed spots of different types. If the spoiled fruit cannot be found it can be prepared by allowing sound tomatoes to stand at room temperature for several days until a growth of mold is visible.

HE should examine the sound ripe tomato first. By cutting it in half transversely the various parts can be noted—the pericarp or the fleshy wall surrounding the seed cavity, the epicarp or skin, the mesocarp or middle layer of the pericarp, the endocarp or inner layer of the pericarp, the septa or the dividing walls, the seed cavities, and the core. Then, with a pair of forceps or tweezers, a small strip of the epicarp (skin) is stripped off and is floated in a drop or two of water on a clean glass slide, covered with a cover glass, and examined under the microscope, which has been adjusted to give a magnification of 90 to 100 diameters. Very thin sections of the endocarp and mesocarp are examined in the same manner. Small bundles of fibers can be found penetrating these sections, and these particularly should be noted as they very easily might be confused with pieces of mold filiment. The microscopist then should examine a thin cross-section and a thin longitudinal section of the core, and some of the gelatinous substance surrounding the seeds. After this is completed he is ready to examine the decayed tomatoes.



Cross-section of a common tomato: *a, b, c,* pericarp; *a* being the epicarp, *b* the mesocarp, and *c* the endocarp. *D* is a septum, *e* the core, *f* a seed cavity, and *g* several seeds



Left: Aspergillus niger (x100), a type of mold sometimes found on tomatoes. *Right:* Aspergillus clavatus (x100) is a mold causing softening of the pericarp of tomatoes. *Below:* Mucor agariensis from a mushy tomato

The decayed fruit should be examined just as the sound tomato was examined, the parts compared, and the differences noted.

After the microscopist has thoroughly familiarized himself with the structure of the various parts of both sound and decayed tomatoes, he is ready to study the organisms causing the decay. The most prevalent and most easily recognized types of organisms which cause decay are molds.

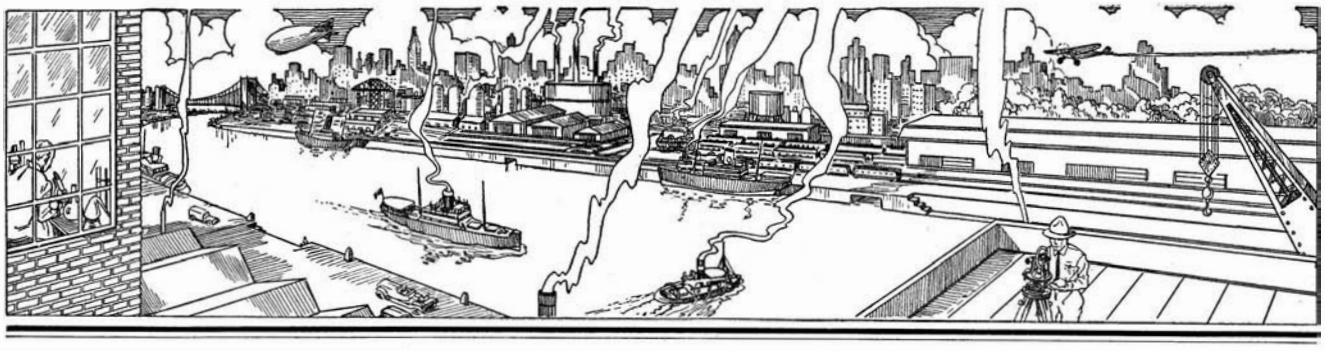
Molds vary greatly in color, shape, size, and method of reproduction, but the types most frequently found in tomato products appear as long hairlike threads. Alternaria, the mold which causes "black rot," produces large amber-colored spores which are shaped like Indian clubs with muriform divisions. This is the mold which most frequently causes decay in cracked and sunburned tomatoes.

To examine the mold, a small portion must be teased from the moldy tomato and placed in a drop of oil or glycerine on a clean glass slide, where it is carefully spread out with needles, a cover glass dropped over it, and examined under the microscope, which is still set to give a magnification of 90 to 100 diameters.

Tomato products such as tomato juice, purée, and catsup can be examined, but even to approximate the results of the skilled microscopist, the amateur must supply himself with a specially designed slide and cover glass, and should study thoroughly and follow carefully the procedure as outlined in detail in certain government bulletins which should be available at most public libraries.

Time, special training, and experience are required of the analyst before his results are dependable, but this type of microscopic analysis rapidly is becoming routine procedure in all branches of manufacturing where tomatoes and tomato products are used.

It is unfortunate that we cannot always be certain that our food is absolutely pure, but in recent years food manufacturers have been striving to produce better foods than formerly were produced, and they realize that laboratory control is the best check of quality of raw materials and finished products; also that a skilled microscopist can save much valuable time and materials by his routine examinations. Perhaps it is partially because of his vigilance that the foods we buy today are purer and less frequently adulterated than those which were on the market ten or twenty years ago.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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

A. E. BUCHANAN, Jr.
Lehigh University

Motor Cars for 1934

WHAT is probably the most notable advance in motor-car engineering for 1934 is the so-called "Knee-Action" front-wheel suspension used by General Motors. In an attempt to improve riding qualities of cars, many changes in design of front ends have been tried, but always along the same general lines. It has been well known that if the front springs could be "softened," a great improvement would be possible, but any such softening, if carried far enough to achieve the purpose, would result in other troubles with steering and braking. Therefore individual springing of the front wheels was tried and after much development work has been offered to the public.

In the design that has been adopted for Buick, and illustrated in these columns, each front wheel is mounted directly to the frame through two V-shaped arms, one above the other. The arms are hinged at the frame, while the apex of each terminates in a vertical steering knuckle support. Thus both the front axle and the conventional flat springs are eliminated. A coil chassis spring is located between the lower V and the frame. By this construction the spring is relieved of all work except that of carrying the load, and the wheel is left free to move up and down in perfect alignment and without motion in any other direction. With this type of suspension there is considerable spring travel and it was found necessary to help dampen this movement by the installation of rubber bumpers inside the coil springs to take care of compression, and other bumpers on the frame to take care of rebound.

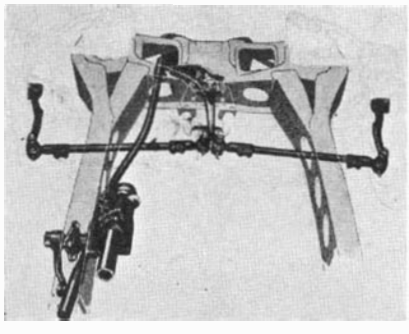
The upper of the two V-arms in the Knee-Action unit is connected directly to the shock absorber mounted on the upper part of the frame. It will be noted from one of the photographs that the whole front end of the car has been redesigned and strengthened to take care of the stresses that were formerly absorbed by the axle.

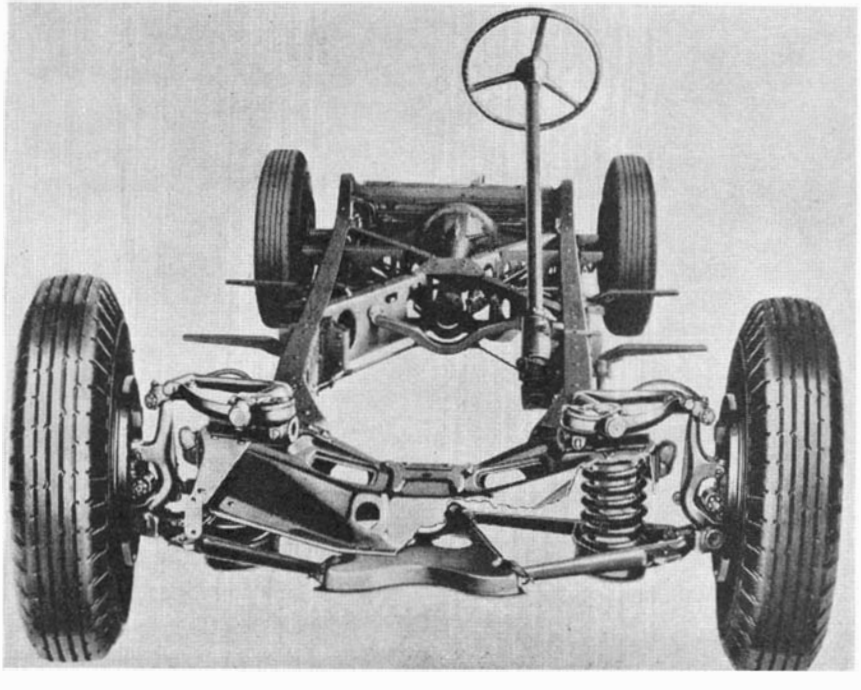
Steering mechanisms with independently sprung arms had to be completely redesigned in order to take care of the wheel action. A bell-crank mounted in the center of the front frame member is connected through a drag link with the Pitman arm. This bell-crank operates individual tie rods to each front wheel.

The above description is of the system used on Buick, Cadillac, La Salle, and Oldsmobile; independently sprung front wheels, also doing away with the front axle, but of different mechanical design, are features of Chevrolet and Pontiac.

Another line of cars which will be equipped with independently sprung front wheels is the Hudson. In these cars will be incorporated what is known as the "Axleflex" method of independent spring suspension, to be furnished as optional equipment. While this new method provides something that might be likened to the knee-action described above, it does not dispense with the front axle which is so designed that flexibility is permitted in a vertical plane.

The outstanding body improvement to be incorporated in the 1934 Ford line is a novel ventilating system which permits the use of single plates of glass in each door. When the glass of the door windows is raised in the conventional manner by turning the handle until the top is reached, another half turn of the handle causes the glass to slide backward horizontally, thus creating a vertical opening between the edge of the door or body frame and the glass. This slot serves as a means of exhausting air from the interior of the body. In addition to normal leakage, the entrance of air in small quantities is permitted through holes in the bottom edges of the doors. This air passes upward within the shell of the door and into the body along the window ledges. The small amount of air thus admitted and the surface over which





Left: **The new Buick steering linkage and, *below*, Buick frame cut away to show spiral spring and "Knee-Action"**

it is spread in entering prevents drafts yet assures an increasing amount of ventilation as one or more of the window slots is opened. There is also a cowl ventilator.

A departure from standard auto finishing practice is found in the Ford bodies where a new enamel, which is claimed to have unusual wearing qualities, will be used for both bodies and fenders of all models. The most noticeable mechanical change in the engine is a dual intake manifold combined with a dual down-draft carbureter. The manifold is combined with the valve chamber cover. The standard Ford models will be equipped with fuel pumps but a limited number of cars will be supplied with a self-feeding carbureter used in conjunction with the present type of single manifold.

Window in new Ford opened from the front edge to permit draft-free ventilation of the interior of the car

Engineers of the Lincoln Motor Company have decided to concentrate upon the production of a single 150 horsepower, 12-cylinder, V-type engine and this will be the only Lincoln power plant available in 1934. It will, however, be mounted on either a 136-inch wheelbase or a 145-inch wheelbase chassis according to the desires of the purchaser. The Lincoln bodies will be equipped with a ventilating system similar to that used in the Ford and described above. New equal-action brakes with cable conduit control and a vacuum brake booster will provide ample braking for even emergency stops with but little pedal pressure. The maximum compression pressure in the Lincoln engine is 132 pounds per square inch but new aluminum cylinder heads are said to permit the use of this high compression without requiring premium fuels. The pistons used in this engine are plated with aluminum oxide which provides an unusually hard surface. (It will be interesting to note in this connection the first paragraph in the center column of page 81 of this issue wherein is described the use of aluminum oxide on telescope mirrors.)

Individual draft-proof ventilating systems were first introduced by Stutz in 1926 and have been available ever since. It is again offered as optional equipment on the 1934 Safety Stutz models. Stutz also offers thermostatically controlled hood doors which eliminate the necessity of the driver opening and closing the doors to conform to weather conditions and engine temperatures. The doors on each side of the hood are controlled independently of the doors on the other side.

De Soto is this year offering the nearest approach to the streamlined motor car that has yet been available in production lines. The reader is here referred to the article entitled "Streamlining and Your Automobile" and particularly to Figure 10 on page 79 of this issue, wherein is shown the general design of a streamlined car similar to that now offered by De Soto. Another feature of the De Soto is that the body and chassis are built in one unit using principles of cross-bracing that have been proved highly successful in bridge construction. Thus the body can be made more rigid and there will be less likelihood of squeaks and rattles over a long period of time.

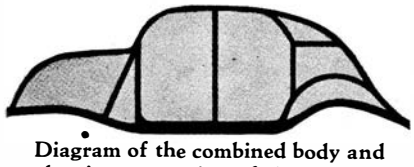


Diagram of the combined body and chassis construction of the De Soto

Physiological Effects of Alcoholic Drinks

AFTER the first glass of champagne we notice the conversation, instead of being spasmodic and forced, becomes general and free. . . . Each man thus not only reveals himself more to his fellows but is more ready to appreciate the merits and conversation of those around him. In a word, the use of alcohol in moderation promotes good fellowship. With this greater freedom of interchange of ideas there is less restraint of gesture; facial expressions become more animated; ideas in every man seem to flow more freely and speech becomes more ready.

". . . But when the party breaks up and its members enter their various automobiles for the trip home, have their psychological reactions and their muscular coordinations been so dangerously affected that, as motorists, they are to some degree menaces to public safety? Or if it is a mid-day meal and they have an afternoon of work in office, shop, or factory before them, have their physical and mental efficiencies been impaired by this convivial feast? . . .

"The basis of discussion of this question (liquor) should be shifted . . . to the sounder basis of the control of the sale of alcohol as a narcotic drug. However, the use of alcoholic liquors by a large proportion of the population is a striking testimonial to its contribution to the pleasures of life and to conviviality. The solution of the question of liquor control should possibly be a compromise between these opposing arguments."

The above comments, taken almost at random from a three-page article with graphs published by us in our October, 1930, issue, were selected to indicate the availability of a sane and authoritative discussion on this very timely subject. Since a number of people have asked us for an article of this nature, we wish to point out that we covered this subject sufficiently far ahead of repeal to give the opposing forces information to help them carry on their fight. We have recently received several requests that we publish an article of this nature; instead, we have planned to make a separate reprint of this discussion in its entirety for any who may desire it. We will be glad to mail these three-page reprints to our readers for 25 cents each, or will be glad to make a special low quotation on large quantities.

Too Much Medicine

MEDICINE droppers with flared tips are not sufficiently accurate to use in measuring a dose of medicine prescribed in drops, it appears from studies by Professor William J. Husa and Lydia J. Husa of the University of Florida. In their report to the American Pharmaceutical Association they mention the case of a child who showed symptoms of overdosage with belladonna as a result of the use of this type of dropper for measuring the dose.

Droppers with flared tips are commonly used for dropping liquids into the eye, the flared tip serving to protect the eye from injury. When used for medicine to be taken internally, the Florida scientists recommend that the dispensing pharmacist check the size of the drops from the dropper before giving it to the patient. The drops from such droppers were found to be from 35 to 60 percent larger than the standard size drop recommended by the International Pharmaceutical Conference at Brussels.—*Science Service.*

Research Makes Little Failure A Big Success

MEN have been recognized and honored for their contributions to science, but it was not until December 8, 1933 that a company was singled out for recognition of group effort and attainment in chemical engineering. The Carbide and Carbon Chemicals Corporation was the company so honored, and the award was made by a distinguished committee of chemical engineers in behalf of the technical journal, *Chemical and Metallurgical Engineering.* This honor was conferred in recognition of the company's unique feat of creating a great synthetic aliphatic chemical business.

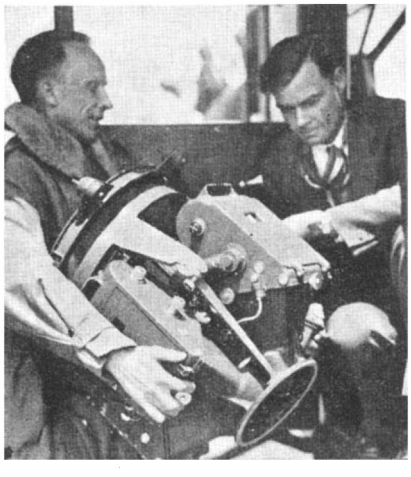
Among the many interesting developments recounted in connection with the award is the story of "Flavorol." According to reports, a number of years ago the research laboratory developed a product that might be substituted for ethyl alcohol in the making of flavors, extracts, essences, and the like. It was christened "Flavorol." It seemed to have all the desirable properties and was an exceedingly good solvent. But marketing was not allowed to begin at once. The management knew this product was to go into many cosmetics, pharmaceuticals, or even

foods. Its physiological properties were investigated by the corporation with the use of thoroughly competent toxicologists and physiological chemists engaged specifically for this purpose. The result must have been something of a shock to the management. The product was so good a solvent that it dissolved material from the stomach and intestinal linings undesirably. No attempt was ever made to market the product for these uses.

"Flavorol" seemed doomed to suffer untimely demise. But a compound with these valuable properties certainly ought to be useful, so the research executives reasoned. They tried it out in new fields, where internal consumption is not contemplated and the degree of toxicity noted is no greater than that of other accepted chemicals. It became necessary to re-christen the child of the laboratories. And under its new name, it is today widely known as "Cellosolve." It is the most potent and widely used of the cellulose nitrate solvents, a necessity for modern plastic making in many of its subdivisions. Research, seemingly unsuccessful, by more research produced a tremendous success.—*A. E. B.*

Photographing a State from the Air

THE Institute of Geographical Exploration at Harvard University performed a wonderful feat in making an air map of Massachusetts, the first state to be completely covered. The area of 8039 square miles was the largest ever surveyed in this fashion. The altitude of the camera was 15,000 feet and the scale of the photographs was 1/30,000 or two inches to the mile. Only 800 composite photographs were taken, with five exposures to each, and the total flying time was limited to 24 hours 40 minutes. This great achievement was made possible by the use of the Fairchild Five-Lens Aerial Camera, the result of many years development by the Army Air Corps, the Corps of Engineers, and the Fairchild company. This five-lens camera has virtually revolutionized the art of aerial photography.

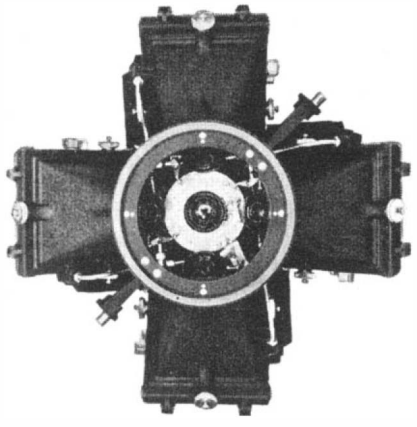


Left: **Preparing to place one of the multiple lens camera in the cabin of the photographer's plane**

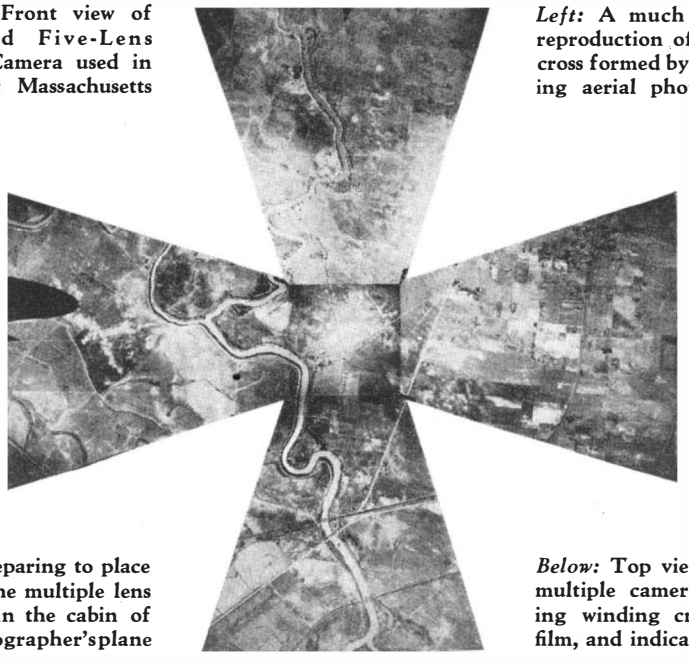
When Lieutenant James F. Phillips of the Corps of Engineers loaded the camera into the Fairchild 71, he was employing a plane standard in every particular, except that the floor had been made thinner in order to avoid interference with the lenses of the camera. The camera hole was located in the rear of the cabin, very close to where the baggage compartment is placed in the regular commercial airplane. By this location, the wheels of the landing gear were almost entirely removed from the field of view of the camera.

The airplane engine was equipped with a powerful blower to maintain power at the high altitude used. Oxygen was supplied to both pilot and photographer to enable them to do their work efficiently. Just behind the pilot a single-lens camera was placed for control purposes, and near each camera hole there was a smaller hole for the vertical view finder. Otherwise no special equipment was called for.

The new camera weighs 104 pounds and is actually five cameras in one. A central lens takes a vertical photograph about five inches square. The four other lenses take oblique photographs simultaneously. The five pictures are assembled into one group in the form of a maltese cross. The camera is able to photograph a larger area in less time than any other camera in the world. A single-lens camera would have required many more photographs and about seven times as long a period in mapping the state of Massachusetts. The camera costs about 12,000 dollars, which includes transforming equipment, arc lights, and so on. The five lenses have to be as nearly identical as possible: actually they are ground down to a common focal length with a variation of less than a quarter of a millimeter. All the final settings and adjustments are done under a microscope. The most precise astronomical instruments are not constructed more carefully.



Above: **Front view of Fairchild Five-Lens Aerial Camera used in mapping Massachusetts**



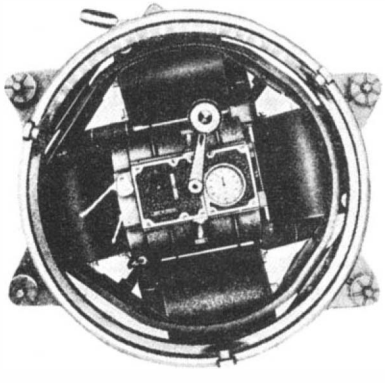
Left: **A much reduced reproduction of maltese cross formed by combining aerial photographs**

Each of the five cameras or chambers has its own film magazine accommodating sufficient film for approximately 200 exposures, but the films in all five are advanced simultaneously by a single crank. The shutters of all cameras are simultaneously tripped. After the film is developed, the negatives exposed in the central or vertical camera are contact-printed. Those obtained in the four oblique chambers are rectified or "horizontalized" and brought to the same scale as the contact print by means of a rectifying printer.

Experience has shown that the most efficent angular scope is about 70 degrees each side of the vertical, for maximum sharpness of the photographic image, which is adversely affected by the large magnification required and by aerial haze.

The covering power is enormous. With the 140 degree coverage (that is, twice 70 degrees on each side), at 20,000 feet altitude the camera photographs a strip of terrain 20 miles wide. This enormous covering power reduces the photographic flying, the instrumental control, and the laboratory work. When using 60 percent overlap, the centers of seven consecutive photographs in each direction fall on each print. As a matter of fact, overlap is used both forward (60 percent) and laterally (50 percent).

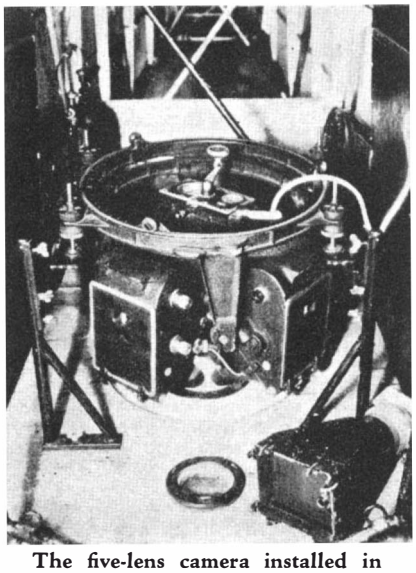
Surveying parties are put into the field and the positions of a number of points which appear on the photographs are ac-



Below: **Top view of the multiple camera, showing winding crank for film, and indicating dial**

curately determined. When these control positions have been obtained and plotted on a master sheet, the photographs are used as plane table sheets as in ordinary ground surveying.

One flight instead of six, and twenty



The five-lens camera installed in the cockpit of a cabin type plane

photographs instead of one hundred is what the five-lens camera achieves.

In the Massachusetts survey, 800 photographs of the maltese cross type were taken. These 800 photographs made a formidable stack eight feet high, for the patient laboratory men to rectify and assemble.—*A. K.*

Australia's Air Trophy

THREE thousand dollars' worth of 18 carat Australian gold has gone to the fashioning of a cup to be presented to the winner of the 75,000-dollar air race from London to Melbourne in connection with the Centenary celebrations this year.

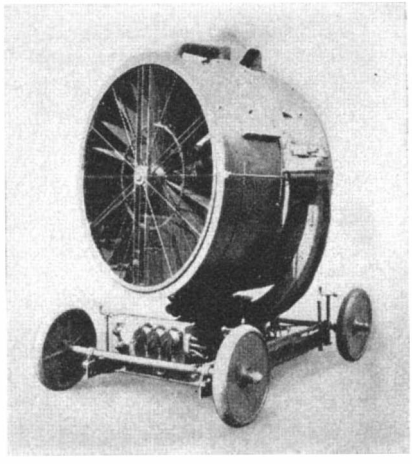
The cup which, with the prize money, has been given by Sir MacPherson Robertson, the Australian millionaire confectionery manufacturer, has just been finished. It is the largest gold cup ever made in Australia. It stands 22 inches high and is in the form of a two-handled vase of classical design. On opposite sides are two solid gold spheres, representing the two hemispheres, surmounted by airplanes. Arrangements are being made for its display in London, New York, Paris, Berlin, Vienna, and San Francisco.

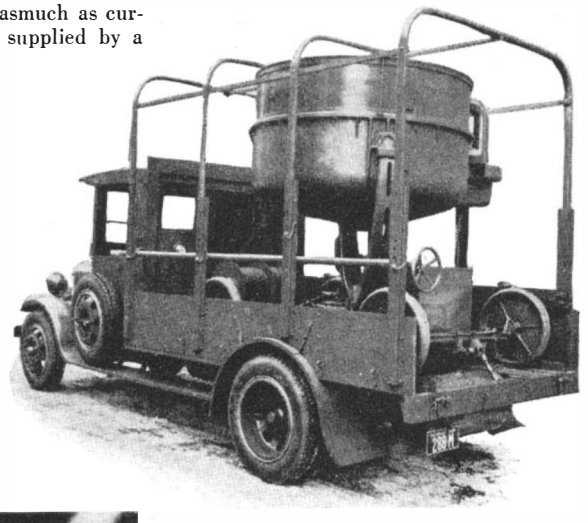
Testing in the Tides

OUR Army Air Corps frequently has to operate in sub-tropical climates; therefore dopes, paints, and protective coatings of their airplanes must be tested for efficiency under sub-tropical weather conditions, as well as moist, salt bearing air. Accordingly, Chapman Field, 15 miles south of Miami, Florida, was selected for a testing station, where wings, bodies, and so on are mounted in exposure racks. Now the severity of the exposure tests has been increased by using "tide-water racks." Wing panels mounted on these racks are subjected to complete immersion at high tide, while at low tides they are exposed to sun and air. These tests will give, in particular, valuable information on the corrosion resisting properties of the metal airplane.—*A. K.*

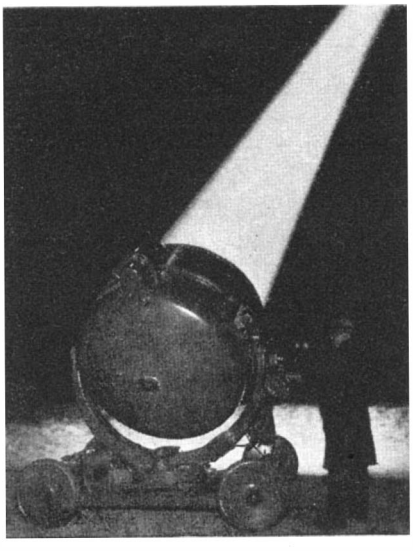
Anti-Aircraft Searchlights

AN important step in the modernization of the equipment of our Army was taken when the War Department announced the awarding of contracts to the Sperry Gyroscope Company of Brooklyn, New York, for 104 sixty-inch high-intensity anti-aircraft searchlights amounting to 2,015,900 dollars. These are the largest and most powerful searchlights in the world. Sixty-one will be mounted on trailers and 43 will be of the mobile type, which are mounted on a small chassis which can be easily loaded on a truck. These searchlights can be operated anywhere that it is possible to drive a truck, inasmuch as current for the searchlights is supplied by a





Upper right: **One of the largest and most powerful anti-aircraft searchlights, mounted on a small chassis.** ***Right:*** **The same light ready for transportation on a motor truck.** ***Below:*** **800,000,000 beam candlepower piercing the darkness, from one of the remarkable searchlights described in these columns**



generator driven by the power plant of the automotive trucks. The power of each light is 800,000,000 beam candlepower, the results of some 18 years' development carried on by the Sperry Gyroscope Company, in co-operation with Army engineers. The rays of these powerful lights have been seen by fliers at distances exceeding 100 miles.

Remote control makes it possible for the operator to stand several hundred feet from the light and yet maintain perfect control of its operation. Remote control is essential in efficiently operating these lights. The useful range of a searchlight is increased by placing the operator at a point remote from the searchlight, thus eliminating the necessity of peering through the beam.

These new lights are constructed of an aluminum alloy which, due to its light weight, makes it possible to produce 480,000 beam candlepower for each pound of weight compared to only 27,000 candlepower per pound developed in older types of searchlights constructed of sheet metal.

Baby Planes

THE recently appointed Director of Aeronautics in the Department of Commerce, Eugene L. Vidal, is an experienced pilot, well versed in aviation matters. He has caused an immense stir in the aviation world by issuing a questionnaire to licensed pilots, student pilots, and mechanics, inquiring whether such men would purchase a baby or "flivver" airplane of low price and certain special characteristics. In the introduction to the questionnaire Mr. Vidal said: "We cannot hope for a natural, healthy, and widespread growth in the private flying business until we develop a product that will appeal to the man who can afford only a few hundred dollars for an airplane. Volume production and consumption of a popular priced airplane will give the proper impetus to an increase in the number of airports, flying schools, flying clubs, and pilots who will fly only for pleasure."

He defined the characteristics of this plane for private use as follows:

"It is comparatively easy to design and turn out, on a volume production scale, a small airplane which will sell for around 700 dollars. Such a craft would be a two-place, low-wing monoplane, constructed of a new steel alloy, fitted with an 8-cylinder small-bore engine of about 4000 r.p.m. and

a geared propeller. The landing speed would be about 20 miles per hour using air brakes. The plane would be rugged and durable and one that would require very little attention. In fact, it is entirely possible for it to be operated for the full span of its life without major overhauls. Rather than subject the airplane to a major overhaul after several years of service, it probably would be more economical to purchase a new one when that time arrived. Arrangements would be made for selling the plane on a credit basis."

There are about 14,000 licensed pilots, 11,000 student pilots, and 8500 licensed mechanics in the United States, and only about 7000 licensed aircraft. Apparently an opportunity exists to sell say 10,000 planes of this "flivver" type. The proposed construction of 2000 new airports, with loans from the R.F.C., would certainly help this market. That the Chrysler Corporation has engaged Major Seversky to develop his

Eugene L. Vidal, Director of Aeronautics in Department of Commerce

plans for a small ship to sell under 1000 dollars is an encouraging omen.

We thoroughly approve of Mr. Vidal's bold plan, but we see some difficulties in its execution.

It is inconceivable that one manufacturer could capture the entire market. There would be keen competition, and hence a reduced volume for each constructor. This would militate against the theoretically conceivable price of 700 dollars.

To secure a landing speed of 20 miles per hour, even with the use of flaps, is extremely difficult. The loading per square foot of wing area has to be so light that the plane becomes one of comparatively large dimensions, and the top speed becomes low. Moreover, a plane with very light loading behaves badly in gusty weather. It partakes more of the character of a fair weather plane, suitable only for airdrome flying or very short cross-country hops.

Alloy steel, of high strength characteristics, is difficult to employ in small planes. The sections small enough to make use of their theoretical strength are too small for practical construction.

If the plane is to be rugged enough to avoid overhauls, its structural weight will be high. This militates against the light loading necessary to give the 20 miles an hour landing speed.

There is no engine of the desired characteristics yet available.

It is not an easy task to design such a plane. It is a task which will test the ingenuity of the designer to the utmost, and one which may require years for its solution. Attempt after attempt to meet a similar specification has ended in only indifferent success.

But if we differ with Mr. Vidal on the technical aspects, we think he is absolutely right in stating the problem, in stimulating thought, and in setting hundreds of eager minds to work in its solution.—*A. K.*

A "Flying Fortress," carrying five machine guns and a bomb

Gasoline More Powerful Than TNT

GASOLINE is an explosive ten times more powerful than TNT, Dr. George Granger Brown, professor of chemical engineering at the University of Michigan, declared in an address on "Combustion of Hydrocarbons" before the Chicago Section of the American Chemical Society.

"We cannot put TNT steadily to work because we do not know how to control its explosion," Dr. Brown said. "No one would think of trying to run an engine on TNT or dynamite because the violence of the explosions would tear the engine to pieces. A gallon of gasoline exploded under the same conditions could do ten times the damage of these high explosives. However, it works harmlessly and usefully because we know how to control and harness its explosive power."

A Flying Fortress

THE Curtiss Aeroplane & Motor Corporation is building 46 two-seater A-12 attack monoplanes for the Army Air Corps, powered with the Wright 700 horsepower Cyclone engine. The A-12 is often referred to as a "Flying Fortress" because it carries five machine guns and a bomb under the fuselage. It is built entirely of metal, including the covering of wings and fuselage. Slots at the leading edge and flaps at the rear edge reduce the landing speed. Pilot and gunner are seated in enclosed cockpits, provided with ample windows. Ships fly far too fast to-day for the open cockpit to be really efficient even for fighting planes.

Bracing wires on the A-12 run out from the fuselage to the upper side of the wing, and to the under side of the wing from the landing gear. The principle of internal bracing is sacrificed, but the structural weight is considerably reduced thereby.

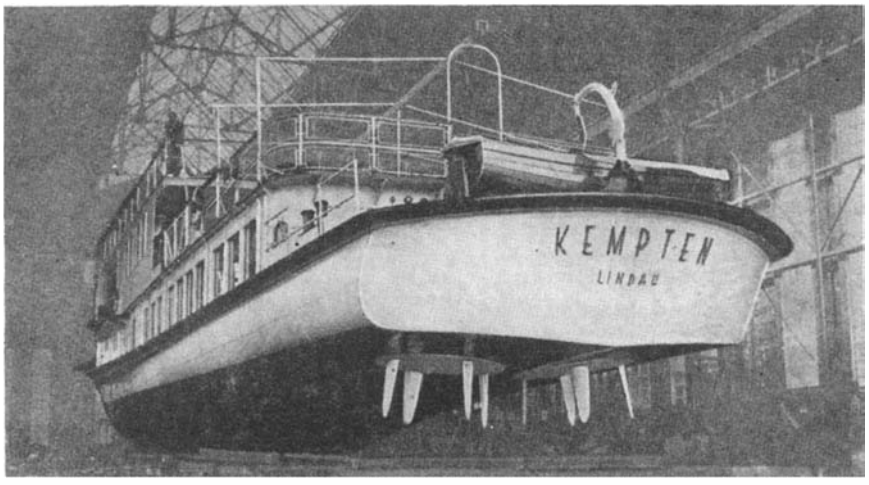
A two-seater attack plane of this type is a terrible menace to soldiers on the march. —*A. K.*

Flying Stewardesses

THE attractive young ladies in the photograph are grouped in front of a Boeing transport of the type used on the

Airline stewardesses

Chicago-Pacific coast division of United Airlines. These young ladies must not weigh more than 120 pounds. They wear trim uniforms, serve luncheons aloft, answer questions concerning points of interest on



Two of the new feathering-blade ship drives installed on the *Kempten*

the airway, provide reading and writing material, see that passengers are comfortably seated in their reclining chairs, and above all maintain the morale of passengers when this sinks low under the influence of strange surroundings!—*A. K.*

Nose Is Gateway Of Invasion

EXPOSED endings of the nerves of smell, in the delicate membranes lining the nose, are the gateway by which the virus of poliomyelitis (infantile paralysis) may enter the system. The nerve trunks to the brain, nerve connections in it, and nerves returning to the body surface are the paths the invasion follows. So long as it stays with nerve tissue, the disease virus is to a large degree isolated from the blood and lymph, so that protective substances formed in the body or introduced into it cannot reach it effectually, and it is free to continue its malignant work.

This, in brief summary, is the story of poliomyelitis invasion, as studied by Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, New York City, and reported before the National Academy of Sciences.—*Science Service.*

(The statements made above have further bearing on the fact, well-known to physicians, that cases of poliomyelitis have been caused by the dangerous practice of pulling hairs from the nostrils, thus opening a path for infection with the virus.—*Editor.*)

Winter in Summer

SHOOTING high into the air from an oil well, carbon dioxide fell in the form of snow and suddenly transformed a torrid bathing beach into a winter scene, according to the Poland correspondent of *Industrial and Engineering Chemistry.* This unique behavior of the gas used to make "soda pop" and "dry ice" occurred at the resort of Krynica in August.

New Ship Drive Uses Feathering Blades

DURING the last few years a series of practical tests has been conducted with a new type of ship drive using a non-reversible constant-speed prime mover which not only gives extreme maneuverability under all conditions but also dispenses with the conventional rudder. Essentially this ship drive unit consists of a series of four or six blades mounted on a disk which is set near the stern of the ship and flush with the hull. The blades arranged near the circumference of the disk or rotor are placed perpendicularly to the hull and are thus completely submerged at all times. The propeller blades have axes substantially parallel to the vertical propeller axis and while rotating around the latter in a circular path feather about their own axes in such a manner that they

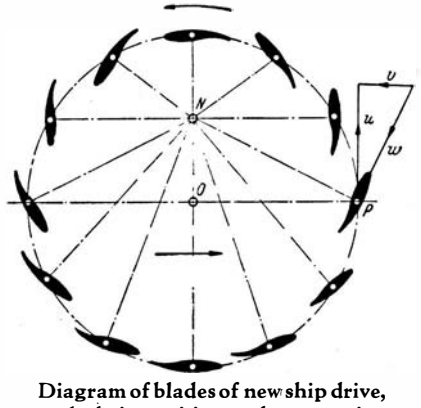


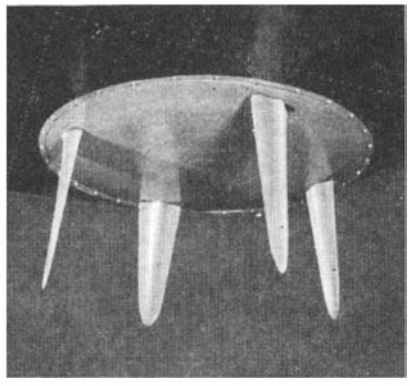
Diagram of blades of new ship drive, and their positions when rotating

cut through the water most efficiently at all times. These blades have been designed in accordance with the best aerodynamic principles and thus reach a high degree of efficiency.

Steering with this type of drive is made possible by the fact that the direction of propeller thrust can be changed at will and set in any direction perpendicular to the propeller axis. Thus the full thrust of the propeller is available for maneuvering purposes in any direction. Propulsion and its control are effected by varying the pitch of the propeller, or, in other words, the magnitude of the thrust, which can be adjusted to all values between full speed ahead and full speed astern, while the direction of rotation and speed of both the propeller and its driving mechanism remain constant.

With small propellers the angle of the blades is controlled mechanically whereas in larger installations the blades are operated hydraulically.

At the propeller controls, which are operated by one man independently of the engineer, there is a wheel which is rotated to change the direction of thrust of the propeller and thereby maneuver the ship, and a speed lever which controls the feathering movement of the blades in such a way that the vessel travels faster or slower while the speed of the propeller remains constant. This Voith-Schneider drive, as it is called, has been installed on several different ves-



Close-up of a four-bladed rotor of the ship drive described herewith

sels ranging in size from 43 feet to 150 feet in length with capacities of 50 to 410 horsepower per propeller. It has been determined that the drive will operate satisfactorily over long periods of time with little or no mechanical trouble and that since the entire operation of the ship is under the direction of one man, a forward step has been made in safety and efficiency in navigation.

Purity Increases Usefulness of Iron

IRON is such a common metal that we think we know all about it. Yet new processes have made available at commercial prices an iron so pure that it is hailed as a "new metal." Analyzing 99.92 percent iron, this metal exhibits properties that open an entirely new field of usefulness for iron, says *Chemical and Metallurgical Engineering.*

As a chemical raw material, the metal is desirable because of freedom from impurities, high content of metallic iron, and lack of iron oxides. In general, this new iron enters into the manufacture of two types of products: organic iron compounds used in the pharmaceutical trade, and iron salts and oxides used in the textile industry and as pigments. Among these, ferric nitrate is used in silk dyeing and weighting and for coloring buff on cotton. Ferric chloride is used as a mordant. Ferrous sulfate (copperas) is used as a mordant and in making ink, Prussian blue, and red oxide. Ferrous acetate is used as a mordant in leather dyeing and calico printing. Ferric hydroxide, called iron buff or Nankin yellow, is used as a dye. The pigments made from oxide are based on the use of pure ferric oxide, F_2O_3, and include red ochre, rouge, and venetian red. The iron is also used in the manufacture of Van Dyke brown and tannate of iron black.

The utility of the metal as a material of construction for process equipment rests upon its unique physical properties and its resistance to corrosion as compared with other ferrous metals. It has a high melting point, 1535 deg., Centigrade, which makes it suitable for heating equipment except that exposed to direct flame and uncooled,

as in roasting furnaces. It also has the ability to withstand alternate heating and cooling almost indefinitely without fatigue, change in structure, or distortion.

The metal, being the softest form of iron ever produced, has been found useful for parts of equipment such as gaskets, shims and spacers, where it is necessary to have a constant thickness over long periods of use. For instance, it may be used for boiler heads, and similar applications where the repeated heating to which it is subjected does not change its thickness.

Another useful characteristic is that the metal will not form an amalgam with mercury under ordinary conditions. This makes it suitable for equipment used in the handling of mercury, as it is naturally less fragile than much of the material that has been used for this purpose.—*A. E. B.*

New Joist-and-Plywood Floor Panel

A NEW type of floor panel built on a principle borrowed from airplane design is demonstrating high strength and efficiency in tests at the United States Forest Products Laboratory. Among the possibilities indicated are a substantial increase in speed of floor construction, a considerable saving of materials, and a distinct gain of head room in each story by the use of the new units, in which plywood sheets are glued to the top and bottom of several joists.

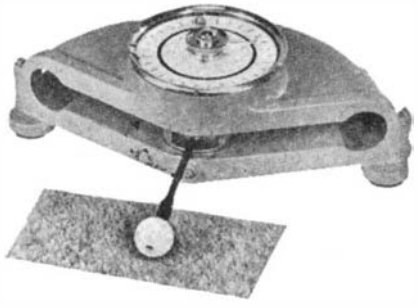
The new panel is regarded as a definite contribution to the ideal of modern wood housing of unit construction. The top plywood, which is relatively thick, serves as a subfloor, and the thinner bottom plywood forms the ceiling for the room below. By virtue of its being glued to the joists, the plywood helps to resist the bending stress, forming what is now called in airplane construction a "stressed covering"—that is, a shell which not only distributes but to a large extent relieves the load on the framework which supports it. In the present experiments it has been determined that, for spans common in house construction, the required strength and stiffness can be obtained with 6-inch joists instead of the usual 10-inch joists—a net saving of 4 inches in the thickness of the floor system.

Of the panel types tested, that which appears to offer the best possibilities, in the opinion of George W. Trayer, engineer in charge of the investigation, is one having a width of four feet, with a nominal two by six inch joist on either side and one of the same size running down the middle, the side joists being grooved at midheight to receive a spline connector, top covering five plies thick, and bottom covering three plies.

One of the photographs illustrates a "practical" loading of two two-foot panels laid together over a span of 13½ feet. In this width, the joist down either side of the panel was resawed to half thickness, and one joist of full nominal thickness occupied the middle. The "live" load as shown, minus the piano, weighed 2806 pounds, representing 100 pounds in excess of the residential floor load of 50 pounds per square foot commonly allowed in building codes.

Under this excess loading, the deflection of the panels at the middle was only 0.26 inch, whereas 0.45 inch deflection was allowable under the ordinary rule of 1/360 of the span.

It is said that the joists have less to do with the strength of this kind of floor than one might think at first glance. As a direct result of gluing instead of nailing, a series of box girders is formed, in which the main tensile and compressive stresses are thrown into the plywood "flanges." The joists serve excellently as web and spacing members. The net result is that the three-joist four-foot unit shown in the machine test picture turned out as effective for all practical purposes as the two in the group picture. At an equivalent load and figured for the average run of commercial material, it gave only 10 percent more deflection, and a full 15 percent less than the common building code allowance.



A device for golf practice at home; it is both substantial and accurate

Golf At Home

A SUBSTANTIAL well-built indoor golf playing set-up is now available for those inveterate golfers who cannot stand the rigors of winter without some substitute for their summer days on the links. This set-up, known as Powell Golf, requires only enough space to accommodate the swing of the golf club, is self-contained, needs no net and no attention, and has nothing to get out of order. The player swings at the ball with all the power that he would put into a normal drive or approach shot. The weight of the unit is such that no amount of force applied to the tethered ball can move it from the floor, yet it does not need to be fastened down.

On the top of the unit are two dials which show the distance of drive and the hole being played. An entire game of 9 or 18 holes can be worked out and played straight through without moving from the device. After the distance pointer is set, it registers the length of the drive, the approach shots, and the putts, thus showing incidentally how many strokes are required to "make" a given hole.

Phosphorescent Pigments

NEW methods of producing phosphorescent pigments are described in a recent issue of *Solvent News*. These formulas are said to have an advantage over conventional types of phosphorescent pigments in that they do not include any zinc sulfide. The following formulas are given:

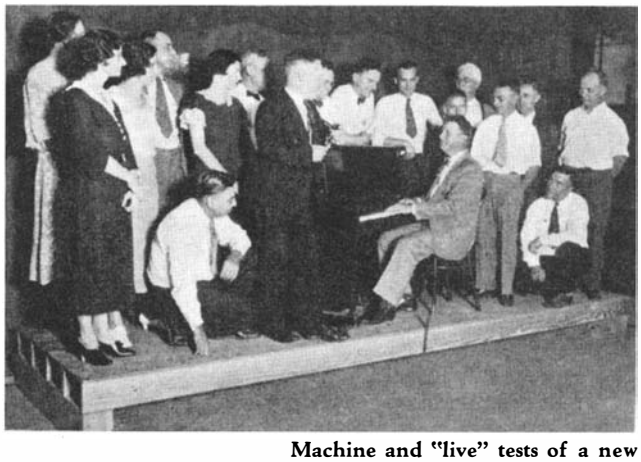
Greenish-blue phosphorescence: A mixture of 20.7 gms. strontium hydrate, 8.0 gms. sulfur, 1.0 gms. lithium sulfate, and 6 cc. of 0.3 percent aqueous colloidal bismuth is heated in a porcelain crucible for 40 minutes to a point of incandescence. The mass is then allowed to cool slowly.

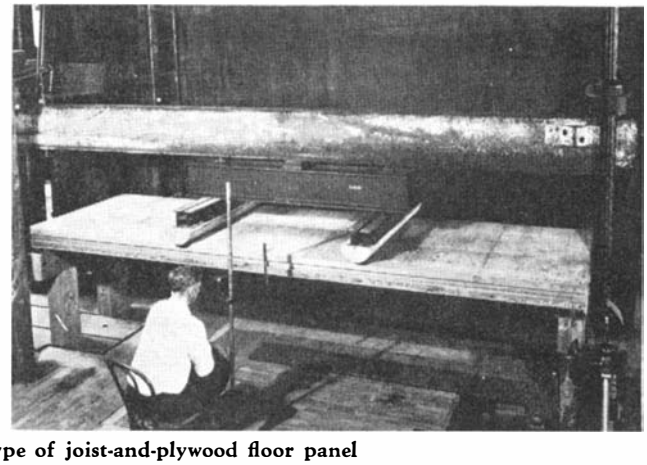
Red Phosphorescence: 40.0 gms. barium oxide, 9.0 gms. sulfur, 0.7 gm. lithium phosphate, 3.5 cc. of 0.4 percent alcoholic copper nitrate. If the lithium phosphate cannot be obtained, it may be replaced by a mixture of magnesium phosphate and sulfate or carbonate of lithium.

Red Phosphorescence: 40.0 gms. magnesium phosphate, 0.7-1.0 gm. lithium sulfate, and 3.5 cc. of 0.4 percent alcoholic copper nitrate.—*A. E. B.*

New Antidote For Mercury Bichloride

AN antidote for poisonous bichloride of mercury (corrosive sublimate) has been discovered by Dr. S. M. Rosenthal of the United States National Institute of Health at Washington. It has already been used successfully to treat a victim of bi-





Machine and "live" tests of a new type of joist-and-plywood floor panel

chloride of mercury poisoning. Cautious government scientists point out that the antidote is still in the experimental stage. However, results with animals poisoned by bichloride have been very good and the successful result with the first human case is considered very encouraging.

The new antidote, said to be the first known for bichloride of mercury, is formaldehyde-sulfoxylate. It is given to the victim by mouth and injected into his veins simultaneously.

This type of poisoning is not very common, so that it may be some time before physicians have enough experience with the new antidote to determine its value.—*Science Service.*

Chemical "Flower Gardens"

THIS column frequently receives requests from readers who wish to "grow" a "chemical garden." To produce this interesting phenomenon it is only necessary to prepare a glass jar by filling it with concentrated solution of sodium silicate. To start a "growth," drop into the solution a small crystal of some metallic salt, such as ferric chloride, cobalt nitrate, or nickel chloride.

The explanation of the plant-like growth is given by *Silicate P's and Q's* as follows: "The crystal begins to dissolve and as it does so reacts with the silicate to form a gel-like surface film. Water from the silicate solution diffuses through the permeable membrane and dissolves more salt. The osmotic pressure causes the cell walls to swell, then burst, and sends long tendrils upward. Without apparent reason the growth stops suddenly, a new sac develops at the tip, swells, bursts, and new tendrils thrust themselves upward with surprising rapidity. It is a fascinating phenomenon." —*A. E. B.*

A Versatile Fire Alarm

AN electrically operated fire alarm unit which may be screwed into any lamp socket of a 110-volt 60-cycle alternating current line has recently appeared on the market. Within the unit is an accurate thermostat arrangement and an intermittent howler which, when operated, gives an unmistakable signal.

The thermostat part of the alarm is actually in two sections so as to insure positive operation under all circumstances. It is claimed that a sustained rise in temperature of from 15 to 20 degrees, Fahrenheit, per minute, for one or two minutes, in the room in which a Vitalarm signal is installed, will immediately be detected and the alarm sounded automatically. This will occur regardless of the room temperature at the start of the fire—whether it be 10 degrees below zero or 100 degrees above, a sudden or unnatural rise of temperature will immediately operate the alarm. The adjustment of the unit has been so carefully worked out that ordinary changes in room temperature will not cause false alarms but care must be taken that the unit is not placed too close to a radiator, stove, furnace, or other source of heat, or that it is not placed where the rays of the sun may fall directly upon it.

A small neon lamp is a part of the unit and indicates at all times that the signal is in operating condition.

These alarms are suitable for installation in any part of a home or in storage rooms, garages, and in any and all public buildings where the required source of power is available.

There is no expensive installation as the alarm is just screwed into any socket; if desired, an extension howler may be installed at some point remote from the detecting unit itself.

Courtesy The Gamewell Co.

A fire-alarm unit, self-contained, to be screwed into a lamp socket

Glass Wool "Shot From Guns"

IN a new and spectacular method for making glass wool, molten glass is sprayed out of a "gun," producing a high grade and very uniform result. The gun used is the Schoop pistol, ordinarily used to spray a metallic film on metal surfaces. In spraying molten metal, the metal is atomized, producing a homogeneous coating. When glass is sprayed from the pistol, no atomizing takes place, on account of the high viscosity of the glass. The glass wool produced by this unique method is said to be ideal for insulating purposes.—*A. E. B.*

Auto Telescope Mounting

WHEN a California astronomer decided to move his telescope—the largest privately-owned, Carl-Zeiss-made telescope in the country—from one location to another, in order to obtain the most favorable observations, engineers told him that it would be impractical to transport the telescope by automobile because of the excessive vibration and damage from jolts and road shocks.

A mobile astronomical observatory. See text below

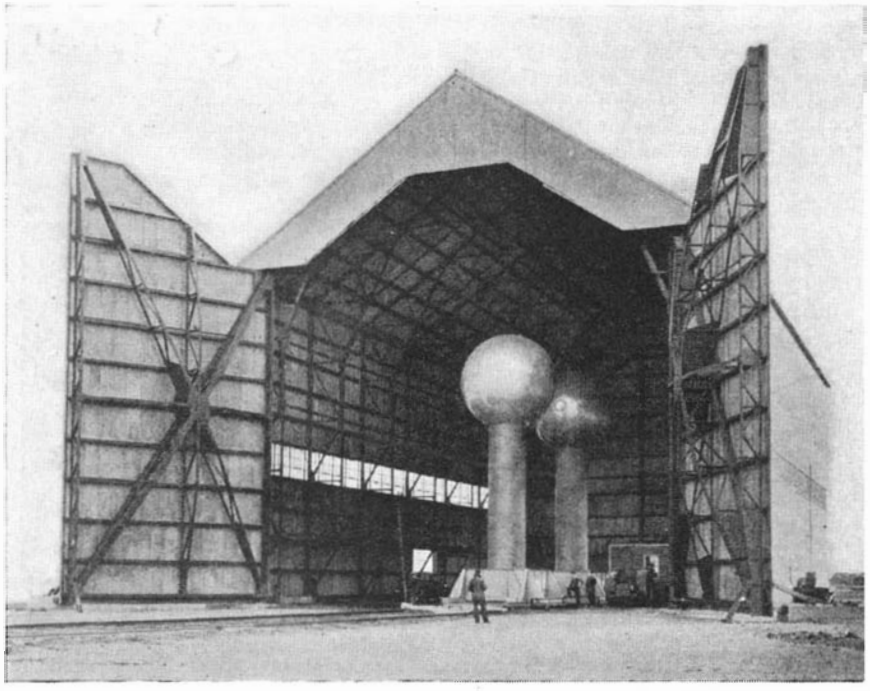
He discovered, however, that when the huge telescope was mounted on a Ford coupe equipped with low pressure streamline Jumbo tires, road shocks were reduced to a point where transportation was practicable, and that, when the telescope was in use, there was even less vibration than when it was mounted on a solid concrete base. He believes this is due to the fact that the tires at low pressure absorb ordinary earth tremors.

Reducing Medicines

A POWDER or pill that will peel off the pounds of surplus weight without recourse to drab reducing diets is the dream of every fat man and woman. Many such are on the market, but they are potent substances, fraught with danger and warned against by medical scientists. No exception is the latest reducing medicine, the powerful and dangerous dinitrophenol. This yellow dye is a close chemical relative of picric acid. Cases of poisoning from it occurred in French munitions factories during the World War.

San Francisco physicians, Dr. W. C. Cutting, Dr. H. G. Mehrtens, and Dr. M. L. Tainter, of Stanford University School of Medicine, have investigated it and reported on its properties to the American Medical Association. The dye has an effect on the body something like that of thyroid gland extract, they found; it speeds up the body's metabolism and in large doses causes fever. The patients lost weight steadily without any dietary regulations, even when taking small doses of the chemical.

The San Francisco investigators suggested that the dye might be useful in cases of obesity and also in cases of the more serious condition of under-activity of the thyroid gland, especially as it does not cause the extreme irritability caused by equivalent doses of the glandular substance itself. It must be noted, however, that



Dr. Van de Graaff's electrostatic generator set up in an airship hangar

the danger of overdosage with this substance was strongly emphasized by the investigators and also by the American Medical Association.

In spite of this, the tragic death of a San Francisco physician from an overdose of the drug, taken in a desperate effort to lose weight quickly, has been reported. According to the attending physician, the victim was literally "cooked to death" by the terrific fever induced by the large dose he took of dinitrophenol.

Human nature being what it is, even this horrible warning may not be enough to avert similar tragedies in the future. It is, therefore, encouraging to learn that British scientists have found a chemical that promises to be safer than dinitrophenol. Dinitro-ortho-cresol is its name. It was described in *The Lancet*, English medical publication, by Prof. Edward Charles Dodds of the University of London and Sir William Jackson Pope, professor of chemistry in the University of Cambridge.

The dinitro-ortho-cresol compound appears from the British investigations to be more suitable for trial on patients, since about one third the amount is required to produce the same effect as with the dinitrophenol. Since the toxicity of the two compounds is about the same, the danger is thus reduced by about two thirds.—*Science Service.*

Man-Made Lightning for Science Research

THE huge Van de Graaff electrostatic generator, which recently underwent its first tests at the Round Hill research station of the Massachusetts Institute of Technology, is designed to develop direct current at approximately 10,000,000 volts. Up to the time the Van de Graaff generator was designed, science with the best means at its disposal had been able to obtain direct continuous current at less than 800,000 volts. The output of Technology's great generator operating at normal capacity is approximately 20 kilowatts, and may be further increased many fold, if desired. The use of this great generator for research is expected to mark the beginning of an era of extraordinary significance in which extremely high voltages will make possible investigation of some of the most fundamental secrets of nature.

This revolutionary generator was designed by Dr. Robert J. Van de Graaff, a member of the research staff in physics at Technology. The generator consists of two separate units, each with a polished aluminum sphere 15 feet in diameter resting on a hollow cylindrical insulating column 25 feet high and six feet in diameter. These columns are mounted on heavy four-wheeled trucks operating on a railway track 14 feet wide. This arrangement permits variation of the distance between the two great terminals and also makes it possible to move them into the open air to avoid flashes to the roof girders of the airship hangar, in which the generator is housed, a distance of more than 20 feet from the spheres.

In the generator as it now exists, endless paper belts, operating vertically within the hollow columns of each of the two units, run from driving motors in the bases to pulleys within the spheres. The electrical charge carried up by the belts is "sprayed" on the spheres at the base at the comparatively low pressure of 20,000 volts. The process is not unlike the old-fashioned method of raising water from a well by means of small buckets on an endless chain, each bucket dumping its load as it turns over a pulley at the top. In the generator the electrical charge carried up by the belts is taken off and stored on the surface of the big globes by means of "brushes" fastened near the upper pulley. Special air-conditioning machinery within the supporting columns of the machine maintains the proper atmosphere for efficient operation.

It should be noted that the belts in one sphere are storing up negative charges of electrical energy, while the belts in the other carry positive charges. When the store of electricity in each sphere reaches a potential of approximately 5,000,000 volts, the terminals will discharge at a combined electrical pressure of about 10,000,000 volts.

To the layman, one of the most amazing features of the generator will be the fact that while the machine is in operation the safest place for the research workers will be within the huge terminal spheres on which the high voltage charge is stored. The interiors of these aluminum globes will be compact laboratories with lighting facilities and various instruments for research. While the machine is running, the bodies of the men in the sphere will be charged to the full voltage of the terminal, but because they are insulated from the ground no harm will result.

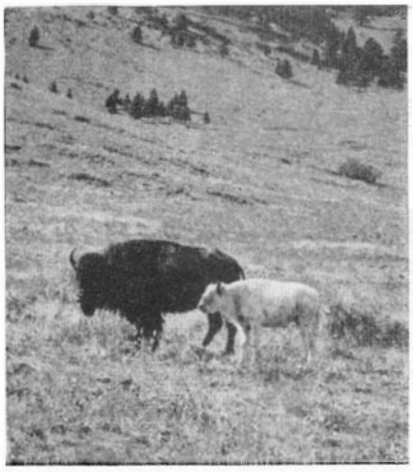
This 10,000,000 volt generator was built for the specific purpose of atomic research —the bombardment of nuclei, the centers or kernels of atoms, which are known to contain the major portion of the energy in the universe. The huge generator, however, may have other significant uses, for whenever a new field of exploration has been opened by an important scientific advance, new and often unexpected applications have followed.

In addition to atomic research, some of the scientific problems which are expected to be investigated with this new tool of science are the production and study of X rays of many million volts, which may, among other uses, be very valuable in the treatment of disease; and the use of X radiation thus produced to extend knowledge of the relation between wavelength of radiation and absorption of matter to the region of much shorter wavelengths. Such a study should make possible, for example, a much more accurate estimate of the wavelength or speed of cosmic rays than is now possible, and would have considerable influence on the astrophysical theories of the fate of the universe.

White Buffalo, "Big Medicine"

AN albino buffalo was born last spring on the National Bison Range, maintained by the Bureau of Biological Survey, United States Department of Agriculture, near Moiese, Montana. The white calf is one of about 75 young born in the first half of 1933 in the herd of more than 400 animals.

Even when millions of buffalo lived on the great plains, a white buffalo was so rare that few were observed. "One or two in a lifetime was the utmost that any hunter secured," says Ernest Thompson



An albino, a rarity among buffalo, born on the National Bison Range

What Would You Like?

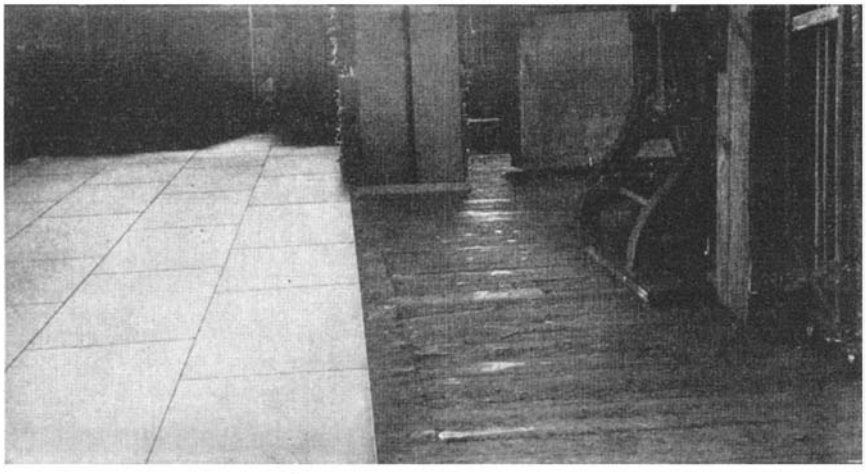
THIS is *your* magazine; it is edited to your taste to add to the sum of your knowledge of doings in all important branches of science and industry, to pass on to you practical information which will help you solve your industrial and engineering problems, to help increase your mental stature. We've recently made many improvements in SCIENTIFIC AMERICAN, have added extra pages, and for 1934 have planned a number of exceptionally fine articles by men of note. If you want a still better SCIENTIFIC AMERICAN, then give us the benefit of your opinions. Definite knowledge of your likes and dislikes will serve as a guide for the editors.

An executive of one of the country's largest industrial corporations recently told us:

> "SCIENTIFIC AMERICAN is of such value to our business that each copy is routed all over our plants through research departments and executive and management offices, and is clipped and annotated until it is literally worn out."

Write us on your business letterhead telling us what *you* think of its value. What criticisms and what suggestions have you? Mention some particular SCIENTIFIC AMERICAN item that has solved a problem of yours. Let us know what kind of articles you wish and who should write them. The majority vote will govern our future policy. By thus assisting us, you will be helping to make, for your own interest and profit,

A Bigger and Better SCIENTIFIC AMERICAN



A new composition flooring being laid directly over old wood

Seton, and Dr. W. T. Hornaday tells that he "met many old buffalo hunters, who had killed thousands and seen scores of thousands of buffalo, yet never had seen a white one." According to E. Douglas Branch, there was "only one white animal in the five million and more bison of the southern herd." Dr. Hornaday believed that "not over 10 or 11 white buffalo, or white buffalo skins, were ever seen by white men." A single albino was raised about 30 years ago in a herd at Pierre, South Dakota, says Dr. Robert S. Norton, Protector of the National Bison Range.

The Indians looked upon an albino buffalo with awe, considered it "big medicine," and for a good skin paid the price of 10 or 15 horses. Then piety, says Branch, demanded that three or fours years after the purchase, the skin should be offered to the wind and rain. The white man also was willing to pay a high price for an albino skin. Branch tells that the single albino of the southern herd fell to the gun of a plainsman, who sold it for 1000 dollars. So highly were the white buffalo prized that, said Hornaday, "not a single one, so far as I can learn, ever had the good fortune to attain adult size."

"The National Bison Range," says Paul G. Redington, chief of the Bureau of Biological Survey, "is maintained to assist in perpetuating the American buffalo, which at the time of the establishment of the range was threatened with extermination. We are, therefore, much interested in having in the herd an example of a variation so rare as the white buffalo. When only one was known in a herd of more than 5,000,000, it is particularly interesting that we should have this 'big medicine' in a herd of about 500 animals."

Permanent Floor Covering

FOR covering old wooden floors, aisles, and so on in factory, schools, offices, homes, and other public and private buildings, there is now available a strong, uniform, compressed fiber board called Stonhard Goverwood, which comes in sheets 45 inches long, 12 inches wide, and 3/16 of an inch thick. This material is placed directly over the old floor, as shown in one of our photographs, and nailed in position with six or eight penny nails.

The new surface thus obtained is practically dust free and can be washed or mopped. It may also be waxed and polished to improve the appearance, or can be painted after a priming coat is applied.

Noiselessness is one feature of this floor covering material as it acts to prevent reverberation of sound normally caused on wood floors by heavy walking or trucking. The surface is said to be resilient and consequently less tiring and more pleasant to those who have to walk or stand on it.

A Modern Desert Coach

IT has always been a long journey from Damascus to Bagdad—25 days by water, completely around the Arabian Peninsula. While these two ancient cities lie only about 500 miles apart, the distance between them is a trackless desert—no roads, no habitations, nothing but sand, terrific heat, and sometimes severe cold in the mountain passes.

What has been accomplished in solving the problem of overland travel between these two cities marks a new epoch in passenger bus construction. A bus has been built with an all-metal body, by Bender Body Company, that is dust-tight, insulated, and over 68 feet long, 8 feet 8 inches wide, and 11 feet high. It is fitted with spacious, comfortable reclining chairs, ample ventilation, cooled drinking water and other facilities. Everything has been foreseen and provided for comfortable, safe transportation under tremendous difficulties.

The tractor, by Marmon-Herrington of Indianapolis, has three driving axles powered by a 6-cylinder Diesel engine of 185 brake horsepower at 1600 r.p.m. (The tank at the rear of this cab holds 250 gallons of fuel oil, enough for a round trip.) The complete coach is carried on 18 pneumatic balloon tires.

This caravan coach has both first class and second class passenger compartments, with front and rear inside storage spaces accommodating 6100 pounds of freight and baggage. Interior luggage shelves in the first-class compartment accommodate 2500 pounds. Additional luggage may be carried on the roof. The crew consists of conductor, steward, and three drivers. One driver sleeps in the berth located just back of the cab seat, while the others are in charge.

It is anticipated that this coach is the forerunner of a number of additional units for the Nairn Syrian Desert Service.

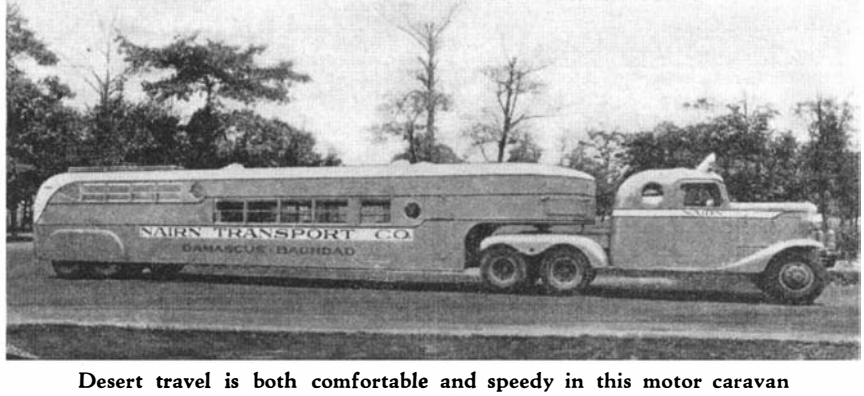
Perfuming Rubber

VULCANIZED rubber, while immensely useful, is not distinguished for its pleasant odor. Neither are the various accelerators and other malodorous substances usually incorporated in its manufacture. Hence, a good deal of work has been done by rubber chemists to de-odorize or cover up the smell of rubber. Writing in *India Rubber World*, Max A. Foley suggests that essential oils be used to perfume rubber, the controlling factors being the boiling point of the essential oil used and its cost per pound. He also presents a table of data with the results of some experiments carried on with a number of natural and synthetic perfume materials. On two batches of material, Foley reports results in which citranellol, cumarone, and pine-tar appear to have proved most satisfactory.—*A. E. B.*

Dangerous Eyelash Dye

LETTERS received by the Federal Food and Drug Administration concerning injury to users of "Lash-Lure," an eyelash dye manufactured by Lash-Lure, Inc., Los Angeles, Calif., led W. G. Campbell, Chief of the Administration, to issue the following statement:

"We recently investigated the case of a prominent Dayton, Ohio, clubwoman who was made totally blind as a result of an application made by a beauty parlor operator, of this highly poisonous cosmetic. Lash-Lure, according to the *Journal of the American Medical Association*, contains an aniline dye which is extremely corrosive and capable of burning away the outer coating of the eyes. The Administration has investigated a number of cases of blindness or seriously impaired vision attributed to the use of this injurious eyelash 'beautifier.' The medical literature contains accounts of a number of ocular injuries caused by the

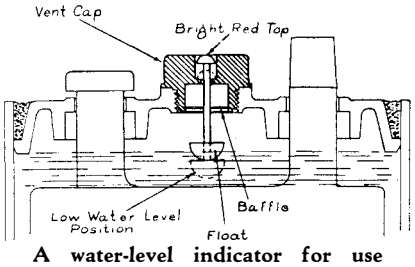


Desert travel is both comfortable and speedy in this motor caravan

cosmetic. A number of these are printed on pages 1016 and 1017 of the *Journal of the American Medical Association*, September 23, 1933."

Battery Tester

THERE was a time when the average man could not test his automobile battery for water without wrestling floorboards, juggling flashlights, and swearing profusely. Apparently those days are over, for a battery water-tester has been invented which does everything except remove floorboards. It permits the measurement of electrolyte by a glance, without the necessity of flashlight or eyestrain.



A water-level indicator for use in all types of storage batteries

A plunger inserted in the battery cap suspends a float. The passage in which the plunger rests is large enough to permit the necessary escape of gases and at the same time give the operation of the plunger free play. The little red cap on the plunger is easily discernible when level with the battery cap. If it is not in view the battery needs water and as water is added the float rises gradually. Where there is sufficient water the red cap is exactly level with the battery cap (as shown in the diagram).

Thermoplastic Cements

A NEW line of products, known as du Pont thermoplastic cements, has been perfected at the Parlin, New Jersey, laboratories of E. I. du Pont de Nemours and Company. These cements are composed of nitrocellulose or cellulose acetate plasticizers and synthetic resin of the modified polybasic acid-polyhydric alcohol type which are dissolved in suitable solvents. They are waterproof, very flexible, resistant to the action of oils and grease, and are not affected by mild acid and alkaline solutions. They do not become brittle on aging.

The surfaces which are to be joined together are coated with the cement by means of a brush, spray gun, or coating machine. This coating of cement is allowed to dry thoroughly, requiring about 20 minutes at ordinary room temperature. After the cement is thoroughly dry, the two surfaces are brought into contact, and heat and some pressure are applied. This fuses the cement film which on cooling becomes hard, joining the two surfaces and forming a strong, waterproof, flexible bond. Materials can be coated with this cement and stored for an indefinite period, the actual cementing operation being carried on at some future time.

Uses for thermoplastic cements range from laminating foil and paper or Cellophane for use as food wrap, to laminating thin metal sheets to composition board or ply-wood for use in the construction of commercial automobile bus bodies. They

(*Please turn to page* 103)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

PERHAPS the most onerous and dreaded job astronomers have to do is guiding when taking celestial photographs. No telescope, however well and delicately adjusted, can simply be set in motion by its driving clock and left exposing a plate on a field of stars. Even were the mechanism kept really perfectly in step with the earth's motion the variations in atmospheric refraction still would cause the star images to shift on the plate from moment to moment, and the result would be far from satisfactory on a long time exposure. Therefore the plate is set in a holder having screws which can shift it in two directions, and the astronomer sits with his eye glued to an eyepiece focused on some one star in the field, keeping that star on a pair of cross-hairs by shifting the plate with each little deviation. Why not let automatic machinery do this?

That is what L. Jackson Bulliet, of 7609 Fourth Avenue, Brooklyn, N. Y. had in mind when he submitted to us a memorandum containing an idea which he wishes to present for all and sundry to wrestle with.

"The following discussion," Mr. Bulliet writes, "is concerned with a device to eliminate the necessity for an observer giving constant attention to the guiding of a photographic telescope. It is believed that such a contrivance would not only save the photographer from an exceedingly tedious job on long exposures, but would also result in better pictures. The reason for expecting better pictures is that this device should respond at once to a drift so slight that it would not be noticed by a human observer. Thus, corrections would be more frequent than with the method now used, resulting, in effect, in a steadier position of the image on the plate.

"Considering Figure 1, the reader is looking into the top of a round light-tight metal box B. This box is divided, for its entire depth, into quadrants by the exceedingly thin opaque partitions P and P'. It may be well to make the actual partitions of glass, with one side of each coated with a thin opaque film. The films may then be regarded as the partitions here referred to. In each quadrant is mounted a photo-electric cell R, R', D and D'.

"Suppose now that this box is affixed to the eye end of the guide telescope of a photographic telescope in such a manner that the top of this box coincides with the focal plane of the telescope. The connection to the telescope must be light-tight, so that no light may reach the photocells except through the object glass of the guide telescope. The top edges of the opaque partitions now correspond to the cross-hairs of the guide telescope. The box is oriented as indicated by compass points on the sketch. That is, the cross-hairs (partitions) lie NE, SW, and NW, SE, with respect to the telescopic field. At the intersection of the cross-hairs (partitions) is an opaque disk M, slightly larger than the image of the object to be guided upon. This disk would actually be a spot on a removable glass cover or slide over the box, so that different sized disks could be used for different sizes of images. If the field of view included objects other than the one to be guided upon, an opaque diaphragm (not shown) with a center opening somewhat larger than the disk M, would have to be provided to keep the light from the other objects from reaching the photocells.

"So long as the object is centered on the cross-hairs (partitions), no light can reach any photocell because of the disk M. But any drift will cause the image to creep off the edge in some direction, so that light will fall into one or two (if over one of the thin partitions) of the compartments where it can affect the cells in them. This

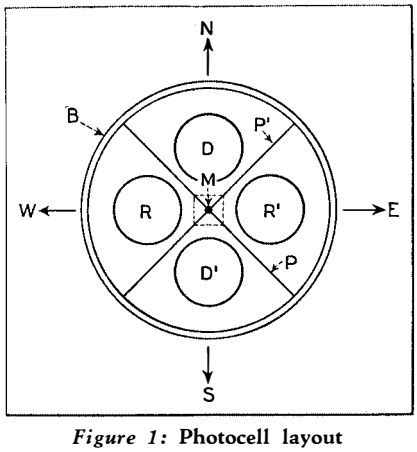


Figure 1: **Photocell layout**

effect could be greatly enhanced by fitting a triangular mirror into the corner of each quadrant, to reflect the light directly into the cell. The apex of the mirror would be at the top and the base at the bottom of the box, so that the four mirrors would form a pyramid. Perhaps a better arrangement would be to leave out the partitions entirely, and place in the center of the box a square based pyramid of optical glass with its faces silvered and with its apex just under the disk M. This pyramid would be oriented as indicated by dotted lines in the figure. The rest of this discussion will continue to refer to the partitions and the rest of the arrangement as first described, but the argument would not differ essentially in the pyramid scheme.

"Referring now to the wiring diagram, Figure 2, it is seen that each photocell feeds through an amplifier into a relay. The relays associated with the cells R and R' control a reversible electric motor C, which drives the regular slow motion screw on the right ascension axis, or a special screw provided for the purpose. Likewise, the cells D and D' control the similar motor C', on the declination screw.

"Should the image in question drift toward the northward with respect to the cross hairs (partitions), the cell D would function to start the motor C' in proper direction to compensate for the drift. Similarly, a drift to south would start the same motor in the opposite direction; and the same reasoning applies to drifts in right ascension. The more general case, of course, is that in which the drift is in some direction other than the cardinal compass points. The light would probably fall in only one quadrant in this case but, the correction being in a cardinal direction, the light would fall into another quadrant before it got back to the center. Thus the correction would be brought about by motions in right ascension and declination successively or simultaneously (the latter when the image falls on a cross-hair).

"It will be noted that the circuit to start a motor includes contacts of both relays associated with that motor. Thus the operation of one relay will not start the motor unless the other relay of the pair is unoperated. The idea here is that in time of poor seeing the image might become fuzzy and larger than the disk M. In that case, both cells associated with each motor would be energized. Neither motor, however, would start, due to the relay circuit. In other words, any anomalous condition tending to bring about directly opposing corrections would cancel out.

"Another possibility in times of poor seeing would be rapid shifting of the image in random directions. This would tend to bring about incessant efforts to correct for erratic motions for which corrections are inherently impossible due to inertia of the telescope mechanism. By using relays of the type which have a slight lag in their operation, these rapid shimmerings would not operate the relays and so not start the motors. Only true drift would be corrected for."

WE passed this communication to Mr. Alan R. Kirkham of Tacoma, who commented as follows:

"The photocell tracking device interests me. As a radio nut, the thing looks OK, except for the terrible cost, and awful difficulties of making large amplifiers work. The worst bug I see is this: the gadget that splits the rays is much larger than a star image. The prism, for example, cannot be made with edges good enough. The size of a star in the focal plane of a very good 12-inch telescope runs from 1/2000 to 1/10,000 inch in diameter, depending on the focal length."

The above comment was relayed back to Mr. Bulliet, who replied:

"As I wrote the paper, the apex of the pyramidal prism was to be placed exactly in the focal plane of the guide telescope objective. Now, as Mr. Kirkham points out, the said apex would necessarily be somewhat larger than the image of the star on which we are to guide. Hence the star may drift more than its own diameter before light will have a chance to strike one of the sides of the prism and be reflected into a photocell. That would, of course, be an intolerable drift. But suppose we introduce a convex lens or lens system between the

focal plane of the objective and the prism and put the prism back far enough so that it will be in the plane of the new image (equivalent of using eye-piece and eye and putting the prism at the retina of the eye). Now the drift will be greatly magnified (assuming proper placing of the new lens) but the dimensions of the prism have not changed. Also, if we are dealing with a star, the actual image of the star will not be increased. It seems to me that the new arrangement should work all right because the secondary image of the star will move several times the width of the prism point

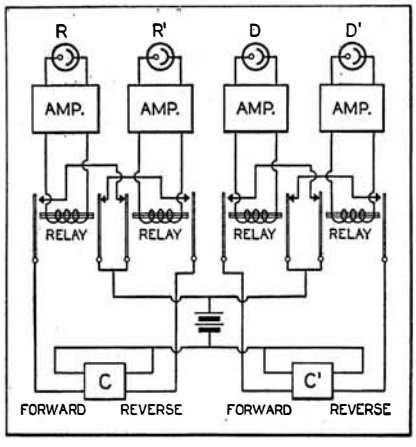


Figure 2: Wiring diagram

before the primary (photographic) image has moved a perceptible distance."

Well, there you are, folks, just as these two left it—probably in a pretty raw stage at present but ready to be improved and made to work. Somebody ought to derive some fun perfecting this thing—not to speak of the fame.

SEVERAL workers have inquired about making rifle telescope sights, and we have advised them that we had no data but to go ahead and see what they could finally work out and then make their findings available to the rest of the amateur telescope-making fraternity who might have similar interests. An effort of this kind is being made by Harry A. Peck of 205 Kenmore Avenue, Youngstown, Ohio, who is also making a rifle—barrel, receiver, bolt and all—while he is at it. He says the telescope sight will cost him around 35 dollars, not to mention his time. Those who may be interested in this endeavor might well pool their knowledge with Mr. Peck.

LAST month we omitted a credit line and we hope we can make amends by saying here more than the credit line could have said, had we not plain forgotten it. On page 28 of last month's number there was a short article about Professor R. W. Wood and his original inventions, including infra-red photography, and one illustration used with that article showed the Empire State Building in New York, taken from a distance of 18 miles (Paterson, N. J.) with a six-inch telescope, by infra-red photography. What was omitted, Professor Wood tells us, was the photographer's name, Mr. Garret Hobart, Jr. We don't knowingly suppress such things but we do sometimes unknowingly forget them. Taking that picture was quite a feat.

CURRENT BULLETIN BRIEFS

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

STUDIES IN SOCIAL SCIENCES 1933 (Engineering and Science Series No. 43) contains seven theses for the degree of Master of Business Administration and deals with important public affairs such as "A Study of the Relation Between the External and Internal Value of the Pound Sterling 1920-1932" and "A Study of the Trends in the Cost of State Government in New York 1900-1931," and similar subjects. *Rensselaer Polytechnic Institute, Troy, N. Y.—Gratis.*

PROCEDURES IN CURRICULUM MAKING (Bulletin, 1932, No. 17, Monograph No. 18, National Survey of Secondary Education), by Edwin S. Lide. The purpose of this study is to indicate the details of organization and the specific procedures in programs of curriculum revision. The subject is a curious one and has probably employed some of our best educational minds. *Superintendent of Documents, Washington, D. C. —ten cents (coin).*

THE GUARANTY OF BANK DEPOSITS (Bulletin No. 3) is a report of the Commission on Banking Law and Practice Association of Reserve and City Bankers. The Association was organized in 1912 to provide a medium for the exchange of ideas among its members on matters relating to banking law and practice. It has hitherto confined itself largely to what may be termed laboratory work in the field of banking. However, the present emergency called for a somewhat different policy, so a Commission on Banking Law and Practice was appointed to undertake an analysis of the banking system as a whole, with recommendations for strengthening the banking structure. *Address J. J. Schroeder, 162 West Monroe Street, Chicago, Illinois.—Gratis.*

RESERVOIRS FOR FARM USE (Farmer's Bulletin No. 1703), by M. R. Lewis. Water is so useful on the farm that it is a wonder that farm reservoirs are not in more general use. The pamphlet gives a wealth of information. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

THE CARE OF LEATHER BELTS is a large wall chart giving all the information. It is filled with tables and diagrams. *E. F. Houghton & Company, Philadelphia, Pa.—Gratis.*

KOHLER ELECTRIC PLANT. The Kohler engineers have just developed an 800 watt, 32 D. C. unit which will prove very useful for farms, summer homes, yachts and boats, filling stations and garages. Four models are available—two battery charging types and two non-battery plants delivering direct-from-generator service. The circular is a guide to the type of independent unit required. *Kohler Company, Kohler, Wisc.—Gratis.*

THE LOUIS ALLIS MESSENGER deals with the problem of selecting the correct motor for any job. This is a bi-monthly publication dealing particularly with splash-proof and explosion-proof motors. *The Allis Company, Milwaukee, Wis.—Gratis.*

LUBRICATING OF GRAIN HANDLING MACHINERY (*Lubrication*, Vol. XIX, No. 11, November, 1933) deals with installations of grain elevators and the handling of grain from ships. Flash and fire points are considered. *The Texas Company, 135 East 42nd Street, New York City.—Gratis.*

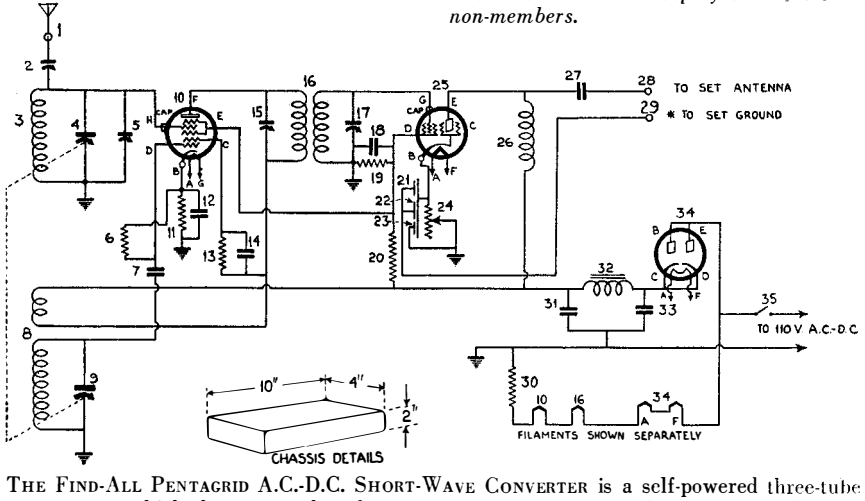
PUBLICATIONS OF THE DOMINION OBSERVATORY, Ottawa (Volume 4, Bibliography of Seismology No. 14, April, May, June, 1932), gives a bibliography in all languages and was prepared by Ernest A. Hodgson, *Department of the Interior, Canada. Ottawa —25 cents.*

RAILWAY STATISTICS OF THE UNITED STATES OF AMERICA FOR THE YEAR ENDED DECEMBER 31, 1932, prepared by Mr. Slason Thompson, Bureau of Railways News and Statistics, is one of the most valuable reports in the railway world. Mr. Thompson compares his figures with the official reports for 1931 and also gives the recent statistics of foreign railways which are so difficult to obtain. The railroads that have gone "modern" and streamlined are included. *Slason Thompson, Daily News Building, Chicago, Illinois.—Gratis.*

THE NETHERLANDS INDIES—A JUBILEE ALBUM was issued to commemorate the 25th anniversary of the travelers' official information bureau of Netherland India. The travel literature issued in far away Batavia is the peer of the best travel literature issued in Europe. We are frank to confess that these publications we have noted from time to time have given us a wanderlust that may never be fulfilled, but those going around the world or to Australia will find the trip to the many islands both easy and fascinating. *Travelers' Official Information, Bureau of Netherland India, Batavia, Java.—Gratis.*

THE ORIENTAL INSTITUTE. This book forms Volume XII of the University of Chicago Survey, by Dr. James Henry Breasted. The entire scope of the survey embraces some 40 or 50 projects, which are being grouped in a series for purposes of publication. A comprehensive survey of a large research enterprise is a new undertaking in educational administration. It is beautifully illustrated showing the latest researches of the thirteen expeditions. *University of Chicago Press, Chicago, Ill.—$3.00 bound in cloth.*

TURBINES (Publication A.3 August, 1933) is a valuable pamphlet, including operating records of 291 large turbines for 1932, and figures covering records for 1932 of 12 turbines operating above 1000 pounds steam gage, together with additional data. *Edison Electric Institute, 420 Lexington Ave., New York City.—Price varies from 75 cents to members and their employes to $1.25 to non-members.*



THE FIND-ALL PENTAGRID A.C.-D.C. SHORT-WAVE CONVERTER is a self-powered three-tube converter which changes any broadcast receiver into an efficient short-wave set. Through the use of Alden plug-in short-wave coils, the band between 15 and 200 meters may be covered. One of the features of this converter is the use of the new 6A7 pentagrid tube, which combines the functions of detector and oscillator. A second feature is the "Cisin" A.C.-D.C. circuit which dispenses with the customary power transformer. The set will work equally well whether the power source is A.C. or D.C. This converter is simple in design and construction—hence it is easy to build. It can be used either with tuned r.f. or with superheterodyne broadcast sets. The Noise-Master lead-in is another feature. Top and bottom views, list of parts and additional information may be obtained from *Allied Engineering Institute, Suite 541, 98 Park Place, New York, N. Y.—10 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page 99*)

can also be used for cementing metal foil to metal foil or to other materials; glass to glass or to other materials; Bakelite to Bakelite or to wood, glass, metals, and so on.—*A. E. B.*

Lung Ventilation Measured

A METHOD of using X rays to find just how efficiently a person's lungs are being ventilated was described by Dr. Walter W. Fray of Strong Memorial Hospital, Rochester, New York, at a recent session of the American Congress of Radiology.

Apparently some patients suffering with tuberculosis and other lung diseases have more difficulty with breathing than would be expected from the amount of lung tissues that is seen in X-ray pictures to be affected, while in other cases the patients are able to breathe with little or no difficulty in spite of a large diseased area. Lack of a standard of the ventilating efficiency of normal lungs has handicapped physicians in determining the extent of disability along these lines.

Dr. Strong and associates worked out a method of determining the normal pulmonary ventilation, and then used the method in over 100 cases of various kinds of lung diseases. It proved to be useful in the following ways: In following the progress of chronic forms of pulmonary disease such as pulmonary emphysema, asthma, chronic bronchitis and bronchiectasis; in assaying the degree of disability in industrial disease such as silicosis for purposes of compensation; in identifying suitable cases of tuberculosis for treatment by collapsing part of the lungs; in determining the presence or extent of disturbed ventilation in cases of a certain kind of heart trouble; and, finally, in establishing both the diagnosis and progress of chronic pulmonary disease.—*Science Service.*

High Compression—High Economy

FUEL savings as high as 29.6 percent are revealed by motor tests of high compression ratios conducted by engineers of the Ethyl Gasoline Corporation. A large six-cylinder commercial engine, of the type which must carry heavy loads over steep grades, was employed for the trials. Data were gathered over a range of loads at constant speed and two compression ratios, 4.03 to 1 and 5.48 to 1 respectively.

Charts of the tests carried out showed that the low compression unit in first gear is capable of supplying considerably more power than is necessary to propel the vehicle on the grade considered, although there is not sufficient power to operate in second gear. Consequently, the governor throttles the air-fuel mixture flow into the engine so that it develops only 70 horsepower, thus driving the truck at seven miles an hour, which corresponds to the governed speed of 2100 revolutions per minute for the engine.

The high compression engine, utilizing the best grade of anti-knock fuel, will drive

the same truck up the same grade in second gear. With the combination of high compression and second gear, the vehicle speed may be increased until the available horsepower is exactly equal to the horsepower required, which happens to be at a speed just slightly less than the governed speed of the engine. Consequently, the high-compression truck climbs the grade in second gear at a little more than 14 miles an hour, developing 142.5 horsepower as it does so.

The low compression engine developing 70 horsepower at the reduced throttle opening consumes 0.76 pounds of fuel per horsepower hour or at a total fuel consumption rate of 53.2 pounds per hour. Since the vehicle speed is seven miles per hour, the fuel consumption per mile is 7.6 pounds.

The high compression engine, however, operating at nearly wide-open throttle develops 142.5 horsepower at a specific fuel consumption of 0.53 pounds of fuel per horsepower hour. Since the vehicle speed is 14.12 miles per hour, this results in a fuel consumption per mile of 5.35 pounds, or a decrease of 29.6 percent below the low compression fuel consumption rate for the same grade.

Moonlight Indoors

THE ready banishment of such nighttime terrors of household darkness as bogeymen, barked shins and bruised toes has been made possible through the development of two types of All-night lamps by G. F. Prideaux, General Electric engineer at Nela Park, Cleveland, Ohio.

The new lamps, which emit illumination intensities comparable to moonlight, are of three-watt consumption and employ a recently developed tungsten filament wire so fine as to be almost invisible to the naked

Two sizes of tiny lamps designed for use in the home as night lights

eye; one that is only three ten-thousandths of an inch in diameter.

Flexibility in the application of these lamps has been provided, as they are made with standard prongs that plug into the baseboard or other convenience outlet. Adding the screw part of a standard attachment plug permits them to be used in any regular socket. A choice in the amount of light desired is possible, as the output of the little lamps ranges from approximately

one lumen for the smaller size which is equipped with a resistor, to twelve and one-half lumens for the larger size which operates on regular line voltage.

All-night lights may be used for protection, safety, convenience and as an assurance that all is well for the little tots who dislike going to sleep in the dark. Statistics show that crime is lessened where light is provided. Intruders hesitate to enter homes where they could be quickly seen by an awakened member of the household.

In addition, the small night light in a dark room proves of assistance in finding the electric switch. That people do desire assistance in this direction is evidenced by the thousands of luminous buttons that are made and sold every year.

Waste Products Improve Cadmium Plating

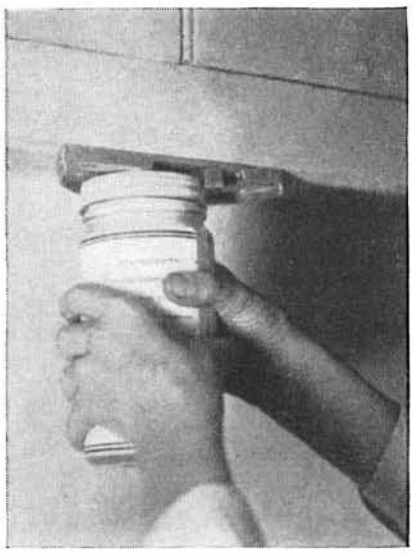
CADMIUM plating has been growing in popularity because of its beautiful, non-tarnishing finish of excellent wearing qualities. The technique of cadmium plating is still somewhat uncertain, and it was therefore a topic of lively discussion at the recent convention of the Electrochemical Society. R. A. Claussen and H. L. Olin, of Iowa State University, reported on their experiments to improve the quality and efficiency of cadmium plating by the addition of various substances to the plating solution. With the proper addition agent, higher current densities may be used and the throwing power is improved. The experimenters found that the desired effects were obtained by the use of "Steffen's waste"—a byproduct of the sugar industry and also by the use of the water in which corn is soaked in the manufacture of cornstarch.

While this discovery is interesting and perhaps useful, it seemed to be the general opinion of the electrochemists present that the ideal addition agent for cadmium plating, when discovered, will probably be a relatively simple and readily obtained substance.—*A. E. B.*

Opens All Bottles and Jars

A CLEVER little device for removing the tops from all types of bottles and jars has recently been devised and placed on the

The new jar and bottle opener, tilted up to show the knurled steel stud



Both hands may be used to grip the jar when using the new top remover

market by W. N. Lurcott. It consists of a single casting of light metal with a knurled steel stud firmly fixed in place as shown. Any size cap, from a small toothpaste tube to a large preserve jar, can be firmly gripped and removed with little exertion. The cap is merely placed between the knurled stud and one or the other of two curved flanges. Then with both hands pressure can be exerted and the cap readily loosened. A notch in the casting permits removal of crown caps.

This device is to be screwed to the under side of a kitchen shelf or cabinet and thus becomes a permanent fixture always ready for use.

Frozen Rum Punches Made At Dinner Table With Dry Ice

POINTING out that Americans have always liked their drinks cold, Lewis C. Chamberlin, manager of the solid carbon dioxide division of the Michigan Alkali Company, said that now they can have their drinks frozen. Whisky or rum punch can be frozen at the table before the eyes of guests, and be eaten with a spoon like ice cream or sherbet.

The trick of making frozen rum punches is not difficult, according to Mr. Chamberlin. A jigger of water, a jigger of rum, and a tablespoonful of sugar or honey are mixed together in a glass. Proportions may be varied to suit various tastes. To this is added a tablespoonful of powdered dry ice, which can now be obtained at almost any soda fountain. The punch is stirred as the dry ice is dropped in slowly, and in a minute the punch is frozen to a consistency of sherbet. A cherry adds to the attractiveness of the punch. Care should be used in handling dry ice, as it has a temperature of 109 degrees below zero. It should not be touched with the hands, for it will cause burns. Dry ice is solid carbon dioxide gas, the same gas which makes the fizz in champagne. Some of this gas remains in the frozen punch and adds greatly to its appetizing qualities.

Frozen cocktail lolly-pops are another novelty which will be popular. They are easy to make. A cake of dry ice is used, on the top of which recesses are chopped

out, and the cocktails are poured into the depressions. Sticks are held in the cocktails as they freeze, which takes but a moment.

Many other novel frozen liquor concoctions can be made with dry ice, and Mr. Chamberlin predicts that dry ice will be as necessary to the modern post-prohibition bartender as oranges and lemons were to those of bygone days.

Industrial Uses of Ultra-Violet

ULTRA-VIOLET radiation, sometimes in conjunction with visible light, is being used in a large number of industrial processes. In the textile industry it bleaches the best quality of linen; in the petroleum industry it removes bloom from lubricating oils; in the leather industry it enters the final step in the manufacture of patent leather. For the sterilization of water for public supply, the manufacture of various beverages, and, through its bactericidal action in the preservation of food, the ultra-violet ray finds wide use. Artificially-generated ultra-violet is also used in the food industry to increase the vitamin-D content of foods and, in some cases, to improve flavor, while various pharmaceutical preparations are likewise subjected to artificial ultra-violet radiation in order to secure certain specific properties.

Other uses of ultra-violet radiation, not yet extensive but which have been discussed occasionally, include the production of scrim oil in linoleum manufacture, the final treating of oil-cloth to remove stickiness, the bleaching of oil for food and technical uses, the synthetic manufacture of rubber from unsaturated compounds such as vinyl chloride, and the manufacture of chlorinated solvents from chlorine and hydrocarbons, such as chloroform.—*A. E. B.*

YOU HAVE ONE CHANCE IN A HUNDRED TO UNDERSTAND EINSTEIN

(*Continued from page* 73)

crease is due to increased opportunity. It is idle to speculate whether the increase may not again be tenfold in the next 30 years. If we plot the number for each year, draw a smooth curve as closely as possible through the points and extend the curve in approved statistician fashion, the graph would indicate around 4000 for 1960. However, this signifies nothing for our purpose.

The psychologists who make mental tests consider that, ranging a large number of people in the order of their intelligence, the upper ten percent are very superior. The upper one percent are, I believe, all sufficiently intelligent to become psychologists, if they should consider such a course desirable, but are also wise enough to observe that this would lead to deplorable overcrowding, so that the great majority end by pursuing other learned professions.

The population of the United States, in 1930, was 122,775,046. Accordingly, there are over 1,000,000 people in this select class. Reference to any good atlas will give the corresponding figures for the other civilized countries of the world. Confining our attention to the United States for the time being, it is possible, I believe, that a person of this class, given the time and the inclination, might successfully pursue

the studies necessary to understand the theory of general relativity. However, considering only those above 21, the number would be about 700,000. If we wish to be safe in our guess, let us say at least 70,000, and possibly 7,000,000, persons in the United States may possess the necessary intelligence. We shall have to wait for some psychologist actually to measure the mental capacity required to tell which figure, if either, is correct. And we may have to wait for some time, for it would appear necessary that the psychologist should understand the subject very thoroughly himself, in order to work out the tests. At present the psychologists are too busily engaged in keeping abreast of the new developments of psychology, to find time for the study of relativity, and the relativists are not also becoming expert psychologists. It looks like a promising field for an aspiring pioneer.

PERHAPS some of my readers, assuming that they should be included in this group of persons with high mental endowments, but lacking the opportunity of attending a graduate school of science, would like to know how long it would be necessary to study, and what subjects should be pursued, in order to be ready to read the paper mentioned with understanding. The average student probably reaches the subject in his seventh year of collegiate work. However, his entire seven years are not spent solely on preparation for Einstein. Assume that our aspirant is a high-school graduate. The equivalent of collegiate undergraduate mathematics would take him through higher algebra, analytics, calculus and the elements of differential equations. The various universities differ somewhat in their requirements and in the methods of evaluating them, but a fair average would probably be about 30 quarter units for a first class grounding in undergraduate mathematics. This would represent perhaps 1000 hours of actual work—hard work, mental concentration. To be safe, let us require an equal amount of physics, which would include mechanics and electricity. Add a pinch of astronomy and stir well.

There are some text-books of mathematics, designed for engineers, which contain in one volume all that should be required, except in algebra. Now add to this approximately 2000 hours a course in theoretical physics, perhaps nine quarter units, some study of determinants in mathematics, a course in the calculus of variations, a study of vector analysis, non-euclidean geometry—perhaps 600 more hours in all . . . just absorb that, brother, and then go after Einstein.

It might be possible to do all that in a year, or, if you give two hours per day to the purpose, in four years. If you don't understand him then, perhaps the trouble is that, when we stand the adult population in a row, ranged according to their mental capacity, and count off, you will be Number 7,000,001. That will be a high rank, anyway.

It is possible that an individual with enough intelligence (please don't ask me how much is enough) could, after working through calculus and differential equations, be able to understand a book like the treatise by Weyl, translated under the title of "Space—Time—Matter." However, it would be best to study first a text-book on

theoretical physics, designed for first year graduate students. There are a few which are suitable. They will be difficult but, after all, it is mainly a matter of hard work and determination . . . and interesting, every bit of it. Even if you are sidetracked along the way, and never get to general relativity at all, you will have a most enjoyable time. When George Bernard Shaw wrote a play, laid far in the future, the only satisfactory occupation he could find for his very advanced super-men, in the multitudinous years allotted to them for their span of life, was to ponder on the theory of numbers.

It is quite possible that the exposition of the principles of relativity will, in the future, be greatly clarified. The present workers in the field are writing for their fellow specialists. However, the full mathematical theory will probably not be simplified to such an extent that it will be understandable by students with less than graduate work or its equivalent; at least, not for some time. And most of us, even in the upper ten or one percent, do not have the time to give to the study of mathematical physics, purely as an avocation. There are other things in life. Still, we would like to know something about relativity, just as we should know something about Newton's work, and the Copernican system, and many other subjects. We will ask, then, is the knowledge which a layman may obtain from a perusal of various books treating the subject in a popular manner, of any real value?

To answer that question in detail would be quite an undertaking. It should probably be considered in connection with an investigation to discover how many people are capable of misunderstanding Einstein.

NEARLY all of the books written for the lay reader contain a large amount of material which is not relativity, but merely an outline of certain conceptions of elementary physics and geometry. It is, of course, necessary to state these for the benefit of the student without technical training, but these portions, unfortunately, are hardly ever clearly distinguished as such. The unwary reader gains the impression that certain things are Einstein's discovery, when as a matter of fact they have been common knowledge to physicists, sometimes for a hundred years or more. They should be distinguished as background; important, of course, but not the main show.

On the other hand, none of the books attempts to give a popular idea of what tensors are. I believe it would be quite possible to offer such an exposition, which could be comprehended by at least 2,000,000 readers. The high school algebra text of the present day contains concepts which first required the genius of a Descartes to formulate. A description of tensors could possibly be made understandable to anyone who has mastered high-school mathematics. Not that the reader would thereupon be able to recognize a tensor at sight, or to contract or differentiate them. But he would at least know what kind of things they are, and wherein they differ from abracadabra.

On the whole, the knowledge which the reader will gain of the methods and results of the theory of relativity from the best popular works of the present, will be on a par with his knowledge of other important and significant subjects.

Books SELECTED BY THE EDITORS

NEW INTRODUCTORY LECTURES ON PSYCHOANALYSIS

By Sigmund Freud

FREUD'S notable work on psychoanalysis appeared in 1916 and now come these new lectures by Freud. Their purpose is to bring the student of psychoanalysis up to date with regard to the Freud interpretation. Readers who have already studied Freud will find much that is new and understandable in this book, which contains, in 249 pages, seven lectures respectively on the Revision of the Theory of Dreams; Dreams and the Occult; Anatomy of the Mental Personality; Anxiety and the Instinctual Life; Psychology of Women; Explanations, Applications and Orientations.—$3.20 postpaid.—*A. G. I.*

MAN AND THE VERTEBRATES

By A. S. Romer, Prof. Paleontology, Univ. Chicago

AN authoritative account of the evolution of man and the various forms of life ancestral to him, all the way back to the earliest animals having a vertebra. This volume is used as outside reading in a course in biology at the University of Chicago. It includes a splendid account (90 pages) of the mammals, living and extinct, other than the primates; another of the primates; a 30-page account of human origins; a shorter one of the human races, and a 132-page account of the human body. There are 415 pages and 278 illustrations.—$3.15 postpaid.—*A. G. I.*

TATTOO

By Albert Parry

THE author's subhead of this curious and intriguing book at once attracts attention: "Secrets of a Strange Art, as Practiced by the Natives of the United States." Beautifully illustrated with three color-plates and numerous half-tone reproductions, the book accomplishes its avowed purpose of getting under the skin of the skin game. The reasons for having tattoo applied to one's person are proved to be essentially psychological, whatever the expressed reason of the tattooee may be. Mr. Parry, supported by the assertions of authorities in the field of psychology, shows that there is a close linkage between tattooing and sex. There is a definite erotic basis for the practice of the art, and the author follows the line of reasoning with skill and tact. Such is the subject matter that parts of the book become hilariously humorous, but never get out of hand, and are always done in good taste in keeping with the vast amount of serious research that

One of the striking illustrations in "Tattoo," reviewed on this page

preceded the writing of the volume. If you have ever been tattooed—and it is shown that a surprisingly large number of men and women have—or have ever seen examples of the art, you will want to read this book both for its deep human interest and the amazing information that is revealed. There is a valuable chapter on the removal of tattoo marks. Beautifully printed on fine paper with illustrations inserted. 6¼ by 9½ inches, carefully bound in stiff cloth covers.—$3.20 postpaid.—*A. P. P.*

AND THAT'S WHY

By W. Maxwell Reed

THIS book of 104 pages explains various natural phenomena and is for children of 10 to 12. The chapters are: Ducks, Clouds, and Teakettles; Frost; Mountains, Dewdrops, and Clouds; A Black Thunderstorm; Lightning and Tiny Drops of Water; Fire and Atoms; Salt Water, Rain, and Rocks; Lightning, Mr. Edison and Electric Lights; Sea Shells; Gasoline and Muddy Water; Thunder, Music, and Waves in the Air. After reading it, J.V.I., aged 10, wrote: "I think that this book is very interesting. It explains things that are often questions in the minds of children. I enjoyed it."—$1.40 postpaid.—*A. G. I.*

INTERNATIONAL BOOK OF NAMES

By C. O. Sylvester Mawson

HERE is a dictionary that business men, public speakers, teachers, commentators, and many others will find to be an invaluable reference. A vast amount of research has been necessary to compile this book, and much of the material comes from first-hand information. Spelling and pronunciation of names of modern celebrities and geographical names are accurate and authentic, and the data are up-to-the-minute in every respect. A chapter of 73 pages deals with pronunciation, and constitutes a source of information that would be difficult to locate elsewhere. 308 pages, 5 by 7¾ inches, well bound with stiff cloth covers.—$2.15 postpaid. —*A. P. P.*

GOOD EYES FOR LIFE

By O. G. Henderson and H. G. Rowell

THE scope of this book is what the average intelligent person would like to know about his own eyes and their care. It explains the eye machinery, and the more common eye troubles. It cites the various theories of eye changes and shows us how to avoid some of them by intelligent use of the eyes. Reading parts of this book would be a good prescription for that boy or girl of yours who insists on reading when lying down, slumped down, and so on; and incidentally some grown-ups might profit similarly. It is elementary and could be understood by anyone.—$2.15 postpaid. —*A. G. I.*

THE INVENTOR AND HIS WORLD

By H. Stafford Hatfield, Ph.D.

THIS book concerns the philosophy of invention, rather more than its very practical, immediate side. It also gives some instruction for handling inventions but these are not very concrete. It discusses many subjects which would interest inventors and particularly does it point out pertinent details with regard to inventing in certain fields, such as mechanical invention, chemical invention, electrical invention, biological invention, psychological inventions, and so on. It has 254 text pages and a bibliography.—$2.60 postpaid.—*A. G. I.*

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY
Member of the New York Bar

The "Chipso" Trade Mark*

By JOHN C. PEMBERTON

THIS widely known trade mark to women and many men has recently been canceled by the United States Patent Office (J. L. Prescott Co. v. Procter & Gamble Co., 19 U. S. Pat. Q., 75). [See page 55, January SCIENTIFIC AMERICAN. Editor.]

This comes as a complete surprise to the majority of people and has caused the general belief that the mark "Chipso" can never be used hereafter or again. How could this popular mark be canceled now—after having been registered in the Patent Office since April 12, 1921, and after Procter & Gamble's very great expenditures in advertising soap chips, flakes and granulated soap under this mark? The reasons are as follows:

(1) A cancellation proceeding may be instituted in the Patent Office at any time; literally there is no time limit (Corning v. Robertson, 65 F., 2d, 476).

(2) The Patent Office felt that "Chipso" was confusingly similar to the Prescott Company mark "Chase-O," which had been registered with them seven or eight years *before* Chipso, i. e., December 9, 1913.

(3) The Patent Office felt the Prescott Company's preparation (called Chase-O) in crystal form for washing, cleansing, and bleaching to be of the same class as Procter & Gamble's Chipso products—within the meaning of the trade-mark statutes, as lately construed by the United States Court of Customs and Patent Appeals.

Hence, these two marks applied to the same class of goods having been found confusingly similar—the younger mark, Chipso, had under the statutory law to be canceled in the Patent Office at the behest of the owners of the older registered trade mark, "Chase-O."

By and large, this cancellation is considered unjust and highly technical. And so it would be if its results were actually as they are commonly thought. But they are not. For the Procter & Gamble Company can and will (so far as known) continue to use this well-known mark for its well-known products. This apparent flouting of the Patent Office tribunals is legally and commercially possible and frequent—because the right to *use* your trade mark is one thing, and the right to *register* it is altogether and quite another.

The result of the foregoing decision is, then, simply this, viz.:

(1) Procter & Gamble can no longer have its mark "Chipso" *registered* in the United States Patent Office—provided the latter's action is sustained by the appellate court sitting over it in such matters; that is, the United States Court of Customs and Patent Appeals.

(2) Procter & Gamble can none the less *use* its mark "Chipso" and sell its goods so marked exactly as before.

*Courtesy *The New York Law Journal.*

The apparent anomaly and absurdity of one company owning a trade mark in the Patent Office and another owning the same mark (or a confusingly similar one) outside the Patent Office is due to the fact that the Patent Office has no statutory jurisdiction to decide who may *use* trade marks, but only jurisdiction to decide who may *register* marks with them.

Therefore, before the Prescott Company can prevent the Procter & Gamble Company's use of the mark "Chipso" it will have to conduct a successful suit in the United States District and appellate courts (or, in the alternative they may elect to sue for an injunction in the *state* courts—Tiffany v. Tiffany, 147 Misc., 679, 264 N. Y. S., 459). In other words, it must be established to the satisfaction of our judicial tribunals that our administrative tribunals in the Patent Office were correct in concluding that the public would likely be confused by the similarity of "Chase-O" and "Chipso" on the same class of products.

The same conflict of trade-mark ownership has recently arisen with regard to "Del Monte" coffee. One company has a trade mark registration of the mark in the Patent Office on various food products, and has as well the right to use it in most of the United States, but not on coffee in California, Oregon, Washington, Montana, Nevada or Arizona, where another, judicially and commercially, reigns supreme (Tillman & Bendel v. California Packing Corp'n, 63 F., 2d, 498).

In the same way it has been conceded that although "Chicken of the Sea," as applied to young tuna fish, is the registered trade mark of the Van Camp Sea Food Company, neither the Patent Office nor the Court of Customs and Patent Appeals (sitting over it) has jurisdiction to decide whether the Van Camp Sea Food Company has the right to the exclusive use of this or a similar trade mark throughout the United States (Van Camp Sea Food Co. v. Alex B. Stewart Organization, 50 F., 2d, 976).

Accordingly, the United States Circuit Court of Appeals, in March, 1932, declined to hold that the Van Camp Company had the right to the exclusive use of "Chicken of the Sea" as a trade mark (Van Camp Sea Food Co. v. Cohn-Hopkins, 56 F., 2d, 797).

On the other hand, this same plaintiff, in September of this year, did secure an injunction (in the United States District Court, District of New Jersey) against another's "using the words Chicken of the Sea on canned tuna fish" on the ground of unfair competition. This injunction was awarded in spite of the fact that the court did not consider Chicken of the Sea "as a technical, valid, registered trade mark" (Van Camp Sea Food Co. v. Packman Bros., 4 F. Supp., 522).

It is therefore doubtful whether the trade mark "Chipso" has been materially, if at all, damaged by reason of the Patent Office cancellation thereof.

"Nevertheless," the author of the above adds, in a personal communication to the editor of this department:

"(1) Registration in the Patent Office is an absolute pre-requisite to registration in most foreign countries.

"(2) Registration does constitute *prima facie* proof of ownership of the trade mark.

"(3) Registration confers the right to sue infringers in the federal courts, regardless of the citizenship of the parties or of the amount involved.

"(4) Registration gives the right, upon filing a copy of the certificate of registration with the treasury department, to have goods bearing an infringing mark excluded from importation and made liable to seizure and confiscation.

"(5) Registration affords the possibility of having actual damages trebled, within the discretion of the court.

"(6) Registration affords the registrant the right to use with his mark the words 'Reg. U. S. Pat. Office.'"

Important Points Concerning Italian Patents

PATENTS are granted for a term of 15 years from the date of application.

Patents of addition ("attestati completivi") are granted for the unexpired term of the principal patent.

There is no provision for opposition in the present Italian law.—*Journal of the Patent Office Society.*

Patentability

"THE process of development in manufactures creates a constant demand for new appliances, which the skill of ordinary head workmen and engineers is generally adequate to devise, and which, indeed, are the natural and proper outgrowth of such development. Each step forward prepares the way for the next, and each is usually taken by spontaneous trials and attempts in a hundred different places. To grant to a single party a monopoly of every slight advance made, except where the exercise of invention somewhat above ordinary mechanical or engineering skill is distinctly shown, is unjust in principle and injurious in its consequences. The design of the patent laws is to reward those who make some substantial discovery or invention which adds to our knowledge and makes a step in advance in the useful arts. Such inventors are worthy of all favor. It was never the object of those laws to grant a monopoly for every trifling device, every shadow of a shade of an idea, which would naturally and spontaneously occur to any skilled mechanic or operator in the ordinary progress of manufactures."—*The Atlantic Works* v. *Brady*, 1883 C. D. 214, 219. (Supreme Court of the U. S.)

SCIENTIFIC AMERICAN ADVERTISERS

FEBRUARY · 1934

Allied Engineering Institute	103
American Farm Machine Company	105
American Machine & Tool Company	105
American Rifleman	109
American School of Photography	105
American Telephone & Telegraph Company	59
Bannerman, Francis, Sons	109
Bausch & Lomb Optical Company	107
Broderick & Bascom Rope Company	105
Chicago Gear Works	105
Corn Exchange Bank Trust Company	109
Cornish Wire Company	105
Crescent Tool Company	108
Cross & Brown Co.	103
Cutting & Sons	105
Dieterich, Albert E.	108
Evans, Victor J., & Company	108
Falstaff Press	103
Gagnon Company, Ernest E.	109
Gilson Slide Rule Company	105
Greene, H. W.	101
Hamilton, Alexander, Institute	Fourth Cover
Harpers Magazine	106
Hotel Willard	108
Hygeia (Amer. Medical Institute)	99
Kern Company	109
Key to Life Books	106
Merriam, G. & C., Company	107
Metallic Letter Company	105
Modern Psychologist	107
N. Y. Institute of Photography	109
O'Brien, Clarence A.	108
Payn, John K.	109
Pierce, John M.	101
Precision Optical Supply Co.	101
Ross, H.	109
Scott, Charles A.	108
Secretary's Hand Book	106
Sinclair, James	109
Souther, B. L.	101
Tinsley Laboratories	101
Van Nostrand, D., Company, Inc.	107
Veeder-Root, Inc.	105
Vine, Howard L.	109
Wild, George O.	109
Witte Engine Works	105
Woolley Associates, Edward Mott	107
Zuhr, Henry, Inc.	108

ADVERTISING REPRESENTATIVES

EWING HUTCHISON COMPANY
35 East Wacker Drive, Chicago, Ill.

BLANCHARD-NICHOLS-COLEMAN
Los Angeles, San Francisco, Seattle and Atlanta

HEVEY and DURKEE, 10 East 43rd Street, New York, N. Y.

Published by MUNN & COMPANY, INC.
24-26 West 40th Street, New York

ORSON D. MUNN, President JOHN P. DAVIS, Treasurer I. SHELDON TILNEY, Secretary

EDITORIAL STAFF · ORSON D. MUNN, EDITOR

ALBERT A. HOPKINS
A. P. PECK
PROFESSOR HENRY NORRIS RUSSELL
ALBERT G. INGALLS
F. D. McHUGH
PROFESSOR ALEXANDER KLEMIN

CONTRIBUTING EDITORS

A. E. BUCHANAN, Jr., Lehigh University.

CHURCHILL EISENHART, Princeton University.

REV. WM. F. A. ELLISON, Director of Armagh Observatory, Northern Ireland.

MORRIS FISHBEIN, M.D., Editor of the *Journal of the American Medical Association* and of *Hygeia*.

WILLIAM K. GREGORY, Professor of Vertebrate Paleontology, Columbia University.

LEON A. HAUSMAN, Professor of Zoology, New Jersey College for Women.

WALDEMAR KAEMPFFERT, *New York Times*.

SYLVESTER J. LIDDY, New York Bar.

M. LUCKIESH, Director, Lighting Research Laboratory, Incandescent Lamp Dept., of General Electric Company, Nela Park, Cleveland.

D. T. MacDOUGAL, Associate in Plant Biology, Carnegie Institution of Washington.

ROY W. MINER, American Museum of Natural History.

RUSSELL W. PORTER, Associate in Optics and Instrument Design, California Institute of Technology.

DR. WALTER FRANKLIN PRINCE, Research Officer, Boston Society for Psychic Research; and Ex-President, Society for Psychical Research (London).

W. D. PULESTON, Captain, United States Navy.

ELIHU THOMSON, Director, Thomson Laboratory of the General Electric Company, Lynn, Massachusetts.

R. W. WOOD, Professor of Experimental Physics, Johns Hopkins University.

Vol. 150, No. 2. 35 cents a copy. $4.00 a year, postpaid in United States and possessions. Canada, $4.75; other foreign countries, $5.00, postpaid.

Men who "know it all" are not invited to read this page

THIS page is not for the wise young man who is perfectly satisfied with himself and his business equipment.

It is a personal message to the man who realizes that business conditions have radically changed in the last few years, and that there is a whole new set of rules to be mastered. He feels that he ought to be earning several thousand dollars more a year, but simply lacks the confidence necessary to lay hold on one of the bigger places in business.

We should like to put into the hands of every such man a copy of a little book that contains the seeds of self-confidence. It is called "What an Executive Should Know" and it will be sent without obligation.

It contains the Announcement of the Institute's new Course and Service for men who want to become independent in the next five years. Among the contributors to this new Course are:

ALFRED P. SLOAN, JR., *President*, General Motors Corporation.

FREDERICK H. ECKER, *President*, Metropolitan Life Insurance Company.

HON. WILL H. HAYS, *President*, Motion Picture Producers and Distributors of America, formerly U. S. Postmaster General.

BRUCE BARTON, *Chairman of the Board*, Batten, Barton, Durstine & Osborn, Inc., Advertising Agents.

DR. JULIUS KLEIN, *The Assistant Secretary*, U. S. Department of Commerce.

JOHN T. MADDEN, *Dean, School of Commerce, Accounts and Finance*, New York University.

HUBERT T. PARSON, *President*, F. W. Woolworth Company.

M. H. AYLESWORTH, *President*, National Broadcasting Company.

THOMAS J. WATSON, *President*, International Business Machines Corporation.

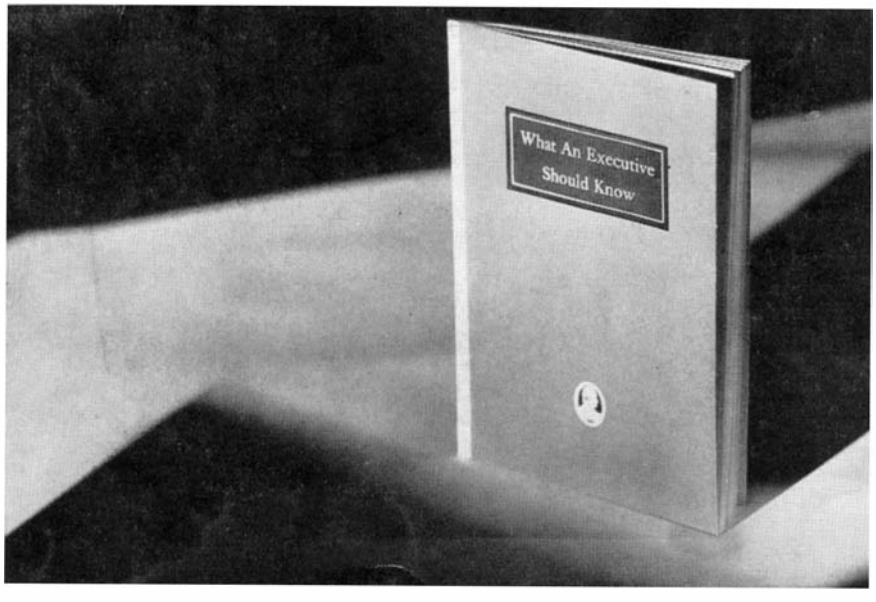
DEXTER S. KIMBALL, *Dean, College of Engineering*, Cornell University.

Can any ambitious man fail to get something of value from contact with minds like these? Here are a few examples, selected from many hundreds, showing how this organized knowledge is translated into added earning power:

CASE 1. Works Engineer, salary $6,000; now Vice-President and General Manager, salary $18,000.

CASE 2. Local Manager at $5,200; now Regional Manager, salary $15,000.

CASE 3. Production Manager, salary $6,000; now President, salary $21,600.



For the Man who wants to be Independent in the next 5 years

THE little book pictured above should be read by every man who expects to win a secure place for himself in the next five years. It explains some of the changes which are taking place in the business world today. It tells how you can equip yourself to take your place in the new business structure with confidence and increased earning power. It contains the condensed results of 20 years' experience in helping men to forge ahead financially.

Send for this Booklet

For the man who is perfectly content with himself and his job, the Alexander Hamilton Institute can do nothing. But there are thousands of men who could double their incomes if they believed in themselves and had the solid business knowledge to back up their belief.

Why not investigate *now?* The booklet pictured at the left costs nothing and places you under no obligation.

To the Alexander Hamilton Institute, 696 Astor Place, New York City. (In Canada, address Alexander Hamilton Institute, Ltd., C. P. R. Building, Toronto.)

Send me "What an Executive Should Know," which I may keep without charge.

NAME.....

BUSINESS ADDRESS.....

BUSINESS POSITION.....