AVIATION NUMBER

SCIENTIFIC AMERICAN

Progress and Power (See page 225)

VOLUME 152
NUMBER 5

WINGS OF EUROPE

By Igor Sikorsky

MAY 1935
35c A COPY

Dear Editor—Give Us More

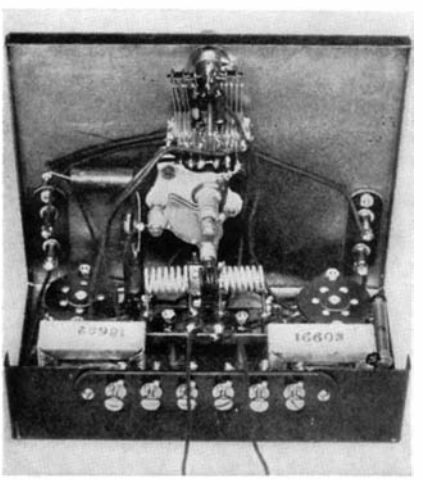
INFORMATION ON RADIO DEVELOPMENTS

THE READERS of SCIENTIFIC AMERICAN help us to edit the magazine. They never hesitate to praise, criticize, and suggest; they demand what they want. In response to an ever increasing number of letters requesting additional authoritative information on radio, we searched the field to find the one man best qualified to give this service to our readers.

Starting with this issue,

M. L. MUHLEMAN,

Editor of "Radio Engineering," "Communication and Broadcast Engineering," and "Service," inaugurates a series of feature articles on this subject. His first article, "International Broadcasting," appears on page 232. We know that you will like it; we will appreciate your comments and suggestions.



Above: A five-meter transceiver in use. The long tubing is the antenna. *Below:* The interior of the unit

EVERY business day the postman brings letters in large numbers to the desks of the Editors of SCIENTIFIC AMERICAN. The range and diversity of the inquiries on every phase and subject of Science and Invention are a revelation of far-reaching influence and a startling testimonial of the confidence of the readers in the Research and Service facilities of SCIENTIFIC AMERICAN.

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SCIENTIFIC AMERICAN

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NINETY-FIRST YEAR • ORSON D. MUNN, Editor

The SCIENTIFIC AMERICAN DIGEST

Of General Interest

Chemistry in Industry

Aviation

Health Science

CONTENTS · MAY · 1935

NRA CODE

COVER

THE transport plane of United Air Lines, viewed from an unusual angle, is truly symbolical of progress and power in the air transport field.

SCIENTIFIC AMERICAN, May, 1935. Vol. No. 152, No. 5, 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. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

ACROSS THE EDITOR'S DESK

AS this issue was going to press, newspaper headlines went wild with news of war rumors in Europe. Germany is Arming—Huge German Air Forces—Gigantic German Bombing Fleet—they screamed, to the mental discomfiture of peace-loving people. In probably no other field do rumors attain such seemingly authentic status as in propaganda, and the present situation is a case in point. *Perhaps* Germany has some bombing planes. *Perhaps* her air force is great and powerful. *Perhaps* she can place in the field a large number of highly trained pilots. But Igor Sikorsky, widely known aviation expert, recently made an exhaustive study of aeronautical conditions in Germany, and he holds other views. He admits the possibility, in the article "Wings of Europe," page 229 of this issue, of secret sources of aircraft supply in Germany, but he deprecates the high rating that has been given to such activity by outside sources. The bogey of German air strength still remains, at the time of writing, just a bogey, and spectacular displays of a handful of planes do not prove the existence of a powerful air arm. Every peace-seeking person will watch the disclosure of the truth with interest.

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SORRY, but the article by J. Reid Moir, "Did Man Exist in the Miocene Epoch?" promised for this month, had to be held over. We will try to include it in the June number.

●

JUST what is "heavy water;" what are its implications in the realms of pure and applied science? The subject of heavy water has been discussed briefly in past issues of SCIENTIFIC AMERICAN, but next month we shall present the full story, as prepared by Dr. Harold C. Urey, discoverer of heavy water and winner of the Nobel Prize in chemistry, 1934. An example of the facts disclosed by Dr. Urey is given in the following quotation from his article: "The biological interest of the heavy water can hardly be over-emphasized, since all living beings live essentially in a water solution. . . . It is my expectation that both animals and plants can be acclimated to high concentrations of heavy water, but that probably their living processes will be much slower."

COMING

¶ "Heavy Water," by Dr. Harold C. Urey.

¶ Industry in the South, by Secretary of Commerce Daniel C. Roper.

¶ "All-Wave Receivers," by M. L. Muhleman.

¶ Spanning the Mississippi at New Orleans, by Harry J. Engel.

¶ The Future of the Diesel in Railroading, by George W. Codrington.

●

"THE South, with slightly more than 30 percent of the nation's population, now employs about 20 percent of the entire country's factory workers. . . . As compared with the late 'seventies, when the Southern States accounted for about 33 percent of the population and only 11 percent of the wage earners in manufactures, this betokens a noteworthy degree of progress in industrialization. . . ." Thus writes Secretary of Commerce Daniel C. Roper, in an article on the industrialization of the South, scheduled for publication next month. Scientific research has done much to assist this industrialization, and Secretary Roper traces the development in terms that give a complete survey of the entire situation. His article is as informative as it is authoritative.

THE city of New Orleans has long been in need of adequate bridge facilities that will enable traffic to move to and from the city without loss of time in ferry crossings. Plans for such a bridge have been completed, and work is well underway. An article to be published soon will give the details of the construction work, as well as a background of the economic significance of this important traffic link.

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YOU, as a reader of SCIENTIFIC AMERICAN, play a tremendously important part in the editorial make-up of the magazine. Your letters serve as a guide to the editor, showing him the type of material that is most desired. Increasingly large numbers of requests for radio information have resulted in the preparation of a series of radio articles, the first of which appears on page 232 of this issue. Next month M. L. Muhleman will write on the subject of "All-Wave Receivers," from the standpoint of the reader who wants to listen-in on foreign broadcast programs.

●

THE third and last of our series of articles on railroading, its present status and future possibilities, will appear next month. This article, prepared for us by George W. Codrington, President of the Winton Engine Corporation, takes up the question of the Diesel engine and its application to railroading problems. Where the Diesel-engined train fits into the picture of rail transportation is a question that has often been discussed as a result of the many Diesel-powered units which have been produced in past months. Our articles on steam (last month), electrification (this month), and Mr. Codrington's (next month), give the reader complete coverage of the situation.

Editor and Publisher

Books SELECTED BY THE EDITORS

UNROLLING THE MAP, THE STORY OF EXPLORATION

By Leonard Outhwaite

THERE is romance in this book. Its 340 large-sized pages, and its numerous maps, tell the complete story of world exploration. In a systematic manner the author takes up in chronological sequence the explorations of each of the world's noted explorers, not merely in our age but right down through all history, and presents an account of the accomplishments of each. The reader thus sees the world map, at first mostly black, grow white or very nearly white, step by step. It is a solid book, either for reading or reference, and the style is both readable and scholarly. This reviewer once attempted to read *all* the books on exploration—a vain ambition which had to be relinquished because a man seldom lives to be more than 1000 years old. But, in "Unrolling the Map," the whole thing is presented within the two blue covers of a single fascinating volume.—$3.95 postpaid.—*A. G. I.*

ANGLING SUCCESS

By Leading Outdoor Writers
Edited by Mortimer Norton

BY obtaining his contributions from various prominent outdoor writers, who are well known as specialists in certain phases of angling, the editor of this volume is able to present a compilation which gives the reader the cream of fishing knowledge. The principal fresh water game fish, from "sunnies" to "muskies," are dealt with in 16 chapters. The articles are all original, not having appeared before in any publication. Each author gives, from his practical knowledge, tips on tackle, and obscure little kinks which are difficult to find elsewhere, but all of which contribute to ultimate success. Illustrated with many photographs.—$2.65 postpaid.—*A. P. P.*

IDENTIFICATION OF FIREARMS

By Jack D. Gunther and Charles O. Gunther

HERE is an honest effort to put on a scientific basis the identification of firearms from ammunition fired therein, usually referred to as the study of ballistics. The authors discuss in logical sequence the principles of firearm identification and include a short yet comprehensive survey of the explosive substances used in firearms to propel the projectile. They then carry on through various types of cartridges and the rifling of barrels. Then is given a résumé of the methods employed by experts in recovering bullets, analyzing the "signatures" and establishing the relationship between ammunition and gun. A large part of the book is devoted to the presentation of testimony at various trials where firearm identification has figured prominently. While the book was prepared more especially for the scientist and the lawyer, it will be of interest to the average reader because of the sociological problems involved and the inherent interest in them. 342 pages, printed on fine coated stock and lavishly illustrated.—$4.20 postpaid.—*A. P. P.*

THE POPULAR PRACTICE OF FRAUD

By T. Swann Harding

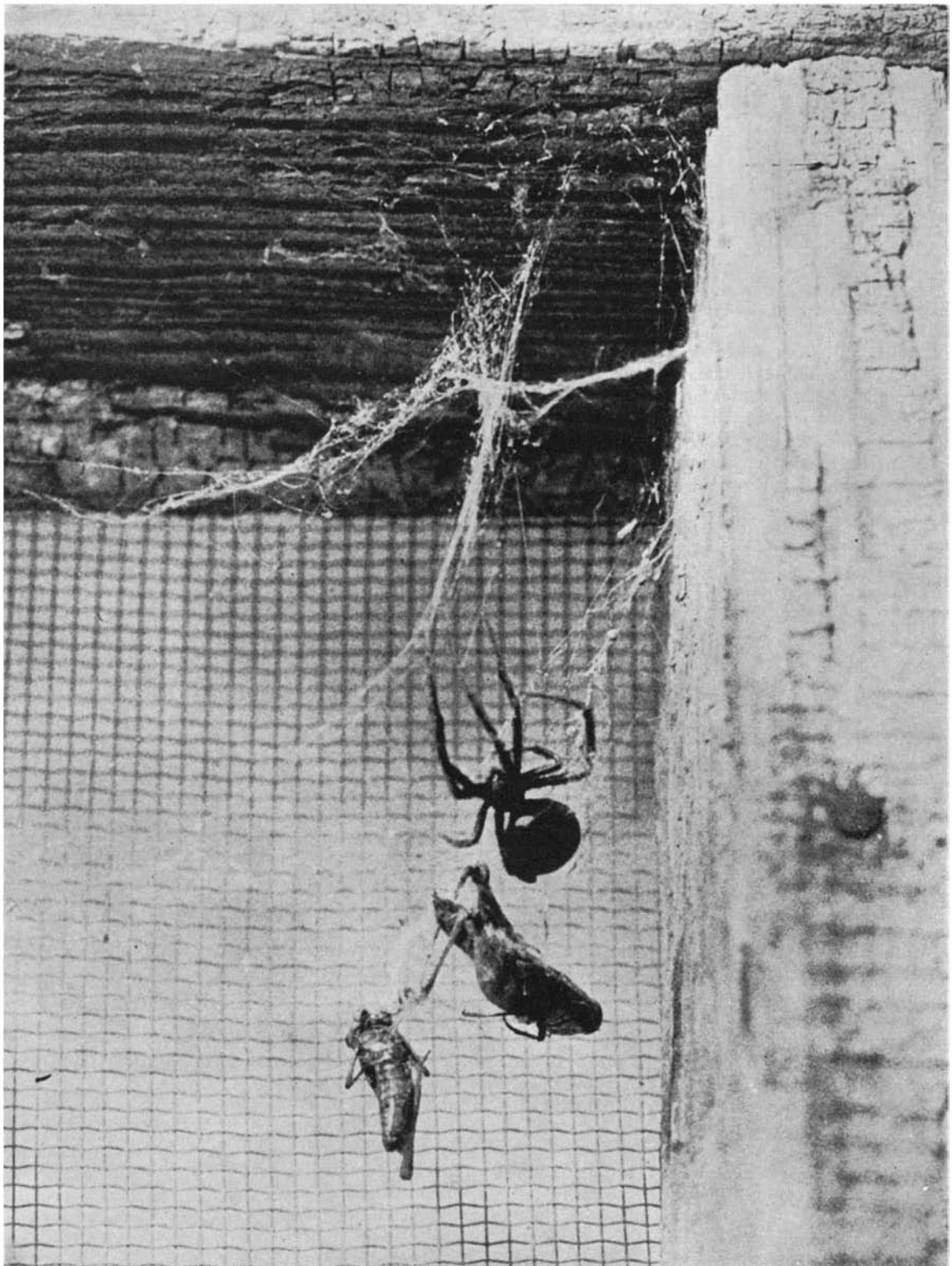
MAINLY this book is filled with exposures of fake foods and drugs, and some of its chapter heads—such as "Hell-Fire Advertising," "Sucker-Trapping by Mail," and "Irresistible Charm in Bottles and Jars"—will serve to give a good idea about the content. On the other hand, this is not a typical crusader's work, for it avoids lambasting everything in sight, in the manner of the professional "crusader's" instinct which some think is to lambast mainly in order to be sensational, and to scare 100,000,000 of us almost to death. There is plenty that deserves lambasting without resorting to that method, which is admittedly successful but not very intelligent. Mr. Harding's potent paddle paddles plenty of persons and patent medicines but, withal, sanely. In 376 pages he covers a lot of territory, in an easy running, readable style. This book strikes a rational norm between total acceptance and total rejection of every food and drug.—$2.70 postpaid.—*A. G. I.*

NEW PATHWAYS IN SCIENCE

By Sir Arthur Eddington

EDDINGTON'S new book is altogether up to the standard of his former ones, which are all famous—*Stars and Atoms* (1927), *The Nature of the Physical World* (1928) and *Science and the Unseen World* (1929)—and is the first real Eddington book in six years (*The Expanding Universe*, 1933, was only a minor note). The new book contains six chapters of a physical and philosophical nature: Science and Experience; Dramatis Personae; The End of the World; The Decline of Determinism (law of causality); Indeterminacy and the Quantum Theory; Probability. Following this are several others which deal more directly with objective astronomy: The Constitution of the Stars; Subatomic Energy; Cosmic Clouds and Nebulae; The Expanding Universe; The Constants of Nature; The Theory of Groups. In a final chapter, Criticisms and Controversies, Eddington replies—how well the reader must judge—to some who have accused him of warping scientific evidence to suit religious ends. The chapters represent the transcript of a series of lectures recently delivered at

(*Please turn to page* 279)



Science Service photo

THE BITING BLACK WIDOW AND HER BADLY BUILT WEB

AN article about the black widow spider, in last October's SCIENTIFIC AMERICAN, was the forerunner of numerous newspaper warnings and items about its highly poisonous bite. Dr. Fred D'Amour of the University of Denver, Colorado, has since then perfected a serum which has proved successful in treating victims of this dangerous arachnid. As shown in the photograph above, the black widow's web is unmistakably characteristic, being entirely without pattern, a loose shapeless structure of very coarse strands which crackle noticeably when torn

Photo courtesy *Aero Digest*

A general view of part of the successful Paris Air Show

WINGS OF EUROPE

American Air Supremacy Threatened . . . The Bogey of German Air Strength . . . War Aspects of Aeronautics . . . Research Must Carry on

By IGOR SIKORSKY
Vice President, Sikorsky Aircraft Corporation

THE main conclusion that the writer has drawn from an air tour of Europe is that American aviation is definitely superior to European aviation, although faced with a real danger of rapidly losing its lead. For a complete study of European aeronautics it would of course be necessary to spend many months in the chief centers of aviation activity on that continent. There are, however, many advantages in a rapid survey; impressions are then sharpest and clearest. In the following paragraphs the writer gives such impressions as were gained from a flight of approximately 4000 miles over the airways of Europe, including visits to the most important aeronautical centers. These impressions may serve to give the reader a broad, general picture of the present situation in aviation. Because of the vast amount of material from which these impressions are drawn, some of the descriptions will necessarily be superficial.

If the French press is to be believed, Germany now has a potential air force at least equal to that of France itself. Glib statements are made regarding immense German activity, telling of innumerable commercial transports which can be transformed quickly into efficient bombers. The impression of the writer is to the contrary. It is my opinion that the only airplanes of any size being built in Germany are the Junkers three-engined transports. These ships, although excellent in themselves, do not attain anything like the performance of American aircraft. Furthermore, comparatively few of these Junkers are being built.

IT is possible of course that there are secret sources of aircraft supply in Germany, but it would appear, nevertheless, that aviation activity in that country is considerably over-rated. One really fast aircraft—fast according to American standards—is the Heinkel seven passenger transport, a low wing monoplane of very clean design. The Heinkel has a somewhat high landing speed for a small single-engined plane, but it has many desirable features, including complete retraction of the landing gear.

Among the three-motored Junkers transports of Lüft Hansa, a large number are equipped with American-made Pratt and Whitney Hornet engines. On the other hand, however, German designers have achieved one development which is as yet unmatched in any other part of the world. Successful installation has been made on a Junkers transport of an aircraft Diesel engine. This ship is in actual service using heavy fuel oil which increases the economy of operation and reduces the hazards of fire.

One of the fine German institutions, which has led the way in aerodynamic

research for perhaps 20 years, is Göttingen University. At present the Göttingen Aerodynamic Research Institute is functioning smoothly in the realm of pure science. The aerodynamic laboratories and wind tunnels are active and apparently well organized, although the equipment is modest in size when compared with the excellent equipment of leading American research institutions.

One of the striking developments at Göttingen is that of a remarkable high-speed electric motor suitable for use in small models employed in wind tunnel testing. This motor, with an outside diameter of only two inches, is capable of developing over two horsepower. With this small power plant it is possible to "fly" four foot airplane models in the wind tunnel with the propellers of a three-engined ship accurately represented and functioning in correct simulation of actual flying conditions. It is interesting to note that the patient research work which has been conducted at Göttingen, using this newly developed motor, is in gratifying agreement with other work that has been done in the full-scale tunnel at Langley Field in this country.

AMONG other research equipment at Göttingen is a special water tunnel. Paradoxical as it may seem, it has been found that the simplest way to study air flow is to study the flow of water around hydrodynamic or aerodynamic bodies. In the water tunnel, water circulates under the action of a propeller in a fashion very similar to the circulation of air in a wind tunnel. A large tank forms a part of the circulating system. This tank is closed at the top and connected to a suction pump so that experiments can be made with water at practically no atmospheric pressure. By varying the air pressure in the top of this tank it is possible to study the phenomena of the stall of the wing, the breaking down of the boundary layer, and other similar subjects which still remain somewhat of a mystery. This water tunnel opens up entirely new lines of research.

When the writer visited the Air Show in Paris, he was most forcefully impressed by the realistic panorama of a bomb attack on Paris which was on exhibition. Hardly anything could be more convincing of the terrible effectiveness of modern warfare with high-speed bombers carrying several tons of bombs, than this panorama which had been worked out with great technical fidelity. The city streets of Paris were shown, with the population equipped with gas masks and the gas shelters crowded. It appears that all of Europe is thoroughly cognizant of this aerial danger. A sales leaflet handed to visitors at the Air Show, advertising gas masks, brought the point home better than columns of newspaper reports could have done. The bombing operations during the World War were child's play when compared with what is technically possible today. Undoubtedly it is the realization of the scope of aerial warfare which has caused European governments to be extremely generous to all forms of aeronautical development.

There is no doubt that the French Government now realizes fully the extreme importance of aviation for national safety and progress. This is particularly evidenced by the fact that the Government is offering several very valuable aircraft prizes. For example, there is a prize of approximately 660,000 dollars for a French built plane powered with a French Diesel engine which shall set a new long distance flight record.

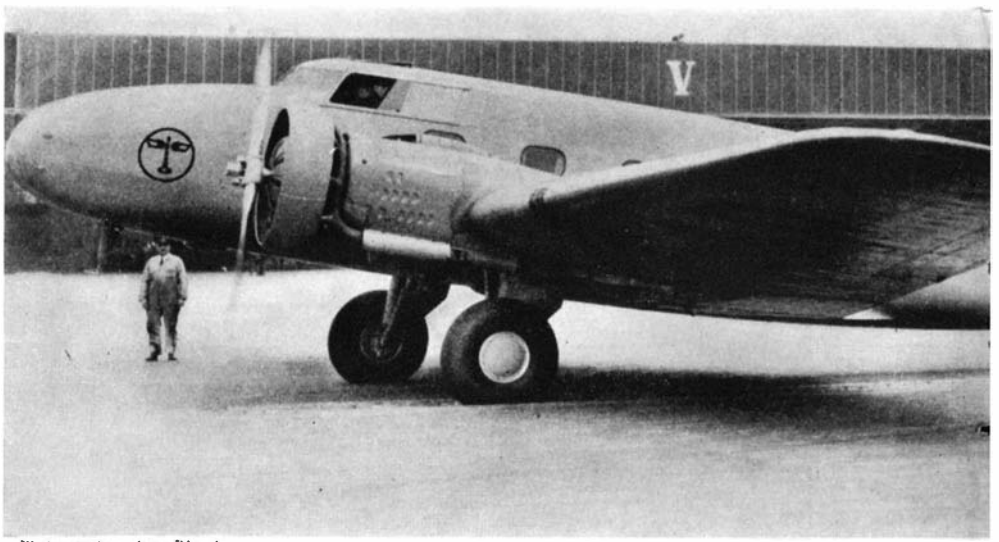
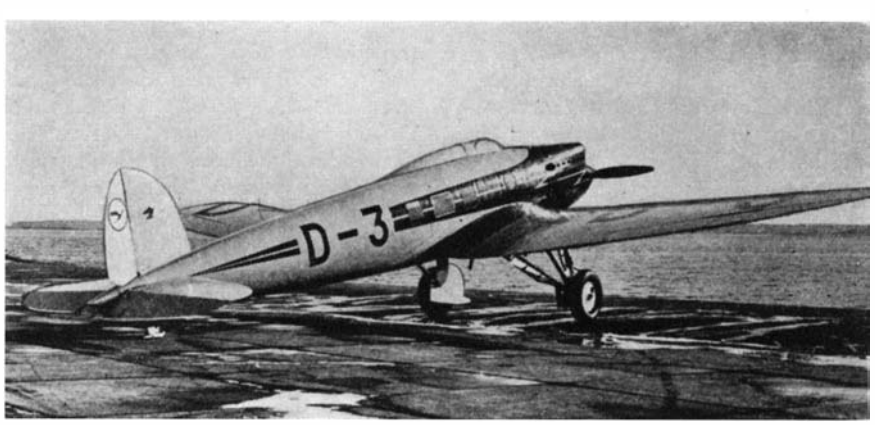


Photo courtesy *Aero Digest*

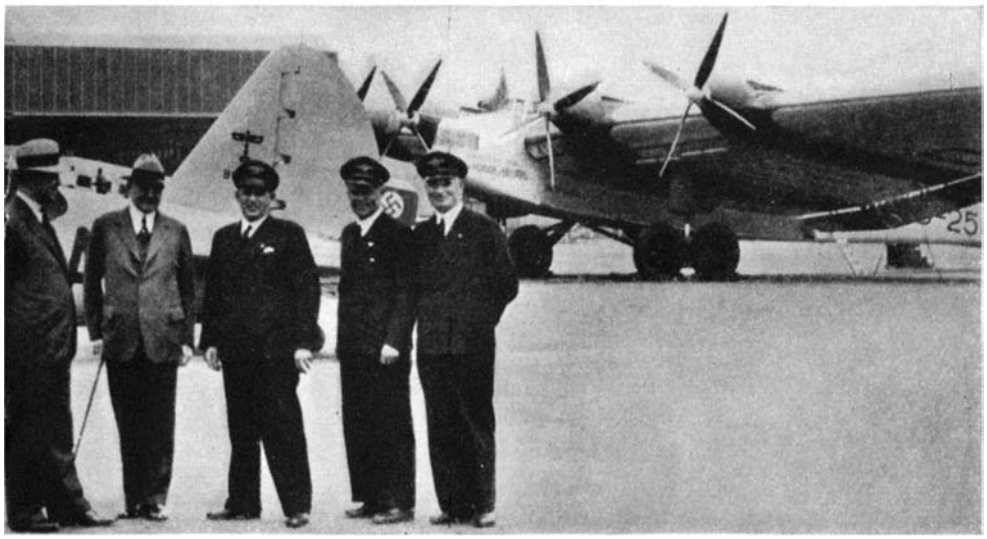
An American-made Boeing 281 transport, Pratt and Whitney powered, used

The only prize of any substantial value which was ever offered in the United States for aeronautical development was the Daniel Guggenheim Safe Aircraft Prize of 100,000 dollars. At the present time, when the officers of our air forces are being condemned for buying the best planes they know how to procure without following unwieldy regulations to the letter of the law, and when the Government is spending so much money for a variety of purposes, would not prizes of similar magnitude to stimulate American aviation be entirely appropriate? One can readily imagine what such prize offers for technical achievement would do for inventors and engineers. The whole art of aviation would thus be stimulated; airplane manufacturers would be able to undertake experimental projects which business considerations would otherwise preclude.

AS was mentioned previously, a perfectly dispassionate view of the entire situation shows that American aviation is in every way superior in the art, when compared with foreign countries. No boasting is contained in the statement that America has the best planes, the fastest and most efficient transport airlines, the best engines and propellers, and superior navigation instruments. The writer, in his survey of the Paris Air Show and of some of the best known aircraft factories in France, England, Germany, and other countries, was not able to find a single essential line of endeavor in which Europe surpassed America. Minor exceptions to this statement might be noted. For example, European-built bombers are noteworthy in offering universal gun fire range with nests of machine guns



The Heinkel seven-place high-speed air transport of Lüft Hansa



by Deutsch Lüft Hansa, photographed at Templehof Aerodrome, Berlin

located at various points, giving real ability to fight off attacking planes. Some gun turrets were seen that were particularly ingenious.

However superior America may be in the aircraft field, that superiority may be short lived. Although American airplane factories have splendid production facilities and excellent engineers, their potential resources are utilized only to a fraction of their capacity. The contrast in Europe is striking. There are located large factories with great forces of men working on large production orders for military and naval aircraft.

AT a time when the United States is actually diminishing its financial support of the aviation industry, European countries are all expanding their programs. Great Britain is planning to increase the speed of its comparatively slow but comfortable Imperial airliners, and to extend its scheduled services all the way to Australia. During 1934 the British Government directly subsidized the Imperial Airways to the extent of approximately 25,000,000 dollars.

France is following the same line of development and is offering a subsidy of 12,600,000 dollars for the operation of its 19,000 miles of airways. The French Air Ministry has spent 5,000,000 dollars for the construction of large flying boats and land planes which are now undergoing tests on the France to South America run. Italy and Holland are taking similar steps to promote their own commercial airlines.

Although the Bureau of Air Mail of the Interstate Commerce Commission is advocating the revision of airmail rates, so as actually to prevent the destruction of American aviation, it is extraordinary to note that, while America is considered the land of wealth and high prices, foreign governments pay much more for aircraft and secure much less for a given sum than is the case in the United States. For example, the Henry Potez Company was paid 430,000 dollars for the construction of a single four-engined transport ship. Although labor in France receives only approximately 60 percent of the wages paid to American laborers, prices for an airplane of a given horsepower and carrying capacity in France are in many cases much higher than in America.

The present superiority of American aircraft is frankly realized by European operators. In Switzerland are being used American-made Lockheed transports. Fokker, the well known Dutch constructor, is building Douglas transports under American license. Douglas transports are also in use on German lines. In the two-motored Fulgur, built to carry 12 to 14 passengers and equipped with two Gnome-Rhone 800 horsepower engines, the Boeing and Douglas influence on the design is clearly apparent. These facts make it desirable to emphasize again that, while American superiority cannot be denied at this time, it is a foregone conclusion that if the present generosity of foreign governments continues and the over cautious policy of the American Government likewise continues, superiority in aeronautics will sooner or later pass across the Atlantic.

After the writer flew from London to Paris he had the opportunity to travel by air from Brindisi, Italy, by Imperial Airways, to Athens in Greece and then to Egypt. Even in winter the Mediterranean Sea is calmer than the Caribbean, and aerial passengers on the Mediterranean flight have an easier crossing than is the case on the North-to-South American line. The general impression which the writer carried away with him of Imperial Airways is that it is a reasonably comfortable travel medium and with good food served on board, but with a cruising air speed of not more than 100 miles an hour.

AS a result of the before-mentioned study of the Paris Air Show, the visits to European centers of aviation and lectures before the Royal Astronomical Society in London and the Société Francaise de Navigation Aerienne in Paris, as well as upon other occasions, the writer made contact with many of the best informed aviation men in Europe.

The strongest impression which he carried away with him was that, while the excellence of American aviation is everywhere recognized, yet in the leading countries of Europe a great effort is being made, well assisted by the various governments, to promote progress in aviation. Therefore, this country can expect to maintain its leadership in aviation only if progressive engineering work properly assisted by the Government is continued without interruption.

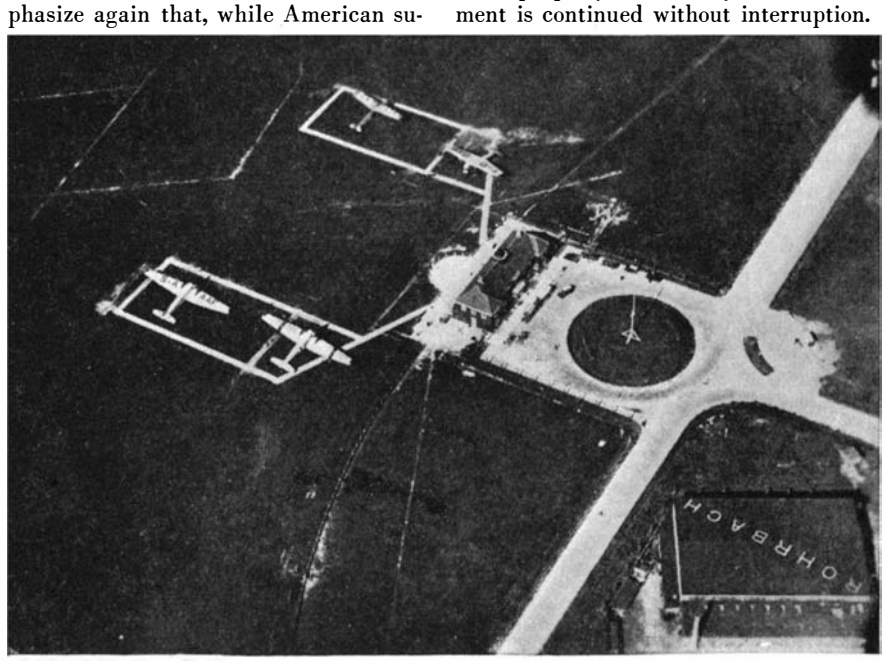


Photo courtesy *Aero Digest*

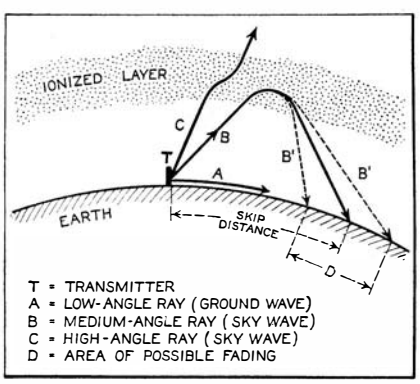
An unusual view of the airport at Rohrbach, Germany

INTERNATIONAL BROADCASTING

Why Long-Distance Transmission is Possible With Low Power . . . Day and Night Wavebands

By M. L. MUHLEMAN*

IN losing his rights to the "choice" wavelengths, the American radio amateur some years ago made an important discovery which has since been instrumental in the development of the vast radio communication and broadcast network occupying the wavelengths from 7 to 190 meters. Forced to confine his activities to wavelengths below 200 meters, it was soon learned that these short wavelengths, considered for years to be worthless, were, as a matter of fact, the very best for communication over great distances. For some peculiar reason, these short radio waves did not seem to diminish in intensity. Low-



The action of the reflecting layer

powered signals transmitted from New York were being picked up in Australia with unbelievable volume.

Later it was determined that a radio wave embraces two components; a ground wave, which travels but a short distance along the surface of the earth, and a sky wave, more complex than the ground wave, which is radiated upwards. Further than this, it was learned that there exists in the upper atmosphere a layer of electrical particles (the Kennelly-Heaviside layer) from which the radio sky waves are reflected back to earth.

Research brought forth the additional point that the shorter the length of the radio wave, the greater its powers of penetration into the layer. It immediately became apparent that the long-wave signals were reflected back to earth from near the surface of the ionized layer in the upper atmosphere, whereas the short-wave signals penetrated the layer for some distance before being sufficiently bent to return to earth. In consequence, the long-wave signal returns to earth some 50 or 100 miles from the transmitter while the short-wave signal, whose angle of refraction is less abrupt, does not return to earth again for some 500 to 6000 miles or more.

It should be apparent from this explanation that there are areas along the surface of the earth where the signal does not appear, which is true. The effect is referred to as "skip distance." The situation is not quite so bad as it sounds since, aside from the reflection and refraction of the waves from the ionized layer, there is also present a considerable amount of diffusion. Nevertheless, this serves to explain why a listener in New York may have difficulty in receiving short-wave signals from Pittsburgh but experience no difficulty whatsoever in intercepting short-wave signals from England.

THIS short-wave communication and broadcasting by "wave refraction" permits stations to cover huge distances with low power, but the means suffers from numerous forms of instability. For one thing, the ionized layer is in constant movement. This alters the reflection of the signal with the result that at one moment it may be focused directly upon a certain receiving area and the next moment have its center of focus some miles away. This is one of the causes of signal fading.

Another form of instability results from the fact that the layer in the upper atmosphere is ionized by the rays of the sun. As darkness falls, the ionization is reduced with the result that a short-wave signal penetrates the layer for greater distances before it is refracted. Therefore, international short-wave broadcast stations use different wavelengths for different times of the day and night.

During daylight, when the reflecting layer is highly ionized, a very short wavelength will provide the longest skip distance, whereas a longer wavelength would return to earth but a short distance from the station. At night, when the layer is less highly ionized, the very short wavelength will either penetrate the layer altogether, or penetrate it for such a distance that the refracted signal strikes a course parallel to the earth. In either case, the signal never returns to earth. Thus, refraction is dependent not only upon the wavelength of the transmitted signal, but also upon the degree of ionization of the refracting layer. Therefore the longer waves, with less power of penetration, are used after dark and, by virtue of the thinning out of the reflecting layer, provide a skip distance about equal to that obtained with a shorter wave during the daytime.

Generally the international broadcasters use 19 or 25 meters during the day, 25 or 31 meters at twilight, and 31 or 49 meters after dark. These short-wave broadcast bands are well established and the 100 or more stations of the world are to be found at, or near, these points on the dial of an all-wave receiver.

●

A list of selected short-wave broadcasting stations of the world, giving wavelength, schedule of transmission, and so on, will be sent to readers upon request. Please enclose a three cent stamp to cover mailing.—The Editor.

W2XAF, Schenectady, New York. Antenna wave-change switch at top

*Editor, Communication and Broadcast Engineering; Radio Engineering; (Radio) Service.

OUR POINT OF VIEW

Shipping Subsidies

FOR several years, foreign shipping interests, lobbying for state subsidies to help them compete with other shipping nations, have pointed to the American Merchant Marine Act of 1928 and to our system of mail contracts to support their pleas. Unmindful of the fact that America builds but a minute fraction of the shipping tonnage the world builds, as we pointed out editorially last month, they have called our system a state subsidy and have expressed fear of the competition from a renascent American Merchant Marine. We, in turn, have denied the subsidy accusation with many fine phrases, yet have hoped they were right in their fears. We denied subsidizing our shipping and on the other hand hoped that our Government aid *would* rebuild our merchant fleet. We simply did not face facts.

It has remained for the President to bring the whole subject frankly into the open. Our present system *is* a subsidy but far from an effective one. We have built several fine ships under it but not enough of them; and, so far as the mail contracts are concerned, the system is discriminatory against those lines not on mail routes. The President recommends abolishing subterfuges and setting up a new and correctly labeled subsidizing program. He would provide Government aid in ship building to an extent that would offset the differential between the costs of building ships in this country and abroad, and further aid to take care of the higher cost of operating American ships.

A difficult situation promises thus to become clarified. There is much merit in the President's remarks, but when analyzing them, basis for doubt is found. It would indeed be a splendid thing to throw off the disguise and proceed to build a finer Merchant Marine with direct Government aid. All thinking people believe we need more ships for reasons widely known and often discussed in these pages. But to build them with Government cash, whether by one scheme or another, is not the same simple thing as rehabilitating a park with PWA money. We have had shipbuilding scandals before; unlawful practices, abuses, and favoritism have reared their ugly heads. They can easily show up under a direct subsidy plan and it is to be feared that they will unless Congress, while striving to solve this problem, first thoroughly canvasses every avenue of approach to the question and effectually blocks off those where chicanery and corruption might later enter. Then and only then may we expect improvement in our merchant fleet.

Pot and Kettle

IN 1925, when America was in the throes of the famous Tennessee "monkey trial," British journals and commentators missed few opportunities to point out America's backwardness. They, of course, were quite right: we were backward. (Tennessee was a part of the American nation.) It came down to this: some Americans—state legislators—were trying to settle a question which a more advanced community would regard as the prerogative of scientists. The Scopes anti-evolution law remains on the statute books of Tennessee today, and it is still illegal, therefore, to teach, in any tax-supported school or university in Tennessee "any theory that denies the story of the divine creation of man as taught in the Bible and to teach, instead, that man descended from a lower order of animals."

It is frequently asserted that this law is only a gesture to appease the people of the community. But if it did not represent the majority opinion of the community to which it applies, the recent attempt to repeal it doubtless would have succeeded. Therefore it unquestionably does represent the majority opinion, and the intelligentsia of Tennessee can no more disown it than the intelligentsia of America can disown Tennessee; all concerned are Americans.

And now Britain has unexpectedly discovered right on her own doorstep an awkward scientific "scandal" of her own, deposited there, too, by one of her own scientific men. Sir Ambrose Fleming, the great electrician whose "Fleming valve" has had so much to do with radio, in his presidential address to the noted Victoria Institute, states his belief that "this sedulously propagated hypothesis of man's age-long evolution . . . is the product rather of the imagination than based on indisputable evidence," and that Adam was created in the year 5411 B.C.

Does Sir Ambrose Fleming stand alone in Britain in these assertions? No, for friends—all Britons—gather round him. G. K. Chesterton, famous English journalist and author, rejoices, in *The Illustrated London News;* a staff writer in *The Sphere* is glad, he says, that Sir Ambrose has thrown a brick at evolution.

It becomes evident that opinion in Britain is not so solidly behind science as British critics of backward America have declared, and that British commentators will now be less inclined to point a finger at the monkey business in Tennessee than they were before the occurrence of this latest monkey business in London. Otherwise the pot would be calling the kettle black.

Identification

NOT to be outdone by New York City, other communities are at the moment intensifying the years-long drive for fingerprinting civilians. While some agitation to compel fingerprinting of every individual is still in evidence, the present activity is voluntary on the part of police departments and of individuals. Police bureaus offer to take the prints of any who wish such service, the records to be classified and filed apart from criminal prints.

Despite reassurance from many authorities and the example set by numbers of public men, people generally still seem to believe there is some criminal stigma attached to the simple fact of placing one's fingerprints on record. This, regardless of the fact that about four million of our soldiers were fingerprinted in 1917 and 1918, and without demur. Nowadays, as criminals widen their kidnap activities, possible victims among those whose wealth is tempting to crooks are frequenting fingerprint bureaus in increasing numbers. Their records may later prove valuable as positive indentification not only of themselves but perhaps, as has once already happened, of the hideouts where they were imprisoned. Amnesia victims and economic casualties, of whom there has been a higher percentage than usual under the strain of recent years, would be quickly identified were their prints on file. The identity of victims of disasters, on sea or land, and unconscious or deceased victims of city street accidents, often unidentifiable by ordinary means, would quickly be learned so that relatives might be notified. Fingerprints also serve as irrefutable signatures on documents or checks.

As publishers of a standard work on fingerprints and of a magazine long concerned with the problem of combating crime, we commend those police departments which now are offering the services of their fingerprint bureaus to the furtherance of this scheme. Particularly do we wish to thank the police of New York City for starting the current drive and helping promote public acceptance of the idea.

BACK TO PROSPERITY

Housing Program Offers Tremendous and Varied Market to Construction Industry, Durable Goods Producers, All Labor, and Business Generally

By JAMES A. MOFFETT
Federal Housing Administrator

(In Two Parts. Part 1)

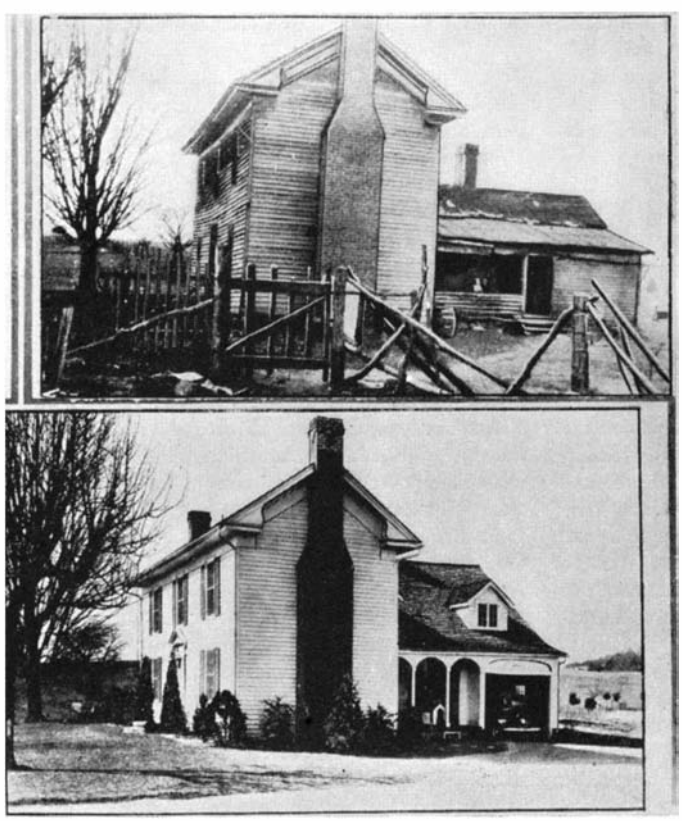
OUR Better Housing Program is America's way back to prosperity; and America is on the way. The National Housing Act, under which that program has been developed, was inspired and approved by President Roosevelt as a sure-fire means of restoring prosperity to this country. It would, he foresaw, create new business for the construction industry; this would inevitably result in big demands upon the durable goods industries; and that, in turn, would mean stimulation of all business.

What the President anticipated when he signed the Act, June 27 last, is now taking place. Railroad car loadings are steadily increasing. The business of certain corporations manufacturing housing materials is 400, 500, even 600 percent greater than it was one year ago. At the call of the builders, sleeping capital is waking up and employing more workers and creating new wealth.

NEVER before, by legislation or otherwise, in this country or any other, has so rich an opportunity been made for business as is created by the National Housing Act.

Never before has so tremendous and varied a market been offered to the construction industry, durable goods producers, skilled and unskilled labor, and to business generally. Never before, incidentally, has there been such challenge or such inspiration to the inventor, to the fabricator, buyer, and seller of new devices for household convenience, of industrial machinery, and of transportation equipment.

It is the Federal Housing Administration's duty to sell the American people the idea that now is the best time for them to modernize and repair their homes and industrial plants and to build the new residences which are so badly needed. That idea is fast taking hold of the popular mind. Already in more than 2600 cities and towns it is striking down through the whole community structure to the point where each home owner finds a canvasser on his doorstep waiting to tell him why he should modernize and where he can, if necessary, borrow the required money on easy, convenient terms. In over 3000 other communities, Better Housing Committees are perfecting organizations for house-to-house canvasses to promote the idea.



Two photographs that tell a vivid story of the rebuilding of an old eyesore into a comfortable and attractive modern home

We figure by a very careful and conservative estimate that the Better Housing Program thus far has generated over 400,000,000 dollars' worth of modernization work.

As this is written (in March), I have on my desk pledges from some of the country's greatest industrial corporations to undertake without delay modernization of plants and equipment that will cost more than three quarters of a billion dollars.

And all this has come from seven months' actual organization work and before the building season has opened up in the greater part of the United States. In other words, so much has been accomplished in modernization and repair in the autumn and winter months that the big industrial corporations — the durable goods industries—have felt the reviving touch of it and have joined that army of modernization and construction whose marching feet are already on the road back to prosperity.

Consider, now, two things: First, why modernization, repair, and new building are vitally necessary to the welfare of America; and second, how our Better Housing Program makes it profitable and more convenient than ever before for the nation to do those jobs.

LAST August, when the Housing Administration's field work really got under way, there were in the United States at least 13,500,000 homes in need of repair. How many of the 29,000,000 buildings of all sorts in the land needed some degree of modernization, it is impossible to say; but we may safely assume that the majority of them needed it, since modernization means bringing a home or industrial structure up to date in condition and equipment.

Neglected during five years of depression, the homes of America were, in many millions of instances, far from up to date, in both exterior and interior conditions. They needed, the experts told us, 3,000,000 new roofs, 6,000,000,000 feet of lumber for repairs, and more

WITH HOUSING

WE have been fortunate, indeed, in obtaining Mr. Moffett's illuminating interpretation of the aims of the National Housing Act and of the reasons for believing that a properly developed housing program will bring prosperity. His arguments are sound—in this and the second part of his article which follows next month.

In public apathy, however, (or caution), there is a stumbling block which so far has retarded expansion of this program. Thinking people know full well that the housing program is feasible and that the accruing benefits to everyone are great; so it is up to them—to all of us—to bend every effort toward its rapid fulfillment.—*The Editor*

than 1,000,000,000 dollars' worth of paint and varnish.

If the salesmen of all the industries and businesses concerned could sell the goods to every real "prospect" for home modernization alone, the experts said, they would do six billion dollars' worth of business.

Does that sound excessive? There are in our homes, according to the surveyors of the situation, 10,000,000 kitchen ranges that are obsolete; *and* 500,000 electric refrigerators; *and* 800,000 electric washing machines. When we move over to the field of industrial plants and transportation facilities, the modernization needs run into figures equally impressive, that show what must be done.

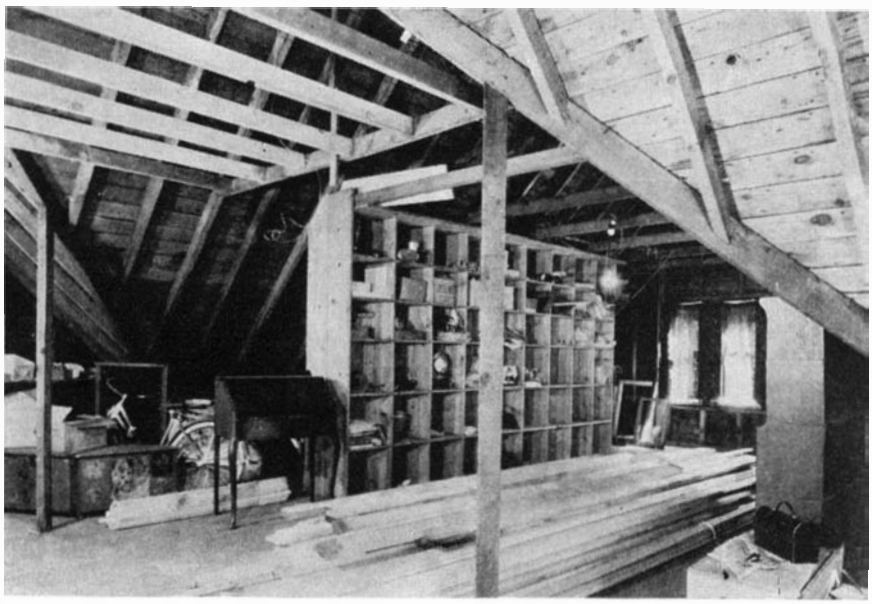
In our eastern states, we are informed, it would cost well over a billion dollars to get rid of the 26,000 grade crossings where motorists are endangered. The railroads need 240,000,000 dollars' worth of new locomotives; and of their 23,000 passenger day-coaches, 4400 are built of wood and 2400 part wood.

Any industrial machinery that is ten years old, the experts claim, can be classed as obsolete, and more than half of the machinery in our factories has been there over ten years. Estimates are given us that America's industrial plants can spend 7,000,000,000 dollars in new machinery and 2,500,000,000 dollars in electrical equipment before they can say they are up to the minute.

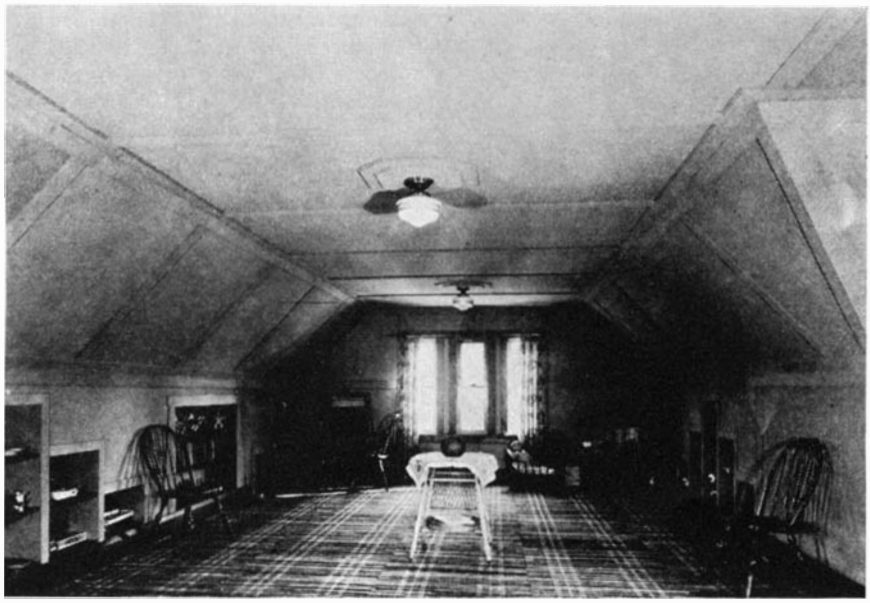
But opportunity, rich and varied, inviting both the manufacturing concern and the individual inventor, points to still other fields, some of them practically brand new.

THERE is, for example, air conditioning, which some of the students say should yield 200,000,000 dollars a year, while others put its annual possible receipts as high as 1,000,000,000 dollars; new materials in farm equipment; and stupendous expenditures by municipalities.

These things I have mentioned are the high-lights of the nation's needs in modernization and repair. There is not space here even to list the countless smaller items which nevertheless total hundreds of millions of dollars—articles ranging from sash-cords to sewing machines.



Rebuilding an attic provides an extra room in the home and at the same time creates work and profits—essentials to the return of more prosperous times



Nor may I linger on the details of our need of new homes. Some of the estimates are that we must have 5,000,000 or more new residences before we can say all our people are decently housed. But for purposes of illustration, suppose we assume that we need only 2,000,000: We see that there is a total of about 3,000,000,000 dollars' worth of new homes to be erected as soon as possible—conservatively figured at a low average of 1500 dollars per residence.

Markets for the builders, contractors, building supplies dealers, and so on, running not only into the hundreds of millions, but into the billions! Not at some time in a far, vague future, but now—TODAY!

Mr. Moffett's illuminating discussion of housing facts will be concluded next month.—THE EDITOR.

SAFETY IN THE AIR

More Improved Weather Service Needed . . . New Radio Aids Important . . . Weeding Out of Incompetent Pilots Held to be a Prime Necessity

By REGINALD M. CLEVELAND

THE airlines of the United States again set an enviable record for safe flying during 1934 with 4,878,655 miles per fatal accident.* But accidents happened which should not have happened and there is still room for improvement in providing for the safety of air travelers.

It is perhaps unnecessary to recall that the year 1934 was a particularly trying one for air transport. Hard upon the heels of the cancellation of airmail contracts, still unjustified by any prosecutions for alleged "fraud and collusion," temporary airmail legislation was set up under which contractors, new and old, secured routes at rates which were frankly sacrificial. Under these rates they have been going rapidly into the red, month by month. Even those with the deepest financial reserves cannot continue very much longer on such a basis. The aggregate losses for the last seven months of the year were about three million dollars net. Individual losses ranged from 10 percent of total capitalization to 100 percent.

Under these circumstances, it was perhaps not reasonable to expect that very much should be done toward improving service and safety in the air. It may truly be said, however, that the lines met their very real and very pressing troubles in an admirably courageous spirit and did provide astonishingly fine service with faster and more frequent schedules and improved correlation of services.

IT was noticeable during the year, however, that, with improvement in aids to bad weather flying, more bad weather flying was attempted than had hitherto been the case, and in view of certain of the transport accidents it is difficult not to feel that the eagerness to maintain schedule was not manifested at some cost to safe procedure.

No one close to the subject of the progress being made in the instrumentation of planes and in the radio aids to flight, doubts that scheduled blind flying and actual blind landings will soon become a commonplace. The danger lies in anticipating this condition before it has fully arrived. Pilots have by no means had sufficient experience with the new aids and instruments at their command to make it safe and proper procedure to place full reliance upon them when flying passenger loads.

To pass an examination in blind flying under a hooded cockpit and to do sufficiently good instrument flying under these conditions, with a check pilot who is not hooded aboard, to meet the Department of Commerce requirements, is one thing. Most airline pilots with a transport rating have been able to do this successfully. To get into actual bad weather, with zero-visibility conditions, and keep on course or reach destination after a protracted period of such flying, is altogether another thing. There are veteran transport pilots who can do this and have proved it, but this type of flying cannot be regarded as safe until the run-of-the-mine pilots and co-pilots on a given airline can do it, too.

Despite the great improvement which has been made in a year in weather forecasting, and the still greater improvements which appear to be around the corner through the further development of the air mass analysis method, old man weather is still unfortunately erratic, and planes still get into spots in which are made the utmost demands for skill and real blind flying and navigation.

*Another statistical tabulation presents the figures in a different manner; 10,727,026 passenger miles were flown per passenger fatality during the year 1934.

The Sperry gyropilot takes hold, permitting the pilot and co-pilot to turn their attention to navigation and weather problems which otherwise would necessarily be more or less slighted

THE safety record of the year would certainly not have been even as good as it is had not the improvement in weather information already noted come about. There was a period in the early part of last year when even the Federal broadcasts of airway weather in widely scattered sections of the country passed through a highly dangerous period of over-optimism.

The writer will not soon forget 40 minutes spent with seven fellow passengers in the vicinity of New Orleans in a big transport plane which was caught in a torrential thunderstorm with a ceiling ranging from zero to about 200 feet over the tree-studded bayous, while over the radio from an airport in the same area came the repeated broadcasts: "1800 feet, light rains." It was only the exceptional skill of the veteran transport pilot at the controls and the fortuitous circumstance that it was just at dusk and the lights of a Federal emergency air-

port flashed on when about 20 minutes of gas remained in the tanks which led to a happy landing instead of what might have been a messy crack-up.

Similar experiences reported from a number of sectors at about that period led to marked improvement in the accuracy of current weather broadcasts, followed by increasing accuracy of forecasting through the balance of the year. This did not prevent a number of passenger planes, however, from coming to grief in bad weather, some with serious casualties and others, smiled on by the gods of luck, unharmed.

It is widely felt that too much reliance has been placed on the radio-beam system and that more exhaustive training in enabling pilots to fly compass courses blind is strongly indicated. Not that the directional beams are not useful. They are, of course, vastly so, and cover the country with a protective network of signals without which the present regularity and safety of air transport would hardly be possible. But, conditions of polarization at certain times of day, such as dusk and night, sometimes limit the range of the beam from its normal 100 miles or so, to about 30 miles. Moreover, its path is relatively narrow and consequently difficult to follow.

IF, under certain conditions, a pilot gets into sudden thick weather, he may easily lose the radio beam through drift. There have been several cases of this kind where the beam has not been picked up again until its source had been passed and the pilot finally discovered that he was flying away from his destination instead of towards it. As one cure for this evil, it has been suggested that sharper differentiation in intensity of the beam signal be required, so that the flier may more readily know when he is approaching or receding from the beam station.

The Bureau of Air Commerce is, of course, sincerely interested in promoting flight safety. It has recently tested and recommended for adoption the Army system of blind landing. This system is to be tried out on a large scale over the lines of TWA—not, however, it should be emphatically pointed out, with passengers—until a complete and satisfactory series of thorough-going tests has been flown.

The system is very adaptable and elastic and appears to be quite suitable for military cross-country flying, where portability of equipment and similar factors are of prime importance. It consists in placing two radio transmitters—which may be portable—at specified distances from the boundary of an airport, and using them to determine the distance of the plane from the airport.

Receiving the signals of the nearest of these stations to the boundary by means of the Kruesi radio compass, which has proved so satisfactory as a homing device,* the pilot passes over this station and then tunes for the one further from the boundary. Immediately after passing over the second transmitter—a fact which he knows by the character of signal received, or by sudden complete absence of signal—he makes a 180 degree turn, again picks up the outer transmitter, flies over it and picks up the inner transmitter, maintaining a predetermined altitude by means of a sensitive altimeter. As he crosses the inner transmitter, this time of course approaching the field, he puts his plane into a fixed glide which will bring him down to a landing in the field.

This method, developed by Captain Albert F. Hegenberger, the noted blind flying pilot of the Air Corps, has been successfully applied by him and by many other pilots in military ships. It is certainly worth investigating for commercial use. Most airline operators, however, are still inclined to the belief that the more positive method of blind landing provided by the bent radio beam system will prove a surer solution of the problem. Early difficulties with this method included costly installation, a flight approach limited to a single direction, and a landing beam too fixed in character to suit the characteristics of varying aircraft. The method has now been greatly improved and simplified, however, through the work of Harry Diamond and other engineers of the Bureau of Standards so that these objections have been swept away.

The transmitter required for the bent beam can now be located in a pit in mid-field, giving a 360° path of approach and has been so simplified as to be greatly reduced in cost. Furthermore, the angle of the beam itself can be varied to suit aircraft characteristics, and is said to be accurate to such an extent that a pilot entirely befogged can be sure of his position laterally within 50 feet and vertically within 5 feet, a margin amply sufficient to assure safe blind landings. Apparatus to provide this system has just been installed at Tempelhof, Berlin.

*See page 240

Structural strength of transport planes plays an important part in air safety. In this crash, the entire passenger cabin remained intact; only the pilot and co-pilot were slightly injured

Distinct gains in safety, as well as in passenger comfort, have been made by wider application of the automatic gyropilot to transport planes. TWA's whole fleet of speedy Douglases are now thus equipped with Sperry pilots and the human pilots of the line enthusiastically testify to their great help in easing the strain of flying, keeping the plane on fixed course and giving them time and opportunity to attend more completely to navigation and weather problems.

Until the day dawns of the aircraft completely radio-controlled from the ground, however, the human equation cannot be cancelled out from the matter of flight safety. Training, yet more training, and culling are still the prerequisites.

FEDERAL authorities and airline operators would be glad to weed out the pilots whom they both know are not capable of 'complete blind navigation and not fully able to meet that thousandth chance when mechanical and electrical aids prove inadequate. The top pilots of the country's air systems would also like to see such a condition. As an obstacle in its path, however, stands the pressure of the less competent pilot who might be one of the tares in the wheat field. He finds it all too easy to get the backing of the National Labor Board. The drive for safety cannot come in full measure to the airlines until they, and the Bureau of Air Commerce, find it less difficult to weed out the unfit and the incompetent for cause.

DOUBLE STARS

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

THERE are at least four prerequisites for a successful program of astronomical observation: a good telescope, a good climate, a good eye, and good judgment.

At this point many a reader will stop and in spirit will inquire, "But why a good eye? Are not almost all observations made nowadays by photography?"

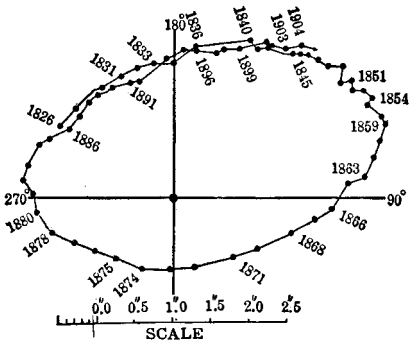
In many fields of work this is entirely true. The whole study of spectra is made on photographs; so are the greater part, though not all, of accurate measures of the positions of the stars. Measures of the heat of stars and planets, and the most precise determinations of their light, are made with thermo-electric or photo-electric devices of one sort or another. But there are certain important lines of astronomical work in which direct visual observation reigns supreme.

One of the most fruitful of these is the study of double stars. For a century and a half subsequent to the invention of the telescope, astronomers had known that a good many stars were double, but no one seems to have taken the trouble to measure the distance and direction of one of the pair from the other till Herschel tried it in 1780. A few years' observation showed him that, while most pairs remained substantially fixed in relative position, a few exhibited a regular and progressive motion obviously of an orbital nature. Then, in his own words, he felt "like Saul, who went out to seek his father's asses and found a kingdom." The realm of gravitation extended to the stars as well as the solar system.

IT was half a century later, however, that Wilhelm Struve began the first systematic search, recording and measuring all pairs which were separable with his nine-inch telescope—more than 3000 in number. Later campaigns with larger telescopes have added to the list, though only Aitken, at the Lick Observatory, has discovered as many pairs as Struve. His recent General Catalog, summarizing the work of the past century, contains more than 17,000 double stars. The southern heavens, south of declination −31°, are not included in this. When the surveys which are still in progress are completed, about 5000 additional pairs should be added to the total, bringing the grand total to 23,000.

Practically all these discoveries have been made by looking at the stars directly through telescopes. The primary reasons are that the vast majority of double stars have a very small apparent separation. Great numbers of pairs, including many of the most interesting, are so close that they can be resolved only with large telescopes. Even with ideal optical conditions the waves of light coming through the circular aperture of a telescope can be concentrated, not into a mathematical point, but into a small "diffraction disk." The size of the disk varies inversely as the diameter of the clear aperture of the telescope, according to the formula $d = \frac{4''.5}{A}$, when d is the diameter in seconds of arc and A the aperture in inches.

With Struve's nine-inch telescope all stars therefore appeared as disks 0″.5 in diameter (which is more than 10 times as large as the real angular diameter even of Betelguese). A pair separated by 0″.5 would appear to be in contact, however wide the real interval in miles between them. With a separation of 0″.4, there would be a single elongated image. Pairs much closer could hardly even be detected. The 36-inch Lick refractor gives a "spurious disk" of only 0″.12, and reveals thousands of systems which are utterly beyond the power of the smaller instrument.



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

Orbit of a binary or double star, Xi Ursa Majoris, having a period of 59.8 years. This is the apparent, not the true, orbit, the orbit being seen from our vantage point more or less obliquely and distorted by foreshortening. The little wiggles in the curve merely show the kind of slight differences in observation which cannot be eliminated entirely and, at worst, represent inaccuracies of about one tenth of a second of arc. After smoothing off these irregularities, the curve is an ellipse

With a suitable eyepiece of high power the skilled visual observer can detect and measure equal pairs right up to this theoretical limit. Unsteadiness of the air, of course, may smear out the images, so that he can do nothing. The photographic plate is at a hopeless disadvantage. Star images on the negative at best are little round bundles of black silver grains, many times larger than the tiny optical images of the stars themselves. There are several reasons: the light spreads out on the plate, so that the images of bright stars are bigger than those of faint ones and, during the minutes of exposure, when the air is as steady as can be hoped for, the star seems to dance about—not much, but enough to blur its image. Even on the best plates taken with great telescopes it is rare to have star images less than 1″ in diameter, some eight times as big as the optical image itself. Moreover, when the seeing is a little unsteady, the visual observer can take advantage of a favorable moment to make his setting, while the plate records only an indiscriminate average of good and bad—which for the present purpose is much like a mixture of good and bad eggs.

FOR pairs of unequal brightness photographs are at a still greater disadvantage. The fainter star may be utterly drowned in the expanded image of the brighter and, even if they are widely separated, the image will be over-exposed or else the other under-exposed, and no accurate measures can be made.

There is, therefore, not the slightest hope—or fear, according to which standpoint we adopt—that other means of measuring double stars will put the visual observer out of business. He appears to be in no danger of technological unemployment.

Double star observation has been, all through the past century, one of the most altruistic of occupations. One in two or

three hundred of the pairs a man discovers may turn out to be a rapid binary, completing a revolution in 20 or 30 years, so that he may live to follow it all the way around and compute its orbit. But the overwhelming majority move so slowly that 50 or 100 years are required to show that they are actually changing their relative position. The discoverer's satisfaction here must be that someone a century or two after his death may say, "Thank goodness that faithful old fellow made such reliable measures."

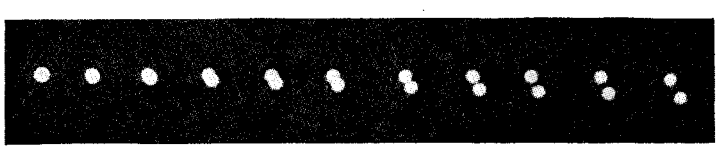
Just because past observers have been faithful and enthusiastic, astronomers of the present suffer from an embarrassment of riches. Like Mother Goose's old woman, they have so many children that they don't know what to do. In principle, every double star should be accurately measured at least twice at an interval of 20 years or more, to pick out the rapidly moving pairs, which should be observed regularly, from the great mass which change so slowly that it is quite sufficient to keep tab on them three or four times a century (provided the observations are accurate). In practice, an observer usually goes over his list at a shorter interval, but he finds that the most interesting objects of all have been neglected.

FOR wide pairs (more than three or four seconds of arc) fairly comparable in brightness, photographic observation is easily possible and more accurate than direct visual measures. But, even so, there is a staggering amount of labor left for the visual observers.

The Realm Where the Visual Observer Still Reigns Supreme . . . and Will not be Dethroned

for which we have even tolerable orbits. This happens because one cannot calculate the orbit of a double star reliably until it has been obscured over the greater part of a revolution. With a century of observation available for the easier pairs, and less than half as much for the more difficult objects, only pairs with periods less than about 200 years in the first case, and 80 or 100 in the second, are yet available.

Now the stars are much more alike in mass than in anything else—which means that a period of 80 or 100 years corresponds to a distance comparable with that of Neptune from the sun. To be resolved telescopically such a pair must be within three or four hundred light years—which is much nearer than the majority of the stars of the eighth and ninth magnitudes. Our list of orbits is therefore a selected list of stars nearer than the average. The few systems with large apparent orbits and easily observable with small telescopes have, without exception, large parallaxes and are among the nearest stars. Suppose, then, that a modern observer starts out to hunt for double stars which are likely to be in rapid motion, and add to our lists of reliable orbits and well determined masses, during the lifetime of the younger at least of present-day workers. What should he do? The obvious answer is to observe the *nearer* stars. Among these he can detect pairs of small real separation and of correspondingly short period.



A photograph by J. A. Anderson, showing the diffraction image of an artificial double star observed through a telescope. The first one shows the image of a single star, but the remainder show the gradual separation of the images of the components of the double, as the aperture of the telescope is step by step opened up. First we see the image slightly oblong, then elongated, and presently it breaks, like an amoeba dividing, and finally the aperture is wide enough to separate the components quite sharply. The larger the aperture of the telescope the closer the doubles it can separate

At this point the function of good judgment enters. Why do we observe double stars, anyway—is it more than a harmless hobby? To obtain knowledge, of course; but the mere knowledge that a star is double is of little profit. In the first place it is from double stars, and from them alone, that we can get direct information about stellar masses. Without this we could not even make a start at a physical interpretation of their internal constitution or their nature. To get the mass we must know the star's distance—given by its parallax—and its orbit. Thousands of good measures of parallax have been made in the last 30 years, but there are only 100 pairs or so

Long lists of measured parallaxes, containing dozens of nearby stars, have been available for a decade or more. But no one seems to have put this simple suggestion into practice until a young Dutch astronomer, Gerrit Kuiper by name, came to work at the Lick Observatory. In the course of a carefully planned campaign of double star observation he set out to examine all stars known to be within 80 light-years from the sun, with the 36-inch telescope on good nights. The results have been amazing. More than 100 new double stars have been found, and a dozen or more are very close. Half of these are faint red dwarf stars with large parallaxes, whose companions appear so close that their real distances probably average less than that of Saturn from the sun. These faint stars are doubtless less massive than the sun. One third the sun's mass for each star of the pair would be a reasonable estimate. On this basis Kepler's law indicates that the periods should be from 30 to 50 years. A few decades of observation should give good orbits, and more than double our knowledge of the masses of these faint red stars.

One of the dozen is much more remarkable—the ninth magnitude star B. D.–8°4352 (that is, star Number 4352, in the zone 8 degrees south, in the Bonn Durchmusterung Catalog). This has the unusually large parallax of 0".15, making its distance only 22 light-years. Last July it was seen to be double, with a separation of 0".20, which (apart from the effects of foreshortening) corresponds to a distance less than that of Mars from the sun. Later observations showed a motion in angle of nearly 90 degrees in four months! At this point the star was lost in the evening twilight, and further observations could not be made till February. If it keeps up its rate of motion it will complete a whole revolution by the end of this year—indeed, the stars were drawing closer together and moving faster when last observed, so that the period may be even less than a year.

THIS brilliant discovery is only an incident in Dr. Kuiper's carefully designed program. It has led to other important results. A spectroscopic study of these nearby stars has found two new white dwarfs, one about one hundredth as bright as the sun, and the other only one six-hundredth. Both have well-measured parallaxes, so that there can be no doubt of this conclusion. The spectra have been observed at Lick and Mount Wilson. Adams and Humason at the latter observatory report them similar to that of the Companion of Sirius. Kuiper considers that this indicates a still higher temperature. In actual diameter these stars can hardly be bigger than Uranus or Neptune, and may be as small as the earth.

These results from a single year's work show that there are still as good fish in the sea as ever were caught—indeed better. The main thing is to know where and how to catch them!—*Princeton University Observatory, March 7.*

SCIENTIFIC AMERICAN'S Monthly

DIGEST OF AVIATION

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

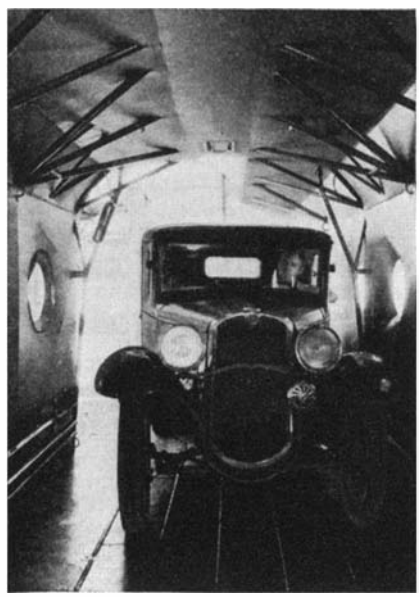
THE CONDOR CARGO CARRIER

UNDER Army Air Corps influence, airplane cargo carriers are receiving a decided stimulus. The Curtiss Condor cargo plane is an excellent and rugged transport of biplane construction, which is nowadays somewhat of a distinction. It is the splendid arrangement inside the fuselage which is of the greatest interest.

The interior dimensions of the fuselage available for cargo space are relatively immense. The length is 22 feet; height 6 feet 6 inches; width 6 feet 3 inches. These would have been unbelievable figures four or five years ago. The main cabin door, constructed of aluminum alloy sheet, and with a similarly constructed hatch, makes available a clear opening of 6 feet 6 inches in height and 6 feet in width. No wonder that it is possible to put a complete automobile into the cargo space.

Monorail hoist with which large cases can be loaded into the Condor

The standard cabin furnishings include 10 pyralin windows each 12½ inches in diameter; a main entrance door; two emergency exit doors, one on either side of the cabin; a hatch in the pilots' compartment for fueling and servicing; a hatch just aft of the cabin in the floor for parachute exit and the dropping of food and other items in containers by parachutes; a first aid kit; a lavatory; a complete cabin heating installation with 12 individually controlled outlets; and two cabin dome lights which also include air exhaust ventilating units.



The cargo space inside the Condor easily accommodates an automobile

As a troop transport, four folding benches are carried, which will seat 16 soldiers with ample space remaining for packs, rifles, and so on. As an ambulance ship, six welded steel litters are provided. These are supported in the front of the cabin, three on each side, leaving the remainder of the cabin clear for other personnel or equipment.

As a freight carrier, a monorail hoist, loading ramp, block and tackle, and hold-down eyes are provided. The monorail hoist consists of a rope-driven screw hoist and trolley which runs on an aluminum alloy I-beam, supported over the door by two diagonal steel tubes with welded fittings. Attachment is made at the ridge pole on the center line of the door by a screw fitting. The track can be disassembled merely by unscrewing this fitting. A removable section of flooring brings the door sill level when the tail of the ship is on the ground. Two channel sections provide a ramp on which standard engine dollies can be rolled on board the ship. For moving freight, engines, and so on, forward in the ship with the tail down, a block and tackle is provided.

We attach particular importance to these developments which represent the highest type of practical engineering. There is no doubt that from Army use, cargo planes of this type will pass into employment on our airlines.

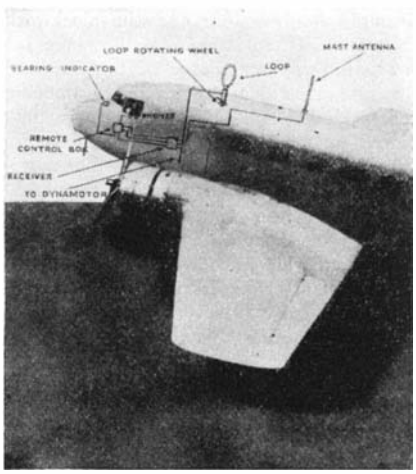
THE KRUESI RADIO COMPASS

WE are indebted to Frederick A. Lutz of the Fairchild Aerial Camera Corporation for a description of the Kruesi radio compass, originally developed by Geoffrey Kruesi at the instrument section of the Army Air Corps Experimental Station, Wright Field, Dayton, Ohio. The Kruesi compass is the key unit in the blind landing system adopted by the Army and has been favorably passed on by the Bureau of Standards and recommended for use on airlines. It can be used in connection with any broadcasting station and, as compared with the radio beacon, it has the great advantage of freeing the pilot from following a definite

The cargo biplane, described above, in flight

airway, and is therefore particularly well adapted for non-scheduled flying. Moreover it is extremely simple in use, and requires very little training for its operation. It has a longer range than the radio beacon.

The Kruesi compass consists of a single compass-receiver unit, mounted in an out-of-the-way place on the ship; a remote-control box mounted conveniently to the pilot; a bearing indicator mounted on the instrument board; a fixed loop for homing purposes (which may also be rotatable so as to



How the various parts of the Kruesi radio compass are disposed within the fuselage of a plane. See text

serve both for homing and for direction finding); a mast antenna; and a dynamotor and the airplane storage battery to supply the necessary current.

The compass receiver has a broad frequency range, and embodies a superheterodyne receiver with five tubes. The remote-control box includes a tuning dial, a convenient handle for turning the tuning dial, a pair of switches, and a jack for the headphone piece. The bearing indicator has a black face with pointer and scale coated with luminous paint. This indicator is very sensitive and is immune to movements of the airplane; static has apparently little effect upon it.

The streamlined demountable loop, 21 inches in diameter, is rotatable through 360 degrees. A standard mast antenna projecting six to eight feet from the fuselage is used in conjunction with the loop. The receiver unit, bearing indicator, loop, and rotating mechanism weigh approximately 45 pounds.

When using the compass, the pilot selects the station to which he wishes to fly, switches on his headphones and sets the tuning dial. Then he switches to the bearing indicator. If the loop is along the right line of travel, and the pointer is at zero, the airplane is heading towards the broadcast station; if the indicator is to the right of zero, the airplane is heading to the right or vice-versa. This is all there is to "homing" or keeping on a course.

But the pilot can also use the instrument as a position finder. He or his co-pilot tunes on any two stations in succession, and by suitably rotating the loop gets the bearing on both stations by use of the indicator. If the two bearings and the stations are marked on the map by straight lines, the intersection of the two lines gives the position.

Professor Klemin's Notes and Comments on All Phases of the Field of Aviation are a Regular Feature of The Scientific American Digest

Twin Engines for the Private Owner

In England, twin-engined airplanes for the private owner are popular and deservedly so. If twin-engined ships are safer for airline work, and therefore more desirable than single-engined types, why should they not be employed in private flying?

The Crusader, designed and built by Thomas M. Shelton of the American Gyro Company, now constitutes an excellent American example of this classification and is being test flown with success. It should also be useful as a feeder to the main airlines.

The Crusader can be used either as a four or as a six seater. It is powered with two 125 horsepower Menasco, four-cylinder, inverted air-cooled engines, supercharged to develop 156 rated horsepower at sea level. Wind tunnel tests conducted at New York University gave evidence of excellent aerodynamic qualities.

Preliminary flight tests at Denver showed a landing speed of 60 miles per hour at an altitude 5000 feet, and high speed, steady flight with only one engine running.

As our photographs show, crew and passengers are housed in a short, well streamlined nacelle, with tail wheel at its rear end, while the tail surfaces are carried on booms extending from the wings in the rear of the engines. Thus the rudder is directly in the slipstream of the propeller, a valuable feature in securing control with one engine not firing. Many engineers are also of the opinion that this type of construction is somewhat lighter than the conventional fuselage type, and that it is quite as efficient aerodynamically. The plane is in general a fine example of modern design, both aerodynamic and structural. Landing gear is retractable. Construction is all metal.

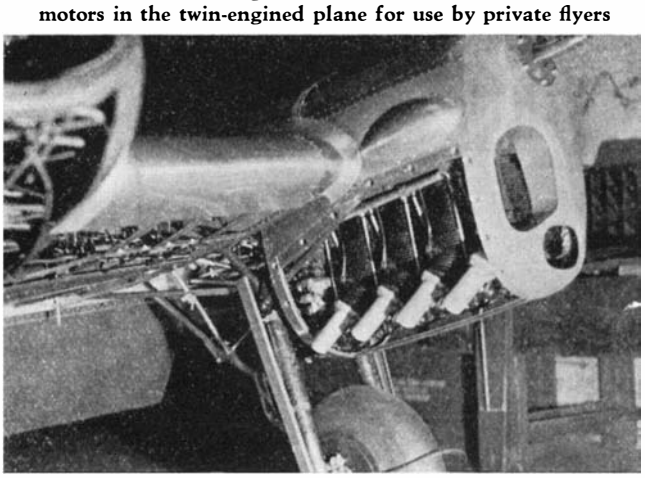
Certain points in the cabin accommodation are worthy of note. The cabin, which is quite roomy, seats four passengers and has an average width of four feet. Entrance is by a door on the right-hand side of the machine, the opening of which extends partly around the top. This eliminates an opening in the top surface of the low wing, which is undesirable from a structural point of view yet frequently employed in small, low-wing machines.

A new material, Plastocele, is used for the windows, which provide splendid vision. Plastocele is used because of its low weight and replacement cost as compared with glass and because it can be so readily molded into the streamline body.

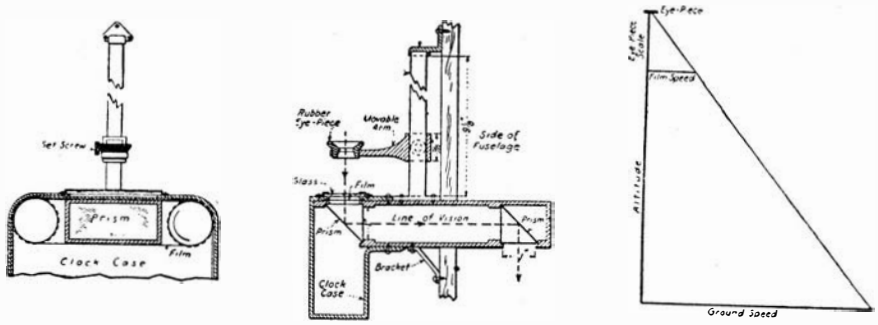
Two Million Dollars an Hour

The severest test to which an airplane can be submitted involves the following maneuver: The machine is put into a vertical dive, from a great height, with power full on. When the greatest possible speed—the terminal speed—has been attained, the

Below: **The mounting of one of the inverted air-cooled motors in the twin-engined plane for use by private flyers**



The twin-engined plane for private owners, in flight. Note the well-designed out-riggers supporting the tail surfaces



Two drawings of the principal parts of the Gatty ground speed meter, and, at right, triangle indicating how the ground speed is shown by the instrument

pilot pulls his stick rapidly back, bringing the airplane into level flight. The machine during this period describes a tight curve, and a tight curve at tremendous speed means a very high centrifugal force which is balanced by an equally high lifting load on the wings. Measurements of the centrifugal force show that the acceleration may be as high as 8 g, or eight times the force of gravity. Thus a pilot weighing 150 pounds is pressed down on his seat with a force of 1200 pounds, the blood may partially leave his brain, he may be temporarily blinded and even lose consciousness. An additional hazard lies in the fact that the wings may come off due to the high centrifugal load at the very instant when the pilot is physically incapable of using his parachute.

Naturally, the test pilot who puts a new airplane through a power dive and subsequent flattening out, is well paid. *U. S. Air Services* reports that Vance Breese, veteran barnstormer and experienced test-pilot, was recently employed by the Northrop Company to put a Northrop Delta through such a maneuver. The Delta is powered with a double-row Pratt & Whitney Wasp of 750 horsepower and is reported to have a top speed of 280 miles an hour. Knowing the dangers involved, Vance taped himself from head to foot to help him withstand the terrific strains. He took the plane up to 20,000 feet and dived through 16,000 feet to within 4000 feet of the earth before pulling out. The speed indicator passed through 200, 300, and 400 miles an hour, finally reaching 425 miles an hour when the instrument broke. But the test was entirely successful.

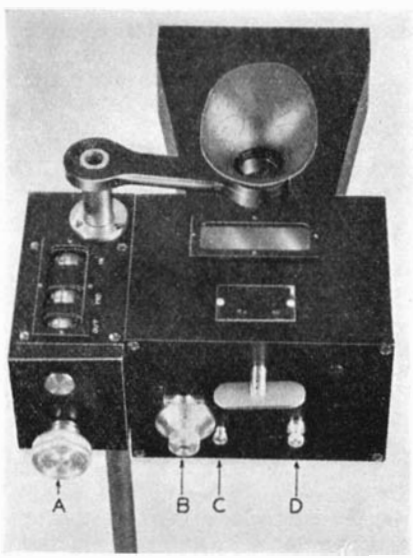
Vance Breese received 8000 dollars for his effort. The dive occupied 15 seconds, so that the rate of remuneration was 32,000 dollars a minute or nearly two million dollars an hour.

Yet we cannot say that the pay was too high!

Gatty's Ground Speed Meter

HAROLD GATTY and his partner, Wiley Post, will long be remembered for their famous "round the world" flight in 1931. On this trip, it will be remembered, Gatty was the navigator, while Post was the pilot. In preparation for this flight, Gatty prepared and used successfully a ground speed meter which since, in refined form, is being largely employed by the Army Air Corps and Navy Bureau of Aeronautics. Writing in *Aero Digest* Lieutenant Commander Weems, himself an authority on navigation, describes this instrument.

In the Gatty ground-speed meter there is, projecting beyond the side of the fuselage, a periscope case with a right triangle prism at its end, one side of which is horizontal. The line of the observer's vision is through the rubber eye-piece mounted on a movable arm; through a constant speed transparent film; then a prism; next, a horizontal tube; and then through the second prism directly



The ground speed meter. A, eye-piece adjustment. B, drift measurement adjustment. C, speed control. D, start and stop button for clock

to the ground. The film is carried at a constant speed over the first prism by a clockwork mechanism and is marked with parallel lines at right angles to its motion. This arrangement is illustrated in the diagrams. In the same illustration is shown a triangle. On this triangle are shown the distance from the eye-piece to the film, the film speed, the altitude of the airplane above the ground, and the actual ground speed.

From this triangle it is clear that the ground speed bears the same ratio to the film speed as the altitude of the airplane bears to the eye-piece scale.

When, therefore, the film appears to the eye of the observer to be traveling just as fast as the ground, a simple arithmetical calculation will give the ground speed, provided the altitude is known.

In operation, the ground is observed through the eye-piece and the clockwork is started. There is then a difference between the apparent speed of the film and the rate at which the ground is moving across the prism. The eye-piece is then moved up or down until both speeds are equal; that is to say, until the film movement is synchronized with the apparent movement of the ground.

There are disadvantages inherent in the instrument. The altitude must be known and the land or water visible before readings can be made. Nevertheless, the meter is of obvious utility.

A German Automatic Pilot

WE have, in the United States, the Sperry Automatic Pilot, which has achieved remarkable success and is making rapid headway on the air lines. Thanks to the courtesy of *Flugsport* and *Flight*, we are able to give some information on the German Siemens Autopilot, the development of which has been a jealously guarded secret for several years.

The Autopilot is like the Sperry robot in design, in that it controls the airplane about all three axes. It differs from the American design in the fact that, although gyroscopes are used, they are not the sole basis of the corrections supplied by the working cylinders to the different control surfaces. The diagram shows the ingenious but intricate system employed. The thorough understanding of this mechanical brain might almost be the work of a lifetime, but our readers will perhaps be content with an outline.

The rudder control, though partially gyroscopic, receives its initial correction from a telecompass mounted far back in the fuselage of the aircraft. The float of the telecompass rests in an electrically conducting fluid, the fixed and movable electrodes being

(*Please turn to page* 278)

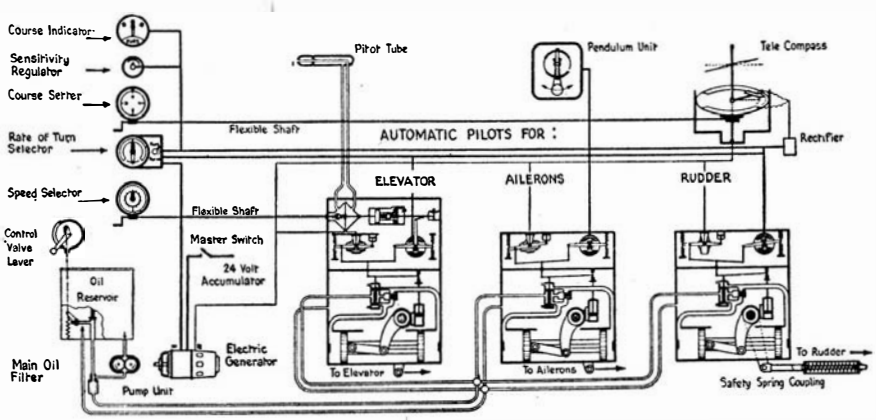


Diagram of the German automatic pilot described above

Electric Hotbeds

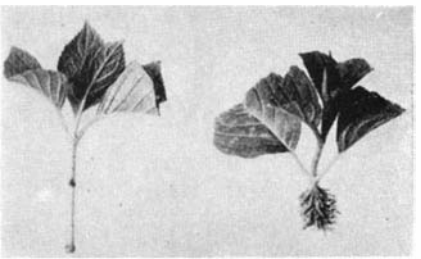
Controlled Heat . . . Higher Percentage Of Germination . . . Better Quality Plants

HEATING soil electrically, in order to stimulate plant growth, apparently originated in Norway, some years ago. In 1928, it was introduced into this country, and several seasons of experimentation have proved its advantages.

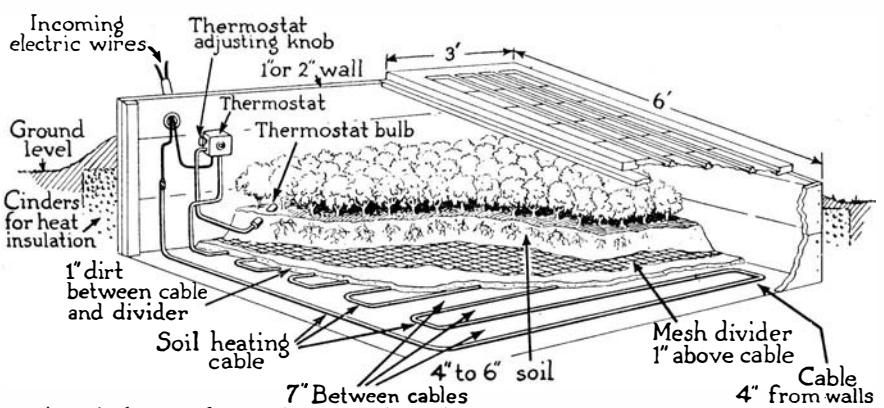
A system for electrically heating the soil in hotbeds and greenhouses that may be simply applied by any gardener, involves the use of a specially designed General Electric cable connected to a house-lighting circuit through a controlling thermostat. The cable is insulated so that there need be no fear of short-circuits, and is flexible enough to be adapted to almost any conceivable position in hotbed or greenhouse bench. The thermostat permits controlling the temperature so that it may be held at any point between 30 and 100 degrees.

In the construction of hotbeds, the cable replaces the time-honored manure, and gives the advantages of controlled heat and freedom from the necessity of rebuilding the hotbed each year or between runs. The cable is laid in the bottom of the bed so that it is approximately three inches from the sides and has from four to eight inches between turns. It is then covered with an inch of soil, and a wire mesh divider laid in place to protect the cable. Over the divider is placed about five inches of rich soil. Authorities say that it is unnecessary to replace this top soil oftener than once every three or four years.

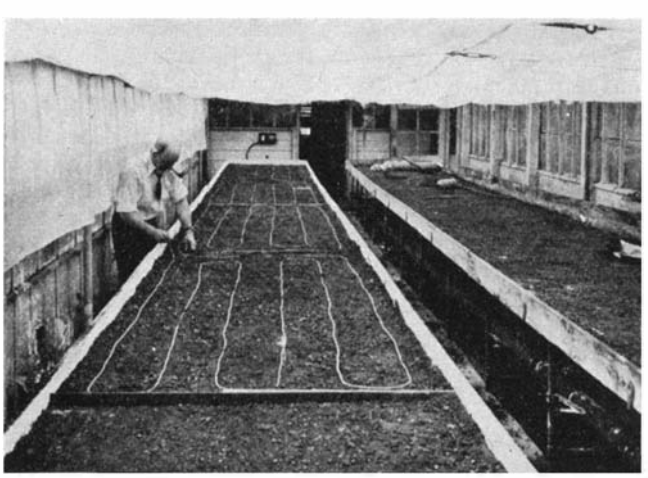
ELECTRIC soil heating has many implications other than for the amateur or home gardener. It permits the market gardener to place on the market many vegetables and flowers, weeks in advance of the regular crops. It results in quicker germination of seed, and in the growth of better root stocks and more sturdy plants.

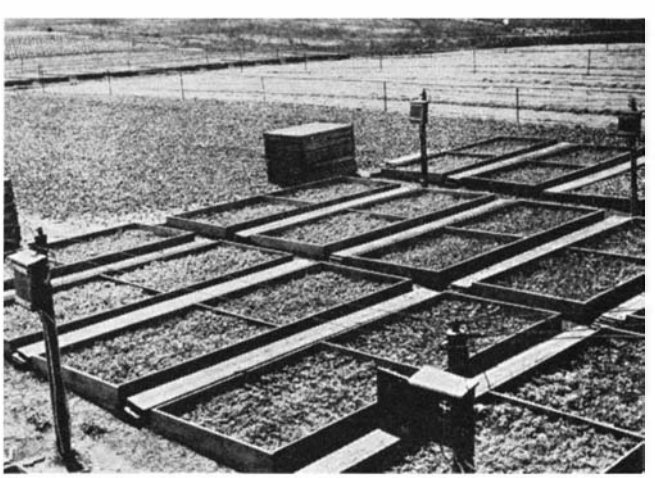


Hydrangea slips 19 days old, grown in same greenhouse. Slip at left received ordinary heat. One at right was grown on a bench with the electric-cable bottom heating



A typical set-up for an electrically heated hotbed, showing the disposition of the heating cable, the controlling thermostat, and the wire mesh divider above cable





Above: **Laying the electric heating cable on a bench in a greenhouse.** ***Right:*** **A group of electrically heated hotbeds, each six by twelve feet, showing power supply lines.** ***Upper right:*** **Cable in a long hotbed, ready to be covered with an inch of soil**

Exploring Prehistoric Georgia

By A. R. KELLY, A.M., Ph.D.

Figure 1: Mound A (in background), a house site, and exploratory trenching

(Part 3. Conclusion)

IN a previous installment, mention was made of the fact that there were really two full-fledged archeological expeditions operating in central Georgia along the Ocmulgee River. Mounds A, C, and D, described before, belong to the Macon group of mounds surmounting the bluffs or plateau just east of the city of Macon, practically within the suburbs of the town.

In the low-lying river plain of the Ocmulgee, south and east of the city, begins the vast stretch of swamp and marshland continuing in an unbroken sweep along the river margins to join with the Georgia coast.

Archeological survey of the swamp tracts to date has led to the discovery of numerous small artificial hillocks of sand, black with decayed organic matter, rising two to seven feet above the tangled undergrowth. These are house mounds, small artificial elevations built by prehistoric swamp dwellers as the sites of timbered houses, thatched and partially walled with palmetto. Groups of seven to 25 of such house mounds are found together in orderly arranged clusters all along the Ocmulgee River and at the junctions with tributary creeks and smaller streams. Many of the house sites have been buried several feet beneath alluvial deposits within the last 150 or more years.

Where the river has changed its course recently, taking a new tangent through territory formerly virgin swamp, in the freshly profiled, river-cut banks, can be seen midden deposits, burials, pottery, exposed under three to five feet of river alluvium. At present no accurate check can be made of the approximate number of these villages and towns found in the swamps of central Georgia. Enough is known to state that the swamp population must have been considerable indeed, if these settlements may safely be regarded as having been more or less contemporaneously inhabited.

The archeological exploration of the swamp sites below Macon should really be the subject of another article. It will suffice now to indicate the nature of our discoveries in the initial excavations at Lamar village and mound site, a type site for the swamp peoples.

On the flood plain at Lamar, numerous undulating, hummocky rises dot the meadow, indicating the site of a house. Fortunately for the archeologist, man is not a particularly clean or tidy animal. Where he has lived the spot grows rank with luxurious vegetation, feeding upon organic wastes in midden and residence floor deposits. Away from the house hillocks the meadow lies flat and monotonous, with close-tufted, lighter colored grasses.

A general view of the early stage of archeological exploration can be had from Figure 1, showing excavations carried on simultaneously on one of the larger burial mounds (Mound A at Lamar) and a house site situated approximately 100 yards south of the mound. The flat expanse of the river plain, an overflow area widely covered with alluvium, extends on all sides of the village area, bounded everywhere by swamp growth. The problem of obtaining detailed photographs and adequate perspective of excavations undertaken on a flat flood plain was solved by the erection of a 40-foot observation tower.

MOUNDS A and B are conical, flat-topped mounds rising 20 to 25 feet above the meadow and surrounding village site. Both mounds probably had an aboriginal temple or important public building on top. The excavations in Mound A revealed that it was of composite structure. A primary mound was found beneath the upper mound. This core mound had a graded approach or ramp leading up to the summit from the north. Mound A was relatively much simpler than the five-in-one mosaic construction of Mound C in the Macon plateau group already described.

Mound B of the Lamar group is one of the most unusual mound structures in the United States (Figure 2). It is conical, truncate in form, with a spiral pathway ascending counterclockwise from the level of the plain to the summit—a Tower of Babel effect on a small scale. Preliminary archeological exploration, and known references to the customs of prehistoric tribes in the southeast, give strong support to the supposition that the summit was the site of important ceremonial observances, probably held within a more or less elaborate religious building. Actual trenching—profile studies of cross-sections—are contemplated in the near future at Mound B, to check these hypotheses.

A Mound with a Spiral Ramp . . . Hastily Abandoned Burning House . . . Largest Archeological Expedition in America . . . Similar Sites Abound

In the Lamar plain, excavation of the hummocky rises marking house sites was a tedious and exacting task. Figure 3 shows a group of CWA workmen engaged in uncovering the floor of a house near Lamar Mound B. To the archeologist the supporting timbers and other charred remains in place give a clear picture of the type of house structure which once stood on this site.

THE swamp dwellers built houses in the Ocmulgee marshes, not different from the rude arbor-like shelters constructed by the Seminoles in the Everglades of Florida today. The walls and roof were palmetto thatch, reeds and cane supplying the lathing upon which yellow river clay was daubed and chinked. Clay sod on top of the thatch made the roof impervious to rain. The walls may have been open or of purely temporary construction.

The charred house debris uncovered at the Lamar village indicates that the structure had been burned. When the central supporting timbers gave way the sod roof fell in, smothering the fire and thus preserving many architectural features which would otherwise have been reduced to ashes.

Figure 2: **Mound B, with its spiral ramp**

Every evidence of hasty abandonment of the burning house was found on the floor of the completely excavated house mound. Figure 4 shows the final stage of troweling, exposing the floor of the house as it had been left by the ancient Lamar villagers. Pottery, charred corn and beans, flint utensils, and other objects of ordinary domestic use were found in considerable quantities on the residence floor. Apparently the tenants had had no time to salvage anything before the danger of fire and destruction was upon them.

Burials within the Lamar swamp village were often made just outside the walls of the residences. In Figure 5 is shown a view of an extended burial just beyond the limits of the excavations uncovering the house site previously described. A refuse pit near the grave yielded many potsherds. This photograph shows another typical interment. Simple, flexed or contracted burials, in the areas of the village site occupation adjacent to house floors, contrast with the elaborate pit and log tomb crypts, secondary or bundle reburials, described in connection with Mound C of the Macon Group.

A difference in burial custom cannot be put forward as a consistent distinguishing trait between the villagers on the bluffs or plateau near Macon and the swamp dwellers (Lamar village), because primary, simple, flexed burials of Lamar type were found in the village on the plateau also. Mound C, the only true burial mound explored so far at Macon, provides an exception in mound structure, burial usages, and in other features not mentioned in this article.

The explorations carried on in central Georgia near Macon during the past season comprise perhaps the largest archeological expedition yet undertaken in America. The discoveries have been numerous and significant for the pioneer approach to a vast storehouse of prehistory in the southeastern United States.

Increasing evidence shows that the rivers and important tributary streams of the "deep south" and the lower Mississippi were densely populated. Ethnological information concerning the historic tribes in the region is confused by the complexity of tribal movements at the dawn of history (point of contact with white colonists, when written records and observations begin). Archeology reveals, in the initial major mound and village sites to be examined in a systematic way, that there was a long period of prehistoric occupation preceding the historic interval.

AT Macon we have strikingly exemplified in house structure, pottery design and technique of manufacture, economic activities supporting the contrasting types of village life led by the swamp dwellers and the older inhabitants on the bluffs and highlands—a consistent series of remains points to the existence of two distinct types of civilization. Archeological methods of establishing chronology, when applied to the problem in a tentative way, indicate that the highland near the fall line was settled at a remote period by people who grew large fields of corn, squash and beans; stored their produce in cache pits and granaries; built elaborate towns and villages on commanding sites, with some suggestions of fortifications around the peripheries; constructed large, flat-topped conical and pyramidal mounds as basic supporting structures for temples and important public buildings; and developed the textile, weaving, and pottery making arts to a high degree of excellence and variation in pattern.

Later—how much later cannot be determined as yet—came massed waves of

Figure 3: **A house site being excavated. Soil is left surrounding post holes**

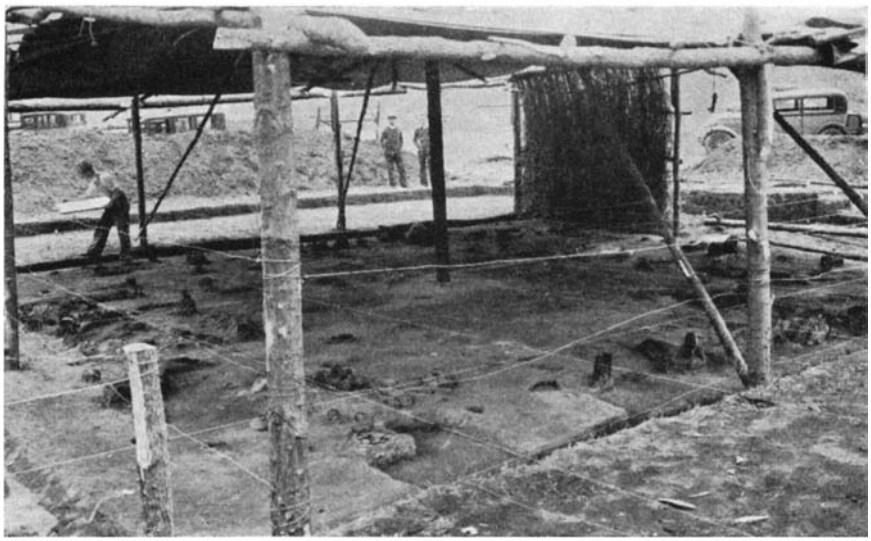


Figure 4: During work this house site was protected by a tarpaulin roof

a different people, who seemed to prefer living in the low-lying, river-swept, malarious swamps. Their villages came to dot everywhere the river margin, extending back into the marshlands where important creeks and tributary drainage afforded opportunity for travel and contact by water transportation. They built artificial hillocks rising several feet above the swamp muck, high enough to protect the flimsy palmetto and reed huts from the swollen waters of the river. Dugout canoes, poled rather than paddled, were used to navigate the swamps.

Today the swamps south of Macon on the Ocmulgee look very much as they must have looked several hundred years ago. The palmetto ridges still bear mute evidences of the populous habitation of the Indian swamp dwellers, in the form of numerous small mounds overgrown with swamp vegetation, the ramps to the mounds often masked or completely covered by a mantle of river silt deposited in the last centuries.

SWAMPS and marshes would seem to many to be the least desirable human environment. A mountain fastness, even the desert, may have an attraction comprehensible to most tastes. The suspicion will probably arise that human groups would not voluntarily seek the swamp as a natural environment or preferred mode of life. If large populations have lived in them over long periods of time, the assumption might be made that they were refugee groups, seeking to escape the pressure of numerically more powerful peoples who had dispossessed them of more fertile areas.

The Seminoles living today in the Florida Everglades are refugees, historical remnants of Creek Indian tribes living in Georgia and Alabama during the 18th and early 19th Centuries. They have found sanctuary in their swamp homes, relatively free from interference by the white man and modern civilization.

One of the most striking characteristics of aboriginal Indian cultures in America is the inherent vitality, the fierce cultural conservatism, which led many tribes to seek the remote and least desirable territory where dominant groups would not molest them.

There are indications that this quality of early American culture is not new —not simply a phenomenon peculiar to the period of conflict and adjustment between the dispossessed Indian tribes and the European colonists. Shell mound deposits cover the coasts of Florida, Louisiana, Texas, and the north Pacific, which must have accumulated over long intervals, in some cases covering a span estimated as over 2000 or 3000 years. Archeological examination of these deposits indicates hardly a distinguishable variation in the pattern of living over such a long period of time. In California, ethnologists have found that at the time just preceding contact with Europeans the whole area of the coastal plains, the great inland valley and the enclosing mountain ranges and foothills, was inhabited by scores of tribal groups speaking languages as different from one another as English from Chinese. The territorial bounds of these divergent tribes were immediately contiguous. Yet the tribal patterns of culture remained intact, little changed or affected, for many centuries. The average Indian grew up, lived and died, within narrowly circumscribed village and tribal boundaries, seldom going more than 15 to 20 miles from home during a lifetime. Such cultural self-sufficiency is inconceivable to a person living in a modern community surrounded by so many media of communications and social intercourse, all tending to give the texture of life a familiar feel wherever one may go.

THE exploration of these swamp villages and towns in central Georgia has only just begun. Reliable information indicates that similar sites are to be found along the margins of other rivers in the state and in the heart of the vast, unexplored Great Swamp on the borders of Florida and Georgia, the Okefenokee.

The 71st session of Congress passed the Vinson Bill, providing for the establishment of a national monument on the Ocmulgee at Macon. Surveys are under way at present to map the archeological and historical sites to be comprised within the monument area. It may confidently be expected that soon thousands of visitors will visit the sites recently explored in central Georgia, and that the interest created by the establishment of the monument may help to bring about a more complete exploration of the southeastern archeological province.

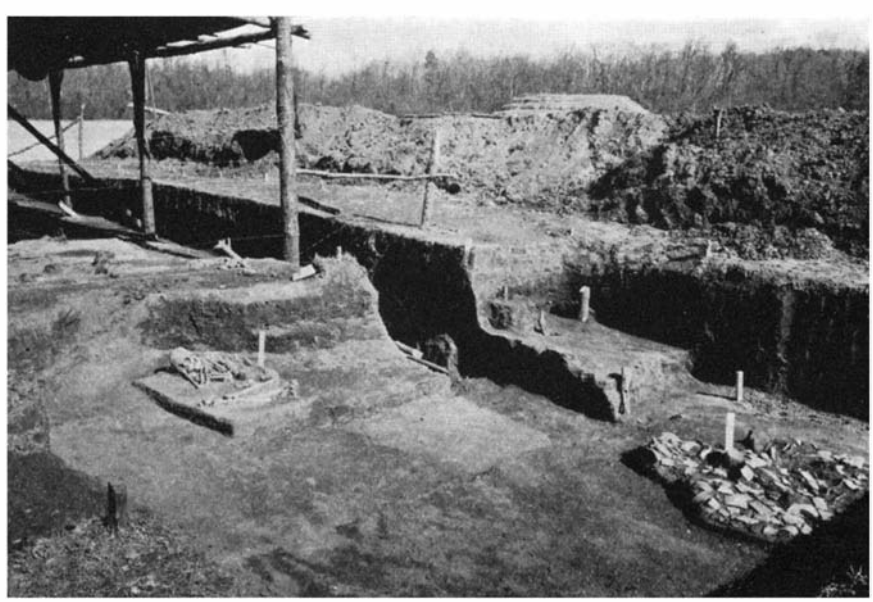


Figure 5: A skeleton found near a house site. Note also potsherds at right

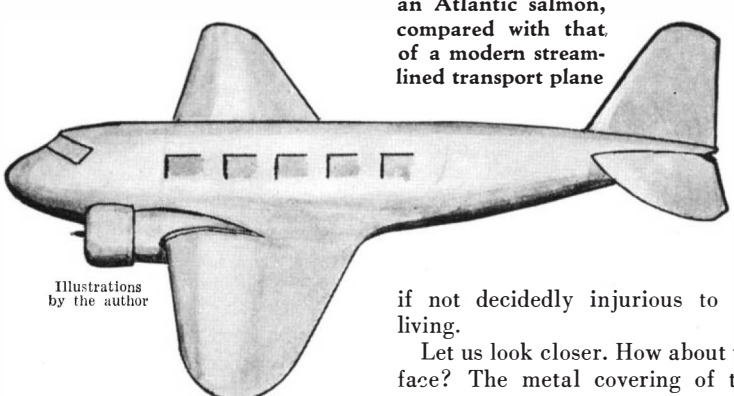
STREAMLINING IN NATURE

How Man May Learn From Nature . . . The Streamlined Salmon . . . Long Over-Seas Flights of Birds . . . Small Details of Vast Importance

By RAY HOLLAND, JR.

IT is common knowledge that fish and birds are streamlined. For that matter, all earthly creatures that move rapidly are, by necessity, well shaped for speed. Insects and land mammals are not exceptions. The interesting thing, however, is not this generality of attention to air and water resistance, but the meticulous sort of work, and the delicate care, which are exhibited by natural streamlining. Close observation of how the avoidable portion of fluid resistance is kept small in nature gives the naval architect or the aircraft designer something to think about. If he believes that his particular design is the ultimate, he should stop to consider the forms found in nature.

But isn't our modern airplane exceptionally well streamlined? To be sure.



Illustrations by the author

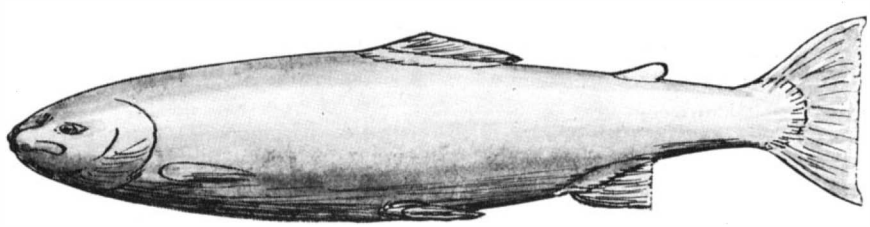
We can not deny it. Its even surface, its smooth curves from nose to tail, its blending transformation from wing to fuselage, its freedom from holes and projections, its full robust form; all of these things make for speed. It is an object of beauty, an artistic triumph as well as an engineering success. It represents the apex of streamlining achievement by man. Where is its parallel in nature?

The first random choice of a natural parallel of the super-speed airplane in the matter of streamlining is the Atlantic salmon (*Salmo salar*). At a glance it appears that the form of the salmon could serve as the fuselage for the transport plane. We notice a slight difference. The airplane fuselage has an elongated section amidships. This is for the cabin, an economic necessity in a passenger plane. Also, there is a discontinuity of form at the nose of the plane to provide for the flat windows through which the pilot sees. Either of these trivial appearing modifications would be highly bothersome to a salmon, if not decidedly injurious to a good living.

Let us look closer. How about the surface? The metal covering of the airplane fuselage, upon close scrutiny, reveals thousands of rivet heads. More often than otherwise they are not indented into the surface and flattened smooth, but stand out full and round in the breeze. The trailing and side edges of dural sheets, put on so as to lap over each other, stand exposed adjacent to the lines of rivets. Probably you think: "Utterly trivial." But what does the salmon say? He is covered with very small scales. These scales also have their edges. But the edges are not exposed. The entire fish is covered with a slime which is exceedingly slippery. The water flowing past him comes in contact with nothing but the essence of smoothness.

The salmon is not a perfect streamline form, by any means. He has a nose which seems too pointed. This, among other purposes, is for digging a trench in the pebble covered stream bed during spawning, to receive the eggs and milt of the parent fish. Also he seems too long in proportion to his depth and beam. The answer to this undoubtedly is that he must use his body for propulsion. It is not merely a shape evolved to have a minimum of resistance in the water. It is provided with the necessary fins for propulsion, maneuverability, and stability.

The airplane has fins projecting from its body; the tail surfaces and perhaps we should include the wings. On a few of the newer machines the filleting of these surfaces into the body is of the same general form as that seen on the salmon. This blending of surfaces is one of the fine points of good streamlining. On the salmon an observer is not able to say where the body becomes the fin and vice versa, the change is so subtle. This degree of filleting has rarely been accomplished in airplanes. It is a phase of design which engineers are appreciating more all the time.



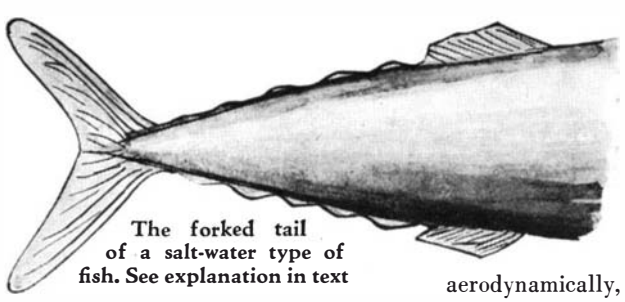
The speed-form of an Atlantic salmon, compared with that of a modern streamlined transport plane

AMONG the fishes, the salmon is probably not the best streamlined. There are several salt water varieties which could vie for that honor. Their very existence in the open sea depends upon their speed, in avoiding being eaten, and in catching their food. In general, the bodies of these fast swimmers have a cross-section which is quite full, approaching the circular. Their bodies taper almost to a point instead of to an edge. Their narrow forked tails represent a very efficient utilization of surface. The whole arrangement points to a different propulsive mechanism, a different tail action. Instead of a side-to-side sweeping motion, it is adapted to a twisting motion about the long axis of the fish. Such a type of propulsion removes the necessity for the large side area required by the other type, and leaves the body free to take a more high-

ly specialized low-drag form. It is in this respect that they are able to boast a better shape than the salmon.

From a practical standpoint we may well ask whether such painstaking streamlining is really worthwhile. Does it produce results? It is very difficult to find out how much resistance a salmon actually has. The moment the fish is removed from the water its covering of slime commences to dry, altering its form appreciably. The eyes become sunken, the fins curl up and split, and the mouth and gills remain open. A shrinkage accompanies this drying which usually draws up the head and tail somewhat. If the fish is lying on a flat surface it will take the form of that surface on one side and be bowed excessively on the other. In addition to these defects of form, the fins, the exact positions of which are variable, are no longer properly aligned. It would be necessary to avoid these and other difficulties in order to preserve the exact form of the salmon for use as a model.

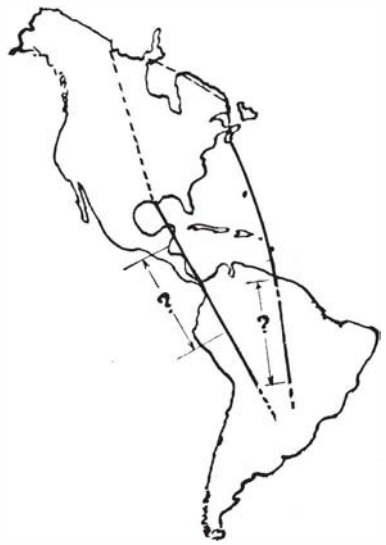
WITH birds the problem is even more difficult. The living bird literally feels the flow of air over its body. It rarely has the same form over two successive seconds. Each feather is located precisely for the airflow existing at any particular instant. Practically the entire surface of a bird is variable.



The forked tail of a salt-water type of fish. See explanation in text

The wings are a complex folding mechanism, with any number of possible positions which might be chosen for testing. Each feather has its particular part to play, and a large number of them require control by the bird. Even the feathers which compose the down depend upon the temperature and condition of the skin for their exact positions. Birds are very fussy about having their feathers properly arranged.

The form of a flying bird depends upon the velocity and direction of the airflow around it. Most of the wing feathers deflect in flight, and, what is important, the deflection depends not only upon the flexibility of the feathers themselves, but also upon the condition of tendons and muscles in the wing and breast. It is hardly reasonable to hope that a dead bird or a mounted bird will be correct in these deflections, even if its feathers could be arranged perfectly to start with. A slight error is all that is needed to make test results invalid, because the quantities being measured are small.



Sketch showing the migration routes of the golden plover. Solid line flown non-stop except in bad weather. Doubtful portions shown

These examples show what the scientific investigator is confronted with when he attempts to learn quantitatively just how well streamlined a bird or fish actually is. However, since we are not satisfied with the conclusions of the eye in superficial comparisons, we seek substantial evidence that natural streamlining has been effective in producing results. How are we going to be sure?

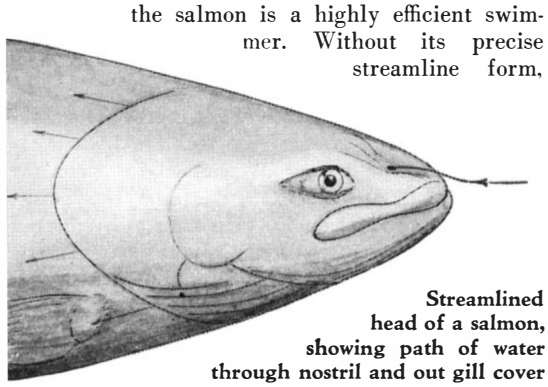
Omitting the case of the soaring bird, which depends so much on the ability of the bird to feel out rising air currents, and which, aerodynamically, is a specialized and simplified case, there is a convincing example which may be cited.

Each fall the golden plovers concentrate in Nova Scotia and fly from there to South America! Only very adverse conditions put them down along our coast or in Bermuda, or at any of the other emergency stopping points along the way. After another hop to the pampas of Argentina, the birds take wing in the spring for Texas, where they arrive in poor condition. That they are not fat is not to be wondered at. From Texas they proceed easily back to the Arctic. This sounds like a tall tale, but the Pacific plover bears out the story by flying annually from Alaska to Hawaii and on south to Palmyra and the Low Archipelego. And then they go back again. Moreover, there is nothing in their food which is obtainable on the high seas. Neither is the bird a swimmer. Its feet are not webbed. It is equipped only to alight on land.

Since birds have a limited energy supply, and since they actually perform these very long flights, we must conclude that their efficiency of flight is remarkably high. This efficiency probably comes from more than one source. They undoubtedly use the winds to advantage, and possibly cover some portion of the distance riding the upward currents, but that is not the whole story. The consistent migratory passage of these birds seems to indicate without much doubt that their air resistance is no greater than is absolutely necessary. Aerodynamics and instincts go hand-in-hand to make these flights possible, and even so, they seem almost unbelievable.

To get to the second point in evidence, that natural streamlining is highly effective, we return to the Atlantic salmon. For many years a discussion has been waged concerning the fresh water feeding of this fish, or the lack thereof. The scientific status of the question at present is that the Atlantic salmon does *no* feeding in fresh water, although some few men find it difficult to believe that the fish might not on rare occasions eat just a little bit. The amount of food it does take in fresh water is negligible.

HERE is the story of its spawning trip. The fish begin to run up the rivers in the spring and continue to come in all summer, usually working up to the coldest water which is in the headwaters and in the deep pools. Spawning occurs in the fall. In some streams the fish return to the ocean before the rivers freeze over. Usually the fish stay upstream in the fresh water through the winter and go out again in the spring after the ice leaves. Many of the fish live a full year without food! And are they active? They are continuously swimming in very rapid rivers. They leap falls. They jump two or three feet clear of the water, apparently just for the joy of it. They swim thousands of miles, measured by the water which flows past them; and all of this on an unimpressive appearing supply of fat! After making all the allowances we can think of, we must still conclude that the salmon is a highly efficient swimmer. Without its precise streamline form,



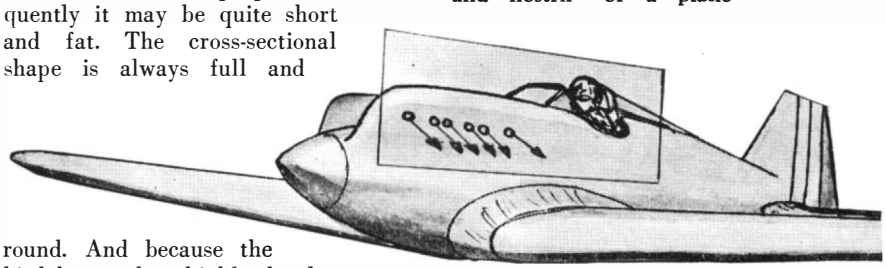
Streamlined head of a salmon, showing path of water through nostril and out gill cover

especially in the tiny details, its life would be a physical impossibility.

What are some of these small details of streamlining which make it possible for the salmon to do what it does? Let us start our observations at the nose of the fish. The comparatively small mouth, when closed, presents a neatly rounded symmetrical prow. The nostrils are two small circular holes. Behind each of them there is a comparatively abrupt rise, to iron out any eddying caused by the nostril holes. The eyes are reminiscent of streamlined wheel fairing on airplanes, with the eye itself corresponding to the side of the wheel. The gill covers fit so closely and smoothly that it is difficult to slide a fingernail under them to lift them open. They are a natural counterpart of the N.A.C.A. cowling.

THE pectoral fins lie flush with the surface of the body during fast swimming. For slow maneuvering they act as paddles or feathering vanes. The dorsal fin may be held up stiff for a maximum of area when that is required. For fast swimming, however, the spines lean toward the rear to reduce the area and also eliminate the hollows between successive spines. The most interesting are the pelvic fins. They must be moved during fast swimming, and so they must be well filleted in different positions. The solution provided for this by Nature is a small movable fillet which lies smoothly between the fin and the body of the fish no matter what relative positions they take. Not a single item has been overlooked to allow this fish to slide through the water with a minimum of effort.

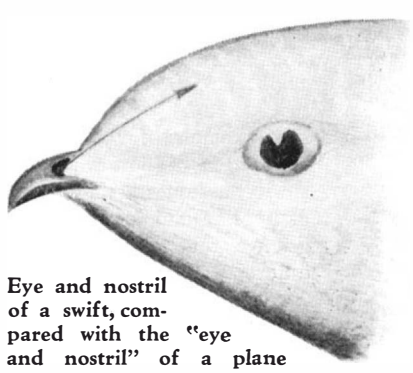
How about birds? What are their fine points of streamlining? The bird's body is exceptionally well formed for speed. It differs from that of the fish in that it is not used for propulsion. Consequently it may be quite short and fat. The cross-sectional shape is always full and round. And because the bird has such a highly developed, flexible, and capable control system, it does not require the long tail which the airplane has for purposes of stability. The only departures from the pure streamline form are the head, wings, and tail. The numerous fins of the fish are not needed.



The head is quite often included in the pure streamline form of the bird's body proper, as in the case of swifts, swallows, and many others. In other birds such as ducks, geese, and cranes, a long neck separates the head from the body. With such an arrangement any disturbance in the air caused by the head is ironed out by the passage of the body, so that the combination has very little more resistance than that of the body alone.

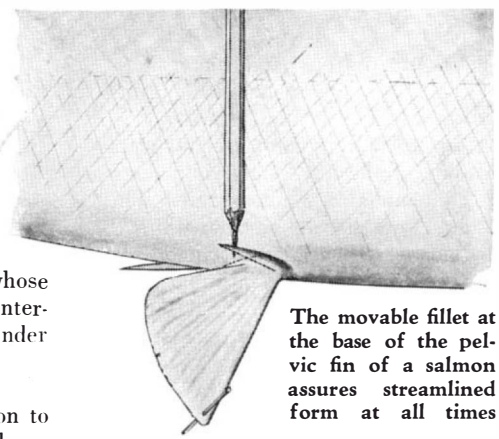
The head and tail of all birds are very neatly faired into the body. The legs, of course, are drawn up into the surface. In many forms of flight the tail has little to do, and consequently is folded so as to be barely visible. The entire arrangement is an extremely simplified form. The thick thatching of resilient feathers makes an abrupt change of curvature an impossibility. Where the wings fold down against the body you might expect to find a sharp angle. It is prevented by a group of long thin feathers whose sole function it is to fillet that intersection of wing and body on the under side.

YOU may say that, in comparison to its size, the feathers of a bird are not smooth, that the surface is composed of small interlocking barbules, and that under magnification hollow spaces could be seen. Feathers of some birds are smoother than those of others. However, if you pluck any feather at random from a bird, an observer is able to tell, by close examination, exactly what position the feather occupied with reference to the direction of airflow. He does this by discerning the fine trailing edge of the feather which transfers the continuity of surface to the next feather in line immediately to its rear. Only by magnification is this information obtainable, the edges are so delicate and perfect. He can also tell which part of the feather is actually exposed. It is the translucent nature of the horny structure of feathers that is likely to cause the belief that the structure is coarser than it really is.



Eye and nostril of a swift, compared with the "eye and nostril" of a plane

As a final example of the careful streamlining in nature, have you ever thought of how a bird inhales and exhales the air it uses for breathing, without upsetting the flow over its body? The swift does it by drawing the air into its nostrils from the rear and exhausting it toward the rear, tangent to the surface of its head. The air passage is situated so that it does not open normal to the surface as it appears to, but the nostrils actually face backward. Even this precaution is not enough. The head and body lie immediately to the rear to catch any disturbance, however slight, which might have been caused. What is true for the swift is probably true for other fast flying birds. What a contrast this offers to the exhaust stacks of most of our airplanes! We, too, would show the same degree of respect for the unchanging demands of the air, if we had been battling our way through it for ages instead of for mere years.



The movable fillet at the base of the pelvic fin of a salmon assures streamlined form at all times

WE are getting down to fine points. That is what makes good streamlining. One totally insignificant appearing source of interference or disturbance may increase the resistance of an object many times over. By the sure process of evolution very effective results have been accomplished. To the aeronautical engineer it is an object lesson in the value of thoroughness and care. Apparently Nature knows more about compounding forms to produce a low overall drag than man will know for some time. Only recently has the effect of one air form on another been seriously considered. Improvement has been rapid, but there is still a long way to go.

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Parts of the foregoing article may appear to be controversial in nature. Both the author and the editor will be glad to hear from readers who may feel that they have something to add to the discussion, or who may disagree with the conclusions drawn.

CANDID PHOTOGRAPHY

By JACOB DESCHIN

THE making of candid snapshots—photography of people without their knowledge—is undoubtedly one of the most exciting and, when successful, one of the most satisfying, phases of contemporary photography. While candid work is definitely within the province of the miniature camera, unposed pictures of persons unaware of being photographed were and still are being made with larger cameras, especially the reflex type. The superiority of the small camera for this type of work, however, is obvious; its compactness, ready accessibility, ease of concealment just before and during exposure, are advantages so patent that no one would think of debating the subject.

Perhaps equaling the value of a really good candid shot is the splendid training in the perception of picture material which the cameraman gets in watching for those fleeting incidents, expressions, situations, which once lost are gone forever. The man who essays "candid shooting" and finds it congenial to his tastes soon becomes a sleuth after human interest; the interesting face, the story-telling situation, the thousand and one fleeting little comedies and tragedies of life are his constant study. His camera, well hidden, is always with him. Spotting a likely subject, he approaches cautiously, outwardly nonchalant but inwardly all concentration, and whips his camera out and returns it to his pocket again all within a few seconds. When there is time, as in the case of a subject giving every sign of "staying a while," he takes the opportunity to wait for the best moment, for that moment in a million when his subject assumes just the right expression and just the right gesture that makes all the difference in the world between a prosaic portrait and the lively unposed snapshot that has all the poetry of life in it.

"In the Subway." An interesting character study taken underground. Exposure made at 1/20 of a second with a diaphragm opening of *f*/2

"Waiting for Business." Unusual types are a rich source of material for the candid worker

The true candid cameraman is the most self-effacing chap on earth; the more he is ignored, the less he is observed, the better he likes it. Among the array of miniature cameras, accessories and wonder-working films and developing solutions that produce prints which would have been impossible only a few years ago, he wants for but one thing—some magic formula by which he might make himself invisible at will.

Lacking such a formula, however, the exigencies of his "now-you-see-me-now-you-don't" career have taught him many subterfuges, in which he is ably abetted by a number of "gadgets." One of the most useful of these is the so-called angle-view finder, a device which by means of mirrors enables the photographer to give the impression of aiming at something down the street while actually taking the picture of a subject standing at right angles to the photographer's apparent vision. A variation of this, where a low viewpoint is desired, is to point this finder straight down to the floor or sidewalk and become ostensibly immersed in the examination of some mechanical problem of the camera itself.

VALUABLE as such devices have proved on many occasions, it has been the experience of the writer that some elderly persons, who comprise one of the richest fields for candid shots and are, at the same time, one of the most difficult to get, appear to sense that they are being photographed and immediately turn their backs or get up and go away. Success in such difficult cases is often achieved by turning one's back on the subject and operating the camera from under the left armpit, viewing the subject either in a reflecting view finder or, in the case of reflex outfits, the ground glass. Nevertheless, the angle-view finder has gotten "candid" workers out of many a "hot spot" and one man has filled a whole book with pictures of city life taken with its help.

No mechanical aids ever made, though in many cases they spell the difference between getting a picture and losing it, will work to full advantage without intelligence, resourcefulness and alertness on the part of the man behind the camera. An excellent precaution being used by many candid workers to great advantage is the pre-

"Hands at the Free Lunch Counter." A night shot taken through a window. 1/10 of a second, diaphragm opening *f*/2

setting of the miniature camera lens (which is usually of 2-inch focal length) for day-shots to *f*/9 and for night shots to the full aperture, and setting the focusing scale at 12 feet. For day shots this will bring into focus all objects from 8½ feet to a little over 20 feet, which gives the cameraman a guessing range of more than a dozen feet. With this set-up he is ready at a moment's notice and has simply to whip the camera out, snap and go (or run, if necessary!)

Night shots will generally require a wide-open lens; since the greater the aperture the shallower is the depth of focus, the guessing-range at night would be approximately two feet. In view of this, night photographers who find it difficult to judge distances so closely without the use of a range-finder will need to focus each time. Against this disadvantage, however, is the benefit of darkness, which permits the cameraman to be less conspicuous than he would be in the same situation in broad daylight. Stationing himself in a doorway or some deep shadow, he will often find, if he works fast, that he can focus and shoot without being observed. Another method is to focus on some point where he expects "action" and wait until his subjects appear, when he can shoot at his leisure by pulling the camera out of his pocket or from under his coat at the psychological moment.

THERE is nothing so disappointing as a batch of dull and worthless negatives which have been shot at random. Patience, therefore, and still more patience, should be the candid photographer's constant watchword. At night, if trying for people in motion, wait for slow movement; slow speeds are as essential for the comparatively poor light available for night work as extreme speeds are for pictures in the full blaze of daylight. In all candid photography see that the light falls on the subject's face, that the "action" or situation has human interest or pictorial value and that the general arrangement or composition is pleasing. There is not always time to watch for the last, but this point can often be taken care of on the enlarging easel in the darkroom.

"A Study in Attention." A hawker demonstrates; a candid camera catches expressions

Elusive Subjects Tax the Advanced Amateur Photographer's Ingenuity . . . Theater Pictures Possible . . . Miniature Cameras Solve Problems

Theater photography, which includes the taking of snapshots during the actual performance of a play, vaudeville show, concert, movie, or other type of indoor entertainment, is allied to candid night work only in the sense that both require working under comparatively difficult light conditions for snapshots and consequently call for miniature cameras equipped with very fast lenses and slow shutter speeds and loaded with the super-sensitive type of panchromatic films. In vaudeville, indoor sporting events, at the circus, and similar situations, where strong spotlights are used, "daylight speeds" are very often necessary, but the ultra-fast lenses have been found equal to the task even at a speed of 1/500 of a second at *f*/2. Shutter speeds of 1/100 and 1/200 with *f*/1.5 and and *f*/2 lenses have been found adequate for most dancing and acrobatic stunts. By watching for those split-second moments when active performers seem to have halted in their motion it is sometimes possible to use much slower speeds.

"At the Theater." Taken from the third row in the balcony. Exposure 1/10 of a second at *f*/2

THE taking of pictures while a play is in full progress has become so popular that it is now a regular branch of photography and a few workers who have specialized in it have made reputations for themselves in the production of so-called "performance photographs" which find their way into magazines in preference to the regularly posed type. In recent months there has also been a tendency to display such pictures in front of theaters.

In this kind of work it is necessary to get as near to the stage as possible, about the fourth or fifth row orchestra or in a box, although in theaters where the balcony is not too far from the stage, a seat in the front row of the balcony may be suitable. An aisle seat is a good vantage point, and care must be taken to shoot over the heads of people in the row in front. It is useless to try to take pictures in anything but white light. Colored or dim lights will register nothing. Speeds of 1/20th to 1/40th of a second are often sufficient, but in many scenes it will be necessary to use speeds as low as 1/10th or 1/5th. For the slower speeds watch for situations with the least movement and hold the camera absolutely still, using the nose to steady it. Resting your back firmly against the seat will help to reduce vibration of the camera to a minimum, and insure sharp negatives.

While the photographer may not wish to make enlargements of all the pictures he takes of both the candid and entertainment variety, he will find it very satisfying to make contact prints of all the worth-while negatives and mount them in albums. Records of contemporary life as he personally responds to it will in retrospect delight both himself and his friends; records of the plays and other entertainments he has seen will be constant reminders of pleasant moments at the theater.

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The list of representative miniature cameras available in the United States, mentioned in these pages before, is still available and will be mailed on request. Three cent stamp, please. A list of up-to-date books on photography, invaluable to the advanced amateur photographer, will also be sent to interested parties, when the request is accompanied by a stamp to cover mailing.—The Editor.

ELECTRICITY'S PLACE IN RAI

Improve Schedules . . . M
lems of Heavy Traffic .
Electric Locomotive, bu

By G. I. V
Chief Electrical Engineer, The Rea

RAILROAD transportation is undergoing rapid change. Many think we are on the threshold of a new era in which basic alterations in methods and equipment will be adopted.

Where does electric traction fit into this picture and what has it accomplished? What are its advantages and its relation to the requirements of the future?

The first railroad electrification in this country was that of the Baltimore & Ohio's Baltimore Tunnel in 1895. As electrification has been extended, the electric locomotive has been made larger and improved and in 1935 there will be about 750 of them in use in this country, or less than 1.5 percent of the total locomotives in use. Also there are 2600 electric multiple-unit cars, which is 5.6 percent of the total passenger cars in use. In Europe these percentages are larger. However, these electric locomotives and cars have been chosen to handle the most difficult operating problems the railroads have had to cope with. It is of interest to touch on these accomplishments.

On the Virginian, three Mallet type steam locomotives formerly were required to handle 5600-ton coal trains up extended lengths of 2 percent grade at seven miles per hour. Under winter conditions it was necessary to reduce this load materially. Since electrification, two electric locomotives haul 6000-ton trains regardless of weather conditions, at 14 miles per hour up the same grades. The two electric engines provide 10,000 horsepower at the rims of the driving wheels against 4500 horsepower for the three steam engines, yet the total weight of the electrics is less.

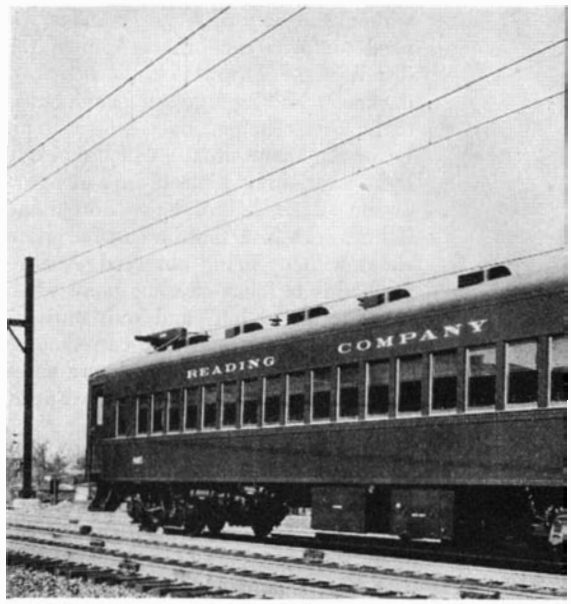
THE Norfolk & Western has a similar operation, and the C. M. & St. Paul, and the Great Northern haul heavier freight and passenger trains at materially higher speeds over the Rockies than formerly. In the east, we are all familiar with the electrified trains operating under the rivers at New York, which make it possible to land passengers in the heart of the city. The Great Northern operates its electric trains through an eight-mile tunnel.

Electrification has been called on to solve problems of heavy traffic. On the Pennsylvania's New York-Washington section, where 639 passenger and 47 freight trains per day are handled under present depressed business conditions, electrification has been chosen to provide faster schedules, higher reliability of arrival, and greater track capacity. In this service, they will employ 4600 horsepower electric passenger locomotives weighing approximately 230 tons each. To accomplish the same schedule as this electric locomotive with a given train, a steam locomotive, due to its greater weight and poorer accelerating characteristics, would require about 25 percent more horsepower and would weigh over 550 tons.

For suburban traffic with frequent stops, the multiple-unit electric car is the only known means of providing the rapid acceleration necessary to maintain high schedule speeds. The ease of turning these trains at terminals, the ability to operate without a fireman, and the flexibility of train make-up provided, all add to their advantages and make possible large savings in operating costs. The Long Island; New York Central; Delaware, Lackawanna & Western; Illinois Central; and the Pennsylvania and Reading are examples of their use.

THE principal advantage of electric motive power for railroads lies in the fact that the electric locomotive or car receives its power from a central power plant through the overhead contact wire and is not limited in its power output as is the case with the self-contained power plant of the steam and oil-electric locomotive. The electric motors can be overloaded for short periods and this enables the locomotive to accelerate at maximum rates to quite high speeds, and to maintain high speeds on grades. This is of great importance to the railroad operator, enabling him to shorten schedules without the necessity of increasing maximum speeds or raising speed restrictions necessitated by operating conditions at various points.

Now let us consider the economics of electric traction. A railroad may be likened to a manufacturing plant the product of which is transportation. Entering into this process are materials, labor, and the necessary tools. By far the most important tool used is the loco-



For short-line and commuter service

On the Virginian, where great coal trains a

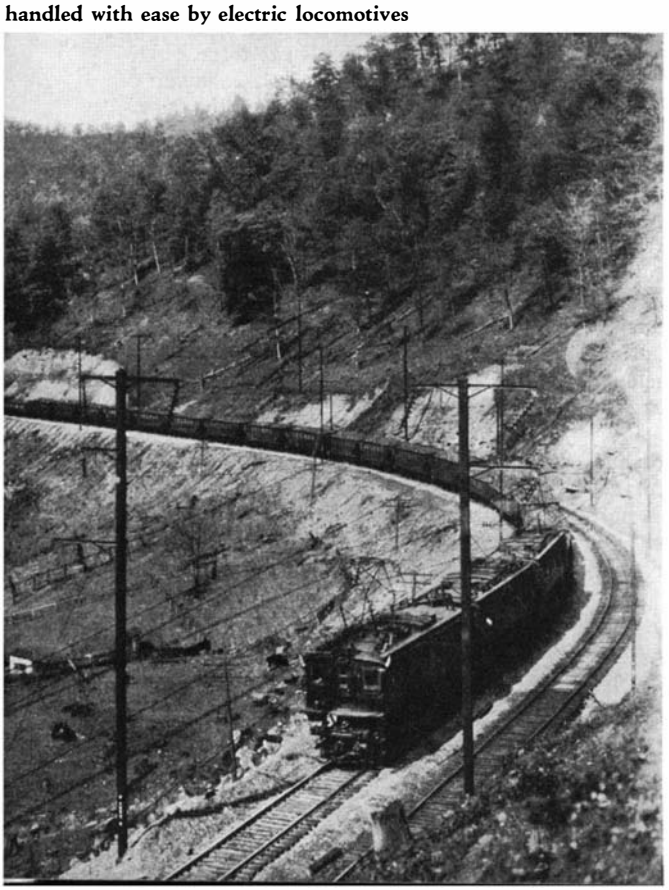
ROADING

e Power . . . Solves Prob-
. Less Maintenance for
Greater Fixed Charges

RIGHT
g Co., and C. R. R. of New Jersey

ıe electric car unit is most efficient

handled with ease by electric locomotives



motive, because it is the plant's power.

The electric locomotive can be maintained for much less than other types due to absence of oil engines, boilers, fireboxes, brick work, steam auxiliaries, and reciprocating parts. It does not require attention at the end of each run for coaling, watering, oiling, cleaning fires, and the like, and is, therefore, available a greater percentage of the time.

As to thermal efficiency, the electric locomotive using power generated in large, efficient, central power plants, and including all the losses from the power plant to the electric locomotive wheels, can do the same work with one half of the coal required for a modern steam locomotive.

Due to all this, the electric locomotive can be operated in similar service for from 50 to 65 percent of the cost of the steam locomotive and multiple unit trains effect even greater savings.

THE electric locomotive, however, requires electric power to be delivered to it from a central power plant by means of a contact system, with substations built along the railroad. The investment in the distribution lines and substations will amount to 25,000 dollars to 50,000 dollars per single track mile. Interest, depreciation, and maintenance on this investment will amount to from 2500 dollars to 5000 dollars per single track mile per year.

The economic picture is now apparent. A better tool in the electric locomotive is available. It, however, costs more than its counterpart, the steam locomotive. It also requires other facilities, the investment in which results in annual charges, irrespective of the density of the traffic. With this better tool, considerable savings in the cost of hauling a train-mile or a ton-mile can be made. If there is not sufficient traffic so that the operating savings will more than offset the increased fixed charges, electrification will not pay. If, however, heavy traffic is to be handled, the operating savings will be sufficient to pay the increased fixed charges and make the electrification a financial success.

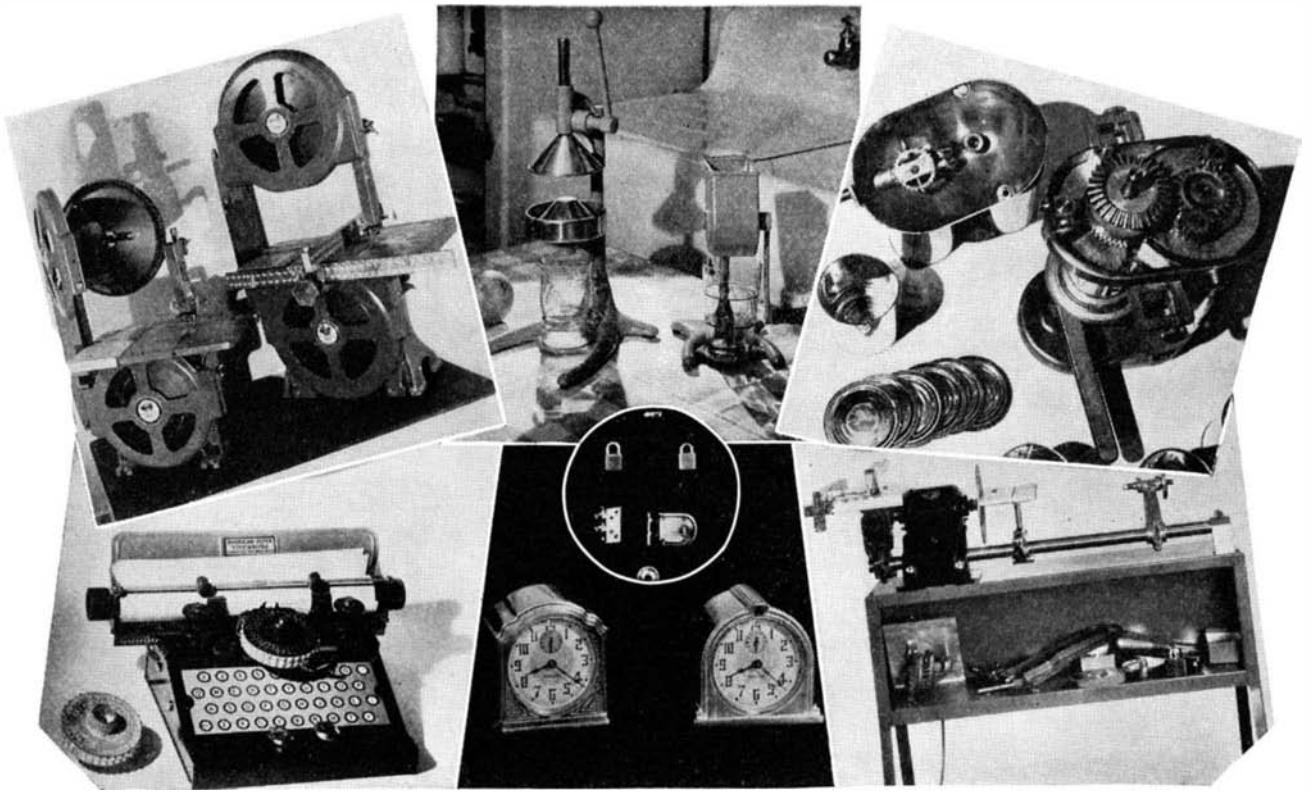
What of the future? Can electric motive power take care of the high-speed trains now coming into use? High speeds require more horsepower which increases rapidly above 70 miles per hour. To increase the speed of a 500-foot train from 70 to 100 miles per hour requires two and one half times the power. At 125 miles per hour it requires about five times the power. The higher ratio of power to weight then becomes of increasing importance. A recent study of this whole subject presented before the New York Railroad Club concludes that the advantages and economics of electrification are greater at the higher speeds with both conventional and lightweight streamlined trains.

As this is written, the Pennsylvania Railroad has just placed in operation the most extensive electrification in the world. It should serve as a transportation laboratory and a yardstick as to what can be accomplished with electricity in mass transportation.

The operation of the first train carrying Government and railroad officials made the 135-mile trip from Philadelphia to Washington in 1 hour and 50 minutes with a five-minute stop in Baltimore, breaking the record set in 1927 by a locomotive and baggage car.

WHEN this project was started it was stated, in terms that outline concisely the case for electrification, that: "It is expected to reduce eventually the number of freight trains by 50 percent for a given car movement, and thus to provide a 100 percent increase in capacity as far as freight movement is concerned. In the case of passenger trains, it is expected to eliminate all double-heading and most of the second sections, which will result in greater comfort, better service, and increased capacity of the line. Freight trains will be kept moving all the time possible while on the road; there will be no stops for fuel or water, and as few as possible for yarding. Engine divisions will be lengthened where possible, and the make-up of trains will be so arranged as to obviate reclassification at intermediate yards. The overall speed of freight trains may thus be raised to a point closely approximating the maximum speed of freight equipment. All traffic may be moved at considerably increased speed, and—within the limits of safe operation—it is expected that this will provide great satisfaction to shipper and traveler alike, in addition to rewarding the railway by greatly improving the capacity and efficiency of its existing transportation system."

THIS is the second of three independently written articles on railroad motive power. Last month the case for the steam locomotive was discussed by William C. Dickerman, President, American Locomotive Company. Next month, the Diesel side of the picture will be presented by George W. Codrington, President, Winton Engine Company.—*The Editor*



INDUSTRIAL DIE CAST PRODUCTS

CUTTING CASTING COSTS

Die Casting of Many Metal Products . . . Least Expensive . . . Process Improved . . . Replaces Other Processes . . . Die Design Advanced . . . Future

By PHILIP H. SMITH

TODAY you can hardly escape making use of a die casting, no matter what your calling. If you drive an automobile, die castings function for you at key points. If you write on a typewriter, they serve you without your knowledge, and when you turn the lock in your door or help Junior play with his streamlined electric train, here, too, they are present. Die castings go to make up all manner of office and home equipment devices, though you might not be able to recognize them because they are so often concealed beneath a coat of metal plating, enamel, or lacquer.

Die casting now affords one of the least expensive methods of making a large number of metal articles, and of making them quicker and better than in any other way.

This is a fact which signals an about-face for the die casting industry. The troubles which toppled the business into relative obscurity after enjoying a mild boom some 15 years ago are a matter of history, for intensive research has led to a revamping of practice and to an ultimate achievement which will astound all but the best informed engineers and production men.

Die castings are being used for hundreds of different metal articles, yet they have not won through to their final position in the production world. They have penetrated a few industries pretty thoroughly, notably the automobile industry, but the full sweep of their possibilities is still in the making. They have had to live down an unsavory reputation and that has taken years of painstaking effort by a few faithful exponents, first to make die castings absolutely reliable and then to convince the production world of the accomplished fact.

Die casting is pretty widely understood to involve the forcing of liquid metal into a die to harden to form. This remains casting practice today. The difference between the old and the new method is wholly one of establishing standards for the metal alloys used, perfecting casting technique, and developing greater skill in the designing of dies. Three factors then—materials, conditions, and technique—are responsible for giving reliability to die cast articles.

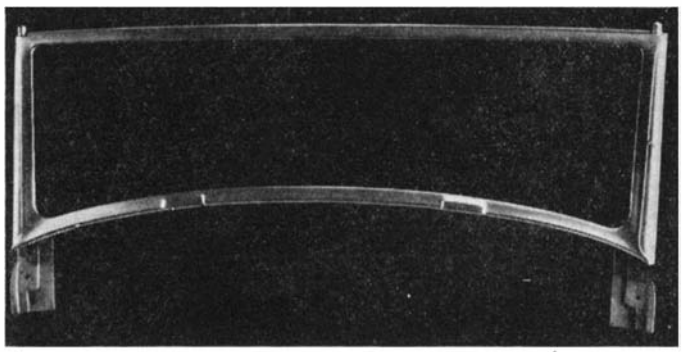
IN the transformation of the die casting industry, the science of alloying has been carried to great lengths, with the resultant knowledge of what can and can not be done by grouping metals in specific amounts. There has also been an increase made in casting pressures so that now 500 to 2000 pounds per square inch is used as contrasted to the former 100 to 500 pounds. Higher pressures make a denser product and consequently a stronger one. Finally, casting speeds have been raised. It is now possible to cast articles at the rate of 150 to 300 an hour and in some exceptional instances

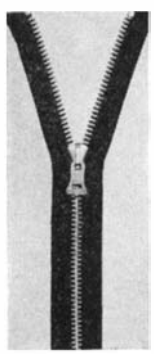
rates as high as 1000 per hour have been reached.

Die castings can and do replace some sand castings, stampings, screw-machine products, and forgings. It is a fact that die castings are stronger than sand castings and come from the die with better surface finish. Even with fairly expensive dies and small quantity output, material savings have been made over identical sand castings. It is also a fact that savings have been made in the replacement of stampings because complex forms can be produced in a single operation, whereas similar stamped forms might require many dies and subsequent multiplication of stamping and assembling operations.

Saving in fabricating, machining, and assembling is the advantage that probably appeals most to the prospective user of die castings. Imagine the possibilities that have been opened up by the everyday success in turning out products requiring complex coring. It means that articles with intricate form can be turned out with a single shot of the casting machine. Such castings can be made with very close dimensional limits, the actual degree of accuracy to which they can be held varying in inverse ratio to the melting point of the alloy being cast. They can combine thick and thin walls, and if the product does not come out of the die with finished surface it requires only a slight grinding or buffing to obtain it. There is no assembly work requiring soldering or welding; usually no machining, except to remove small fins; and there is no scrap metal in the usual sense, since any metal left over is used over again immediately.

A CARBURETER body provides an excellent example of what can be done with die casting. Here a complex form is cast to very close limits, as it must be if the delicate mechanism it is to house is to function properly, and a saving is made in material costs, machining, and assembly. Another example is afforded by the tripod of a motion picture camera. In this instance seven different castings are made with a single die, thus saving on die costs as well as operations since all castings are made with a single shot of the casting machine.





Two extremes in die casting: a 50 by 22 inch, 33-pound windshield complete in one casting, and a slide fastener with 26 castings per inch

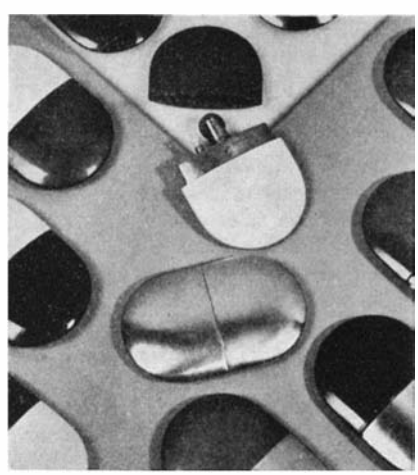
Industry has a wide latitude in choice of materials for die casting and there is a further spread of choice in the variety of alloys possible with each base metal. The ultimate selection bases upon a consideration of physical properties, weight, corrosion resistance, dimensional tolerance, aging and dimensional changes, toxic effect, machining properties, surface finish, and the final cost per cast piece. At the present time casters need spend little time experimenting with alloys because research of the past few years has determined the definite alloying proportions to give satisfactory results under controlled conditions. Prolonged investigation by the American Society for Testing Materials, the Society of Automotive Engineers, and leading producers of the raw metals have led to standardization of practice so that the "guess" is largely eliminated.

Casting practice—that is, the conditions under which casting is carried on—has been very much improved in recent years. Casters now know more about the flow of molten metal under pressure, the effect of cooling jackets and the size of gates and overflows, which must be understood to produce reliable articles of commerce. The improvement is reflected in the higher pressures and greater speeds under which operations are now conducted as well as by the products themselves.

Aluminum die castings for aircraft: light weight, strong, tough, and corrosion resistant

Die designing, too, has been advanced, perhaps fully as much as the science of alloys and casting, but it still remains a matter of individual skill. Granted that a suitable alloy is available, there is always to be considered in relation to each new article, the problem of devising a die that will handle the job expeditiously. If the article to be made is complex in form there arises the problem of coring and the question whether or not a single casting or multiple casting must be used. Even redesign of the product itself may be considered since the consolidation of several parts into one would eliminate machining and assembling operations. This all has a bearing upon costs, and possible savings depend in large measure upon the ingenuity of the designer.

DESIGNERS have shown extraordinary ingenuity in recent years as anyone can see by examining the castings now entering into articles for the consumer. Their energies are by no means spent. There are still many sand castings and stampings that can be replaced by die castings when designers get to them, or rather when the problems are brought to them.



Dainty cigarette lighters are die cast effectively in mass production

The following examples show what has been done and indicate some possibilities.

One manufacturer producing a trolley wheel and contact holder found he could replace the bronze wheel and cast iron holder with zinc castings and get identical performance from the finished product at an 85 percent saving in cost. A clock maker substituted a die cast clock case for a stamping to save weight. He got a 15 percent saving in weight but also a more rigid case and at a saving of 32 percent in cost. A third manufacturer, a producer of high-priced automobiles, cut the cost of a cowl bar from 40 dollars

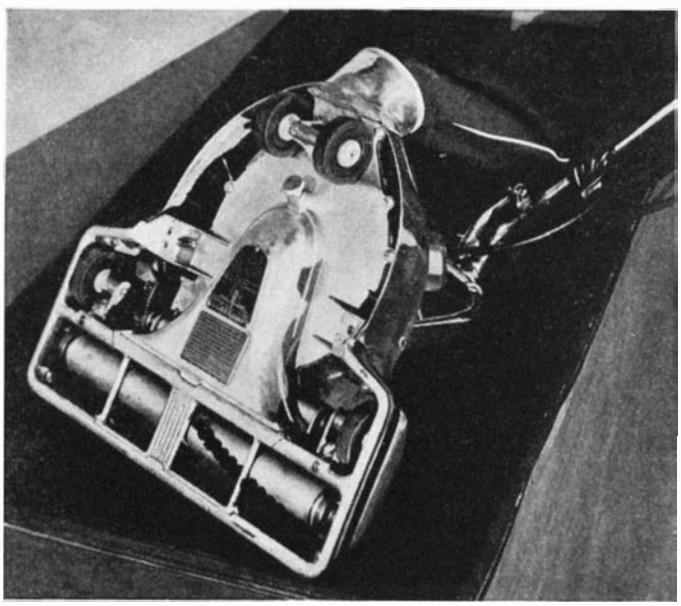
THIS article is the sixth of a monthly series of "word pictures" of different industrial fields by Mr. Smith. Others that have gone before covered:

Diesels; Plastics; Cemented Carbides; Packaging; and Paints.

Mr. Smith's next article will appear in July, as he will defer in June to Secretary of Commerce Daniel C. Roper, who writes on Southern Industry.— ***The Editor.***

to 20 dollars by using a zinc alloy casting in place of a bronze sand casting.

Examples of this nature might be enumerated for several pages, although dollar and cents savings could only be intimated, for the advantages manufacturers have gained by substituting die castings for other metal forms quickly become trade secrets and are not translated into figures for the benefit of competitors. That die castings have come into broad use in industry and that more industries are adopting them is evidence *per se* that a better product can be had or that cash savings can be made—usually both. If further proof is needed it is only necessary to point to the automotive industry as the largest single user of die castings. This is the industry which considers performance and cost reduction more closely than any other and adopts with greatest promptness the means to achieve them effectively.



Complex housing of a vacuum cleaner that was die cast of aluminum. The various smaller parts are die cast of zinc alloy

AT the beginning of this article it was stated that the full sweep of die casting possibilities was still in the making, and it is no exaggeration. It is hard to believe that the ultimate has been reached in the science of alloying or casting, but assuming for the moment that no further progress is made, there could still be an expansion of die casting. It requires only the utilization of the possibilities which have been uncovered so quietly in recent years. As yet applications have been largely of the obvious type, leaving real opportunities for ingenuity to work along new lines. Quite recently some unique applications have been tried and their success points the road to others. A year ago, for example, no caster would have thought to attempt die casting slide fasteners, but it is practical. The metal is cast right on the fabric, the "teeth" being shot on to it hot from the casting machine and, perhaps even more astonishing, the "teeth" are plated while on the fabric with whatever metal style decrees.

Die cast slide fasteners, exhibiting 26 castings to the inch of length, and windshield frames 50 by 22 inches, made in a single casting weighing 33 pounds, represent the two extremes of die casting and they afford the best possible illustration of the present range of this metal handling process.

Die castings do not have to be used alone. They can be combined with other materials. This constitutes an entire field of practice which has as yet hardly been scratched. By the ingenious use of inserts which may be metallic or non-metallic, characteristics can be given to a casting which are not native to it and so broaden the uses to which it can be put. The insertion of steel blades in die cast table knives is illustrative. Then, too, in instances where casting is precluded by complexity of design, it often can be made feasible if the form is simplified and the omitted part or parts be supplied by an insert, such as a stamping.

In combination with non-metallic materials like porcelain, wood, or plastics, decorative effects can be obtained and this creates opportunities for the product engineer. Cast water-faucet handles with porcelain "hot" and "cold" inserts are being used; so are wooden door knobs in conjunction with die cast building hardware. Often the shrinkage of the cast metal upon cooling is sufficient to hold the inserts rigidly, and if it isn't, a simple groove serves the purpose.

The range of die casting use is dictated somewhat by available casting alloys. Some alloys produce articles stronger than ordinary gray cast iron; some approach mild steel in strength and practically all alloys make articles stronger than sand castings. Tensile strength may run from 30,000 to 60,000 pounds per square inch, depending on the alloy, and transverse and impact strengths are usually very high. But a consideration of the various alloys will make this clearer and will explain why castings are coming into wider use for certain purposes.

The casting alloys are always made of zinc, aluminum, tin, lead, copper, or magnesium; that is, these are the dominant metals. They are also used as alloys together with several other metals. Zinc is now by far the most commonly used of casting metals and alloyed with it in very small amounts are copper, aluminum, and magnesium. The principal advantages of zinc are its low cost, its low casting temperature (which means that low cost steel dies can be used), ease of machining, its good physical properties, corrosion resistance adequate for most uses, high production rate, and the simplicity with which surface treatments can be applied.

EARLY failures of zinc alloy die castings were due chiefly to inter-granular corrosion. This trouble has been traced to the presence of tin and lead as impurities and it has been overcome by using zinc of highest purity and alloying with virgin metals. In effect, this means a closer control of alloy content. It is also characteristic of zinc that it shrinks slightly after casting, though in some types of alloys it grows again. Unless a product must be held to very close dimensions this peculiarity does not have to be considered, but if dimensional accuracy is important, an artificial aging process can be employed and machining delayed until the process is completed. There is finally the characteristic of losing impact strength at very low temperatures. If it were a serious deficiency, however, we would not be likely to find zinc alloy castings being used for such articles as automobile exterior hardware.

When zinc castings are used for such parts as carbureter bodies, no surface finish is needed other than that imparted by the die, but where appearance is highly important, as with many fittings and accessories, castings are buffed and then plated. Plated die castings are to be found in windshield frames, lamp brackets, door handles, and horns; but even when plating is involved the casting process represents a simplification in manufacture. An automobile horn, for example, can be cast in one piece whereas former practice consisted of drawing

from sheet metal and then soldering to a casting for assembly; a windshield frame needs only buffing and plating as contrasted with the grinding and polishing prior to the plating of a sand cast frame. All this means substantial cost saving.

Zinc die castings are used extensively as parts for household and office appliances, for hardware, light machines, and parts for electrical goods. But when parts are to come in contact with food having acidity, or must withstand marked corrosive action, or be light in weight, aluminum alloys take precedence over zinc.

ALUMINUM is second only to zinc in importance as a casting metal, but an age that stresses weight reduction presages a rise to greater prominence. In addition to the qualities enumerated above, aluminum has greater tolerance for impurities and it can be polished so that no surface plating is required to enhance appearance, although an anodizing process in which the casting serves as the anode can be used effectively.

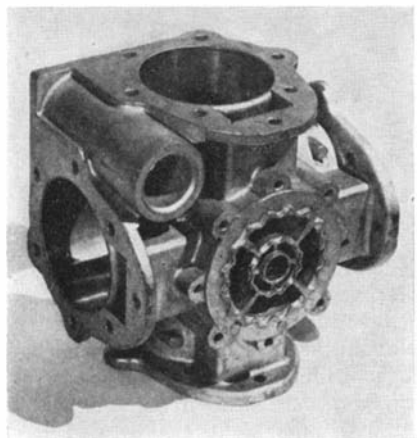
Die castings of aluminum alloys find wide application for automotive parts, but principally where light weight is a factor, as in airplane construction. In household equipment aluminum die castings are playing an ever wider rôle. They go into vacuum cleaners to lighten weight, and they are used in cooking and mixing machines where there is contact with food. This metal, which is alloyed with copper, silicon, and nickel, has a greater dimensional permanence than zinc and so enters into castings for instruments and recording devices such as counters, clocks, and meters.

Copper, as a base metal for casting, now has limited use but a high potential one. It is not the least expensive metal to use and because of its higher melting point more care and expense must go into the making of dies. Machines which are suitable for casting zinc and aluminum are not wholly satisfactory for copper alloys, and there are greater difficulties to be overcome in the casting process. Still, copper has a place in the die casting business. Where strength, ductility, hardness, and corrosion resistance are to be desired, copper is the choice of metals and there are many applications requiring just these qualities.

Recent research in copper, which has led to the development of several alloys, promises to give casters some new copper combinations with higher strength and resistance to fatigue, but as yet these alloys of wide potential use have not reached the stage where they may be put to practical use.

Magnesium is the newest of the casting metals. It has not had very long in which to prove its worth, but even so, its extreme light weight has given it a unique position in the field of casting and we can look to hear more from it. Aluminum and manganese are alloying metals and a variety of alloys are being made by varying the relative proportion of these two metals. Magnesium makes a very stable alloy and one easy to machine. In most characteristics the alloys approach those of aluminum very closely. The finished casting does not lend itself well to electro-plating, but it can be painted or lacquered.

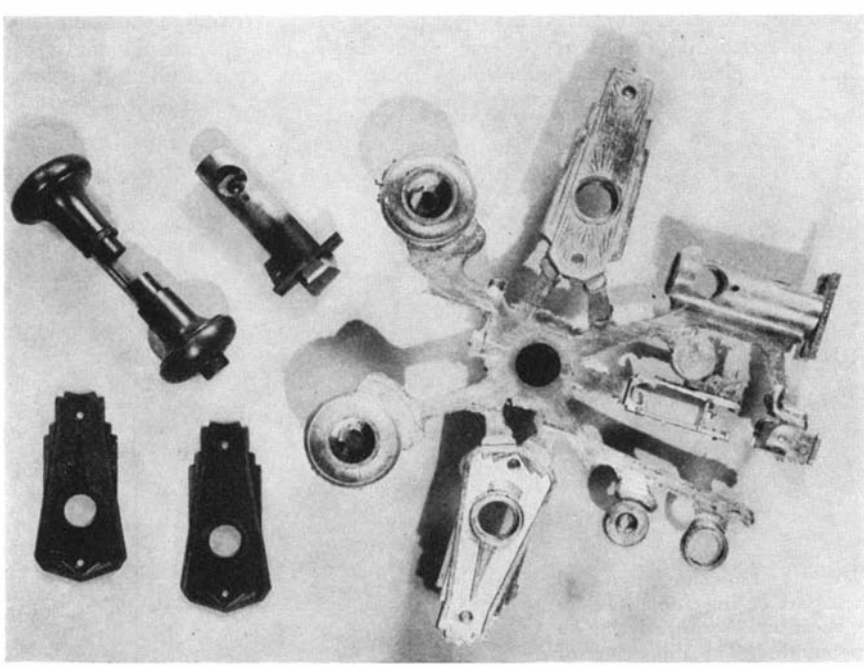
Stringing along at the end of the list of metals are tin and lead. The first was once the most widely used of all die casting metals because of its very low melting point, but with the ironing out of difficulties attached to other alloys it has sunk to relative insignificance. Tin casts with extreme dimensional accuracy, hence it serves well for number wheels and odometer parts. It is also found in food and dairying equipment where all toxic effect must be avoided. Lead, likewise, casts with ease and it has the property of resisting chemical action, but it lacks the strength and hardness needed for most applications. Battery parts are sometimes cast in lead.



Pump body showing the complex design possible with die casting

In the last analysis the future of die casting rests heavily upon the skill of the die maker. Even with the most suitable alloys the finished casting will not be satisfactory unless the designer is well versed in practice. He must understand the action of metal upon cooling in order to avoid strains which might lead to cracking of the casting when in service. He must know just where strengthening ribs must be used to prevent distortion. In short, when everything possible has been done to perfect alloys and casting machinery, there is still required the indispensable ingredient of designing skill to make casting successful; success meaning not only production of a serviceable article, but production at lower cost than by any other means.

ACTUALLY the progress of die casting is to be gaged to a high degree by the advancing skill of die makers since the metallurgical and mechanical factors have been brought to a high state of development. This, in turn, demands close co-operation between designer and caster. What we are now seeing is the building up of a technique, and it is this very technique which makes the future of die casting both limited and unlimited and so fascinating. It leaves much to the imagination—the very same quality which has built up die casting to its present state of accomplishment and which promises to carry it to the winning of new frontiers.



Several parts of a door lock cast in a single die, finished at left, and as they come from the die at right, still connected by the "dead" metal to be cut away later

Photographs courtesy: Aluminum Company of America, Crown Fastener Corporation, and New Jersey Zinc Company.

THRILLS FROM A HOME-MADE POLARIZER

By PHILIP R. TARR

(*In Two Parts. Part 1*)

OF the innumerable thrilling and educational observations that may be made with an ordinary microscope, few can compare, either in beauty or fascination, with those made with polarized light. An unlimited field may be opened by adding the necessary polarizing equipment to your microscope. Brilliant-colored crystals, crystal structure, plant structure, stress effects, and many other sights are revealed in a dazzling array of color, or in beautiful, apparently luminous, form against a practically black, or colored, background.

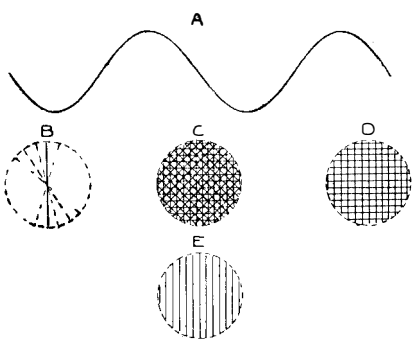


Figure 1: **Diagrams for suggesting the behavior of a beam of light**

Ordinarily, polarized light is obtained by the use of prohibitively expensive equipment such as Nicol prisms. These cost from 25 dollars up, and most of us cannot afford them. However, other methods are available which, although not precise, will for all practical purposes produce equally fine results. The apparatus may be constructed from odds and ends for less than two dollars.

Before describing the apparatus let us become acquainted with a few fundamental principles concerning polarized light. In the following explanation a compromise has been made between technical accuracy and explanatory clearness.

Suppose we examine Figure 1 and imagine we can see an individual wave form of light. Referring to *A* and remembering that this wave form is not perceptible as such to the human eye, we see a side view. If we could view this from a point on its path of travel, the wave form shown at *A* would appear as in *B*, in which the dotted circle represents the boundary of a fictitious beam of light. Light is thought to be composed of an infinite number of such wave forms, whose planes of vibration lie in all possible directions, which are ever changing until polarized. If we imagine them, from our point of view, again within the path of the light beam, they should appear as represented diagrammatically in *C*, in which the straight lines illustrate the changing planes.

If we now place certain transparent materials (*e.g.*, calcite) in the beam represented by *C*, we find that a peculiar thing happens. The light, which entered the substance vibrating in all directions, comes out vibrating in only two directions, always at right angles to each other. In addition, the rays which are composed of these two sets of vibrations emerge at different angles, thereby forming two rays. These rays are known as "plane polarized light."

These two rays are radically different in their behavior. One of them, in passing through transparent material such as Iceland spar, is bent or refracted the same amount as ordinary light, and is therefore called the ordinary ray. The other ray is refracted in a different manner from ordinary light and is called the extraordinary ray. In microscope practice all of the rays of one kind are reflected to one side and thrown out of the field of vision. The remaining rays vibrate in only one plane and are represented by *E*.

Suppose we pass the remaining polarized rays through another polarizing device, set in the same relative position as the first. Under these conditions the polarized rays will be passed through the second polarizer (which is now termed the "analyzer") without change. When observed, as for example through a microscope, the field will be light.

If, however, the second polarizing device, or analyzer, is turned at right angles to the first, that is, the polarizer, the polarized rays projected on the analyzer become the rays which are discarded by reflection, and the field will be dark.

For all intermediate positions of the analyzer between light and dark fields, proportionate amounts of light are transmitted.

ANOTHER method of polarizing light is available, and is the method used in the apparatus to be described. Light reflected at a certain angle from the surface of glass is plane polarized. The transmitted light, or light which passes through the glass at this angle, is also plane polarized with its planes of vibration at right angles to those of the reflected light. This method is known as "polarization by reflection," or as "transmission," depending upon which light is used.

While there are several methods available by which polarizing apparatus may be attached to the microscope, a commonly used arrangement consists of placing the polarizing device immediately below the stage and the analyzing device within, or immediately below,

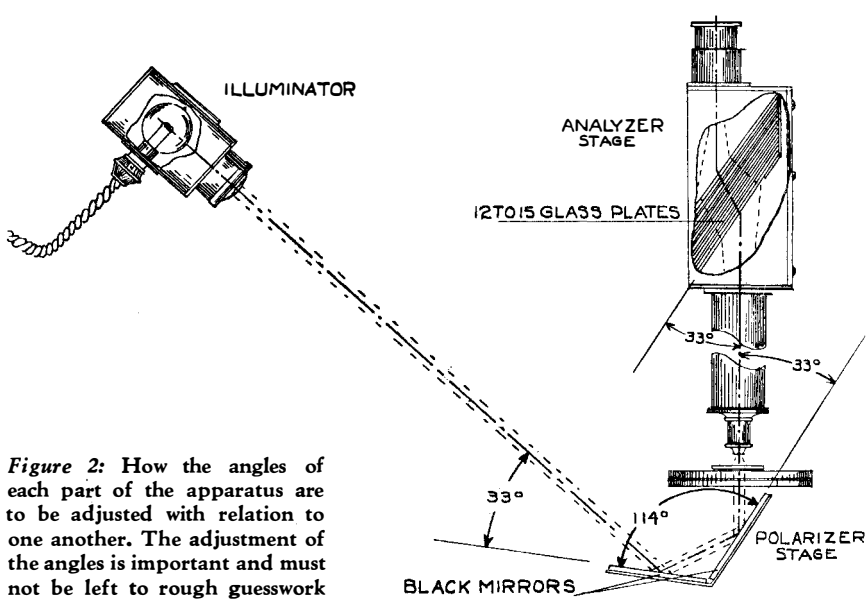


Figure 2: **How the angles of each part of the apparatus are to be adjusted with relation to one another. The adjustment of the angles is important and must not be left to rough guesswork**

An Unlimited Field for Experimentation and Fun . . . Gorgeous Display of Colors Difficult to Exaggerate . . . Cost, Less than Two Dollars

the eyepiece. They are called, respectively, polarizer and analyzer.

As an example, when we place a slide containing a few crystals of oxalic acid upon the stage, polarized white light from the polarizer passes through and around the crystals into the analyzer, thence to the eye. With the analyzer adjusted to the dark field position, the crystals, which are themselves polarizing materials, produce ordinary and extraordinary rays. Inasmuch as these two rays travel through the crystal at different speeds, being refracted or bent differently, they will be "out of step" when they emerge, and when recombined in the analyzer they will produce an effect seen as color. Different portions of the crystals will vary in thickness, consequently varying the color effects within each crystal. The whole effect will be seen as apparently luminous crystals in a myriad of color on a dark background.

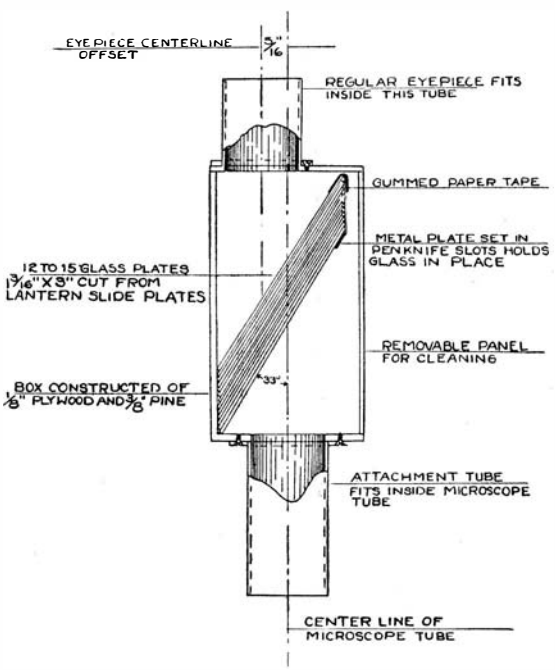


Figure 3: **The analyzer. Note 33 degree angle**

Materials which produce such effects are called "double refractive." The preparation of a few crystals will be explained later; in the meantime let us see how the necessary apparatus may be constructed.

Figure 2 shows the general arrangement of apparatus necessary, and the fundamental requirements for making it. Very few details are given, since the construction is relatively simple, and by making minor alterations the equipment can be fitted to any ordinary microscope.

Particular attention should be given to all indicated angles, especially during preliminary experiments, after which slight readjustment of any or all angles may improve results.

THE polarizer stage consists of two black mirrors. These may be made from lantern slide cover glasses, cut to two-inch squares and painted on the back with a thin mixture of lampblack in shellac. A single thickness of black photographic paper may be cemented over the lampblack layer with an additional coat of thin shellac. The mirrors are finally fastened to a metal plate, bent to the proper angle, as shown in Figures 2 and 4. (A thin melted layer of sealing wax was used by the author for fastening the mirror to the bent plate, although a layer of cloth dipped in shellac would do just as well.) Figures 4 and 5 show how the assembled black mirrors may be fastened over the regular microscope illuminator mirror with brass clips.

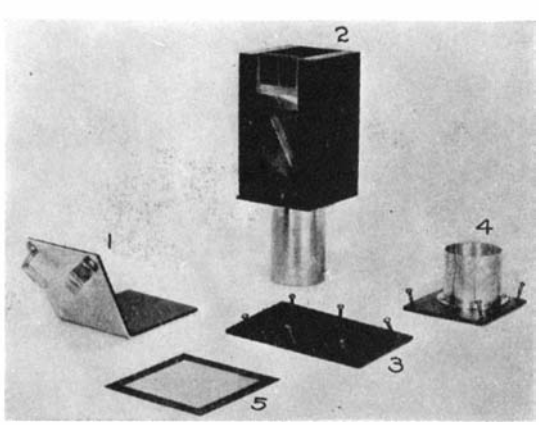


Figure 4: **The entire polarizing equipment, ready for final assembly. 1: Black mirrors. 2: Analyzer box with glass plates in place. 3: Removable door for analyzer. 4: Eyepiece tube fitted to plywood cover. 5: Mica plate**

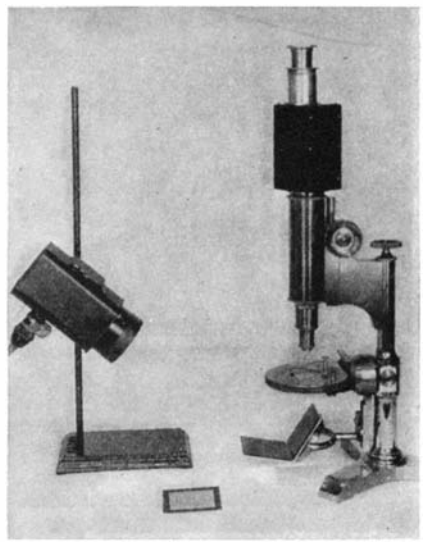


Figure 5: **The completed polarizing apparatus installed and ready for use. When using the apparatus it is best to shade the stage from stray light with a cardboard shield**

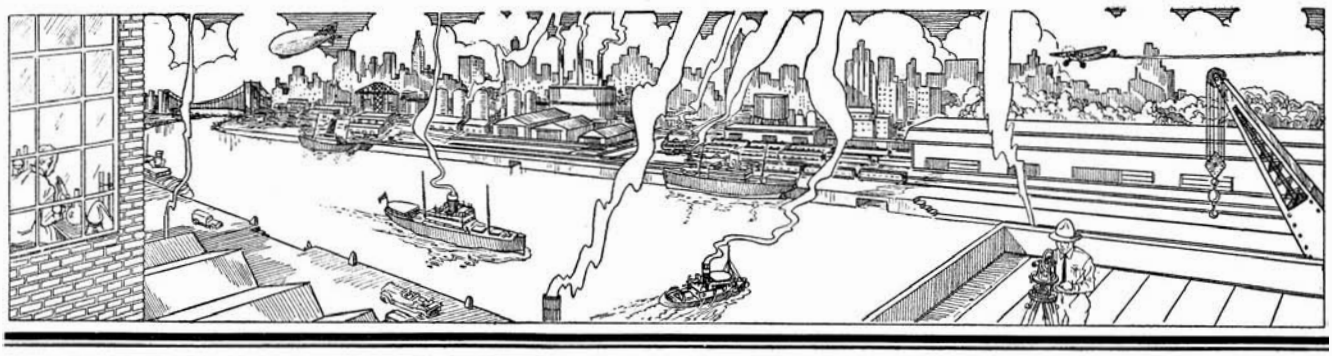
The analyzer, Figures 3 and 4, is constructed of miscellaneous pieces of pine and plywood.

The quality of the image seen through the analyzer is controlled largely by the quality and flatness of the glass used. Ordinary glass is practically useless, although lantern slide cover glasses are quite satisfactory. These may be obtained from any photographic supply house at a cost of 50 to 60 cents. They should be taken to a glazier for cutting, where a diamond-pointed cutting tool may be used, so as to obtain smooth, even edges. Scratching of the surface may be avoided by cutting each individual plate on a small piece of fresh blotting paper, using a new piece for each glass plate.

Before finally assembling the glass plates in the analyzer box, each should be cleaned thoroughly by washing in a hot solution of tri-sodium-phosphate, one ounce to one quart of water. Dry on a clean, lint-free, linen towel, blowing each plate free of dust as it is dropped into place. A small strip of gummed paper lapped over the last plate, as shown in Figure 3, will hold them all in place.

After arranging the glass plates it will be noticed that an image of the ends of the plates nearest the observer is reflected toward the center of the pile when viewed from either end of the analyzer assembly. To overcome this effect the tubes are offset, as shown in the drawing. This arrangement, in addition to placing the reflected image outside the field of vision, also maintains a centrally located field when the analyzer is turned.

The apparatus is ready for use when assembled with all angles adjusted as shown in Figure 5, and its use will be explained in the next installment.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

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

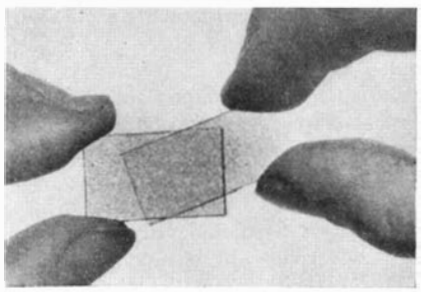
A. E. BUCHANAN, Jr.

Lehigh University

Polarized Light

THERE are several known ways of polarizing light and polarized light is now widely used in the laboratory. However, although there are many known important applications for polarized light in industry, its use has been practically confined to the laboratory because the methods in use have been inconvenient and very expensive.

Alvin M. Marks, research engineer, has developed a means of coating a thin layer of an optically active substance, capable of plane polarizing light, on transparent sheets

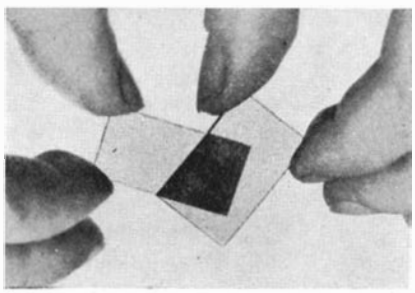


in practically unlimited areas. When one looks through two of these glass sheets arranged to produce light polarized in the same plane, they are quite transparent, but if these are turned through 90 degrees relative to this position, they obstruct almost all of the light and so appear quite black.

The immediate use for this method of obtaining polarized light is in the field of scientific instruments where its use should permit of more extensive research in a most important field of science. However, the widest uses will come in virgin fields. For the motor vehicle, it may serve to cut off the glare of a headlight through the windshield; and thus, incidentally, to permit the use of stronger headlight bulbs, with a resultant greater road illumination. Other large uses are for stereoptic views, variable density goggles, and advertising displays to obtain beautiful color effects of the kind visible with polarized light.

Revolving Auto Service Station

THE first revolving service station in this country was opened recently when the Esso Rotary Servicenter at 93 Lafayette Street, New York, received an automobile on its giant turntable, whirled it around an island of dispensing equipment and in less than two minutes sent it out into the stream of traffic completely serviced with oil, gasoline, air, and water.



Left: **Two plates with their planes of polarization approximately alined.** ***Above:*** **Same plates rotated so as to obstruct almost all light**

Designed by the Colonial Beacon Oil Company, this new unit is a unique development of the service station. Its principal features are that it requires less land than the old type of service station with equivalent facilities; it is economical to operate; it speeds service to the motorist; it necessitates no awkward backing and turning to get to the pumps; and it keeps the motorist indoors while his car is being serviced.

The station itself is a building 41 feet wide by 75 feet long. As the motorist enters this building, he drives on to an electrically operated turntable 37 feet in diameter. This turntable revolves around an island which contains an office, display rooms, and dispensing equipment. As a car drives on, the attendant presses a button and the car is moved to one of three positions convenient to pumps and other dispensing equipment. Three cars can be serviced on the table simultaneously.

Color Photography

A THREE-COLOR amateur movie film that may be used with any camera and projector, has just been announced. Known as the Dufay film, it is being developed also for use in still photography, in which prints will be made on paper. Scant details available at press time reveal the process to involve a screen or mosaic of three-color dots on a single film base. The mosaic is applied to the film by a precise machine which prints in three colors and suitably bleaches

The Rotary Servicenter for quickly servicing automobiles

and dries the criss-cross lines of the color-recording screen.

A full description will be published in our June number.

Chemical Improves Printing Ink

A NEW chemical, colloidal aluminum in linoleate, for use in printing inks, is said to have advantages in commercial printing runs of savings in cost, smoother laying, clearer plates, and less tendency to offset. This chemical is entirely colloidal, without crystalline form, and contains a high percentage of chemically fixed available moisture.—*A. E. B.*

EDUCATION

NEARLY 50 percent of all institutions of higher learning in the United States are located in 10 states. There are 229 colleges for men, 270 for women, 1163 coeducational institutions, and 107 Negro institutions of higher learning.

Our Own Disinfecting Plant

THE upper intestinal tract has a natural disinfecting power that, when we are in normal health, kills off most of the germs that come into the stomach by way of the mouth, Dr. Lloyd Arnold of the University of Illinois told a recent meeting of the Chicago Medical Society. This is the reason why we do not have more diseases of the intestinal tract.

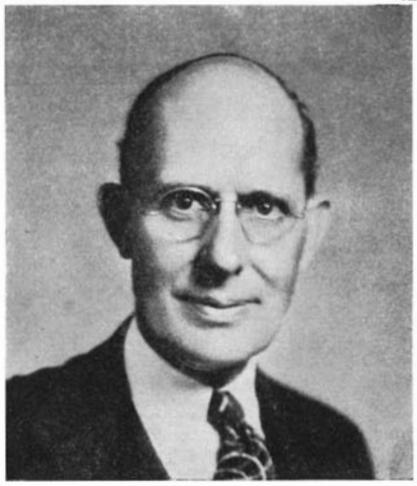
He and his associates have been working for 12 years on determining the bacterial flora of every inch of the digestive tract. The lower intestine is very densely populated with bacteria, he declared, while the upper intestine and the stomach have normally very little bacterial life. The secretions of the stomach and upper intestine are acid in their reaction, while in the lower intestine the reaction is alkaline. There is, however, no "gate" between the upper and lower intestines; it is the line of acidity that determines the height that the bacterial flora will ascend. Consequently, if, for any reason, the acidity of the upper digestive tract is lessened, the bacterial flora of the lower intestine may ascend even as far as the stomach, and the disinfecting power of the mucous lining of the intestine is not able to function properly.—*Science Service.*

PROGRESS In This Age Of Science

As Told to Scientific American

By C. F. KETTERING

General Director, Research Division, General Motors Corp.



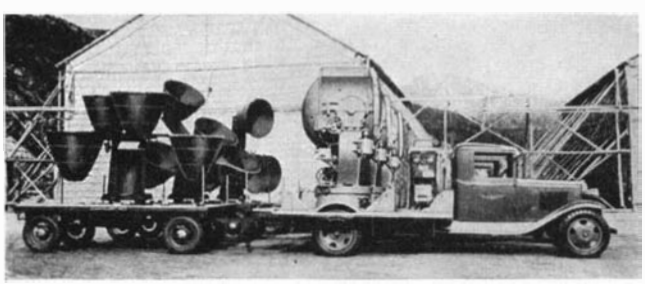
WHAT the world needs most today are new ideas—new things to make jobs to put men to work. One of these days we are going to discover some new fundamental facts which will keep us industrially busy for years. We have been so busy in the past 50 or 60 years applying to every-day use the fundamental information handed down to us by the great scientists of the last century that we have neglected to continue the work they started. It is time we went back and picked up the job of digging into the mountain of fundamental scientific facts where Faraday, Newton, Thompson, Henry, and many others stopped. Some of the recent discoveries in physics and chemistry indicate that this work is already under way.

In applying these new facts in the future we will have to use more intelligence than we have sometimes done in the past. New things should not be built which will be obsolete before they are paid for. We must plan for change, for change is our only constant. No one can tell what the future will bring, but anyone can fortell that there will be change. If those behind our new era of prosperity will realize this fundamental truth, and build and use only what can be paid for as we go along, our future prosperity will be assured and we will be able to continue to progress unhampered by old debts and mortgages for things which have become obsolete. We must build on a firm foundation of scientific facts, realizing that this means constantly providing for new factors in our every-day life without the tremendous upheavals which we have experienced in the last few years.

Chinese Army Motorizes

THE general belief that the Chinese are extremely backward in military affairs is contradicted by the accompanying photographs of modern aircraft defense equipment, belonging to one of the Provincial Governments of South China. A fleet of Chevrolet trucks has been equipped with high-powered search-lights, and generators to supply current to the lights and to their motor-driven elevating and traversing mechanisms. With each search-light truck goes a trailer bearing an elaborate system of electric sound detectors and direction indicators, by which listeners can learn of the approach of an airplane long before it gets within the range of the lights or, by day, of the anti-aircraft artillery.

Modern American motor trucks equipped for military service and owned by one of the Provincial Governments of South China. The trucks serve as fast transportation units for powerful search-lights and sensitive sound detectors



Tides Influence Beach Erosion

WAVES are the sea's battering-rams, in its endless warfare against the land, but tides are the wheels on which these weapons are borne into position to make their attacks.

This, in summary, is the importance of tides in the erosion of shorelines as discussed by Capt. Paul C. Whitney of the United States Coast and Geodetic Society, before a recent meeting of the American Shore and Beach Preservation Association.

Tides affect the height, or position, of the erosional action, so that their rise and fall—as little as a foot in some places, as much as 50 feet in others—is a matter of great importance. Tides also influence longshore currents, which modify the angle of wave attack, and carry away the sand and rock fragments after they have been dislodged.

The Coast and Geodetic Survey, Capt. Whitney said, maintains a number of pri-

mary tide stations where continuous observations are being secured along the coast of this country, as well as numerous short series stations. These data, in addition to serving the basic purposes of the Survey, are available for interpreting and correlating the tidal information secured by engineers in their studies of erosion effects on shorelines.—*Science Service.*

Quick Setting Acid-Proof Cement

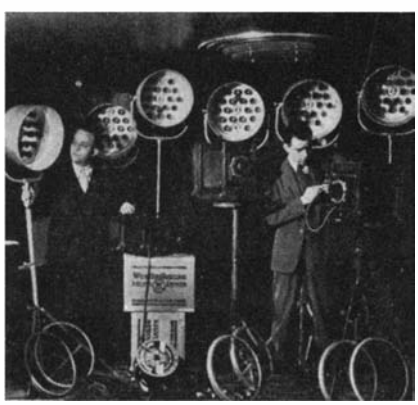
A NEW cement which should be of interest to many lines of manufacture, engineering, maintenance, and construction, will harden by setting within 36 hours. The initial set, which requires only about one hour, is sufficiently rapid to permit a continuous job of bricklaying. The old method of delayed drying is unnecessary.

This new cement is a white powder of high silica content which is mixed with water to a smooth, creamy consistency. It hardens by chemical action into a strong, acid proof and porcelain-like structure of permanent durability.

Heretofore, it has been necessary in plants where there are many acids and their corrosive fumes, or solvents, for the floors to be built of wood as no concrete would withstand these materials. This new cement resists such materials as well as water and fire.

Huge Flashlight Picture Made Indoors

GUESTS of the General Motors Corporation at a recent broadcast in the Center Theater of the National Broadcasting Company, Radio City, were also a party to a flashlight picture made during the program. Three cameras were located in the



***Above:* The camera and flashlight equipment used to make the huge "shot" of a broadcasting studio reproduced in photo at the right**

first and second balconies. Two of these in the front row center of the first balcony made a picture of the audience and stage combined. The third camera took an angle view of the audience and stage from the second balcony. Panchromatic plates were used with an instantaneous exposure.

A total of 138 Photoflash lamps, divided among eight reflectors, were used. Six of the reflectors were located equidistantly along the first row of the first balcony to produce an even spread of light throughout the theater. These were equipped with 19 Photoflash lamps each, one flashing by current, the remainder by induction. Two other reflectors with 12 lamps each, one in each wing, were used to build up the illumination on the stage.

NO DANGER?

ALTHOUGH thousands of "shooting stars" penetrate the earth's atmosphere every day, there is no authenticated case on record where a person has been killed or injured by a meteorite or a particle of one. There are actually only about eight cases on record where even property damage has resulted from a meteorite and this damage has not been serious.

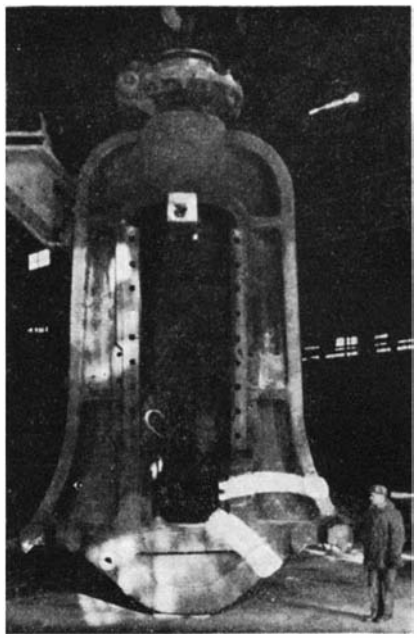
Explosions under the Microscope

TWO French physicists, according to *Current Science,* have exploded a milligram or less of lead nitride—a very powerful detonating agent—under microscopes, and studied the metallic markings on the slide. They have discovered that the air wave from one particle explodes another particle before the hot gases actually reach it. Metallic lead patterns on the slides after each tiny blast show the directions of the forces liberated.—*A. E. B.*

Thermit Welding Saves Huge Casting

ONE of the largest Thermit repairs in many years was completed recently at a mid-western steel mill. The broken part was a housing of a 160-inch plate mill. The casting, minus all appurtenances, weighed 164,000 pounds, stood 21 feet 8½ inches high, and was 14 feet 9 inches wide at the base and 10 feet wide at the top.

The original fracture, which caused the housing to be removed from service, occurred in the lower portion and ran from an inside corner diagonally downward through a tee-shaped section, one leg of which was 38 inches by 12 inches and the other leg 30 inches by 26 inches. In preparing this fracture for welding, another crack was discovered above the first, running through a section shaped roughly like



Four tons of Thermit were used in welding cracks in this huge casting

an I-beam with members 26 inches by 8 inches, 26½ inches by 8 inches, and 30 inches by 15 inches.

Four tons of Thermit—superheated Thermit steel, a mixture of finely divided aluminum and iron oxide ignited in a crucible—were required to make the two welds. The entire job, from the waxing of the first fracture to the pouring of the second weld, was completed in exactly one week. The cost of the two welds was only a fraction of the cost of a new housing.

Fortification with Vitamin D

THERE is no convincing evidence from the standpoint of public health of a need for the fortification of foods with vitamin D other than such staple products as milk, cereals, and bread, which form the basis of the customary diet of the public throughout the year. It is nutritionally unreasonable to add vitamin D to foods consumed mostly in the summer when sunshine is sufficient for producing this vitamin in the body, or to foods consumed irregularly,

(*Please turn to page* 267)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

A TELESCOPE having some new features has been completed by Nathaniel B. Archer, of 310 Pine Street, Green Bay, Wisconsin, whose letterhead indicates that he is a research, experimental, and design worker in machinery, and related problems in electricity, chemistry and physics; a maker of mechanical motions and laboratory apparatus, also of astronomical instruments and fine and small shop work. The optical parts of this telescope, which has an 8-inch mirror, except the polar axis finder, "were made," according to Mr. Archer, "by Mr. C. T. Elias of Appleton, Wisconsin. The main tube was made, chiefly, at the Green Bay Vocational School under the direction of their Mr. Thorpe.

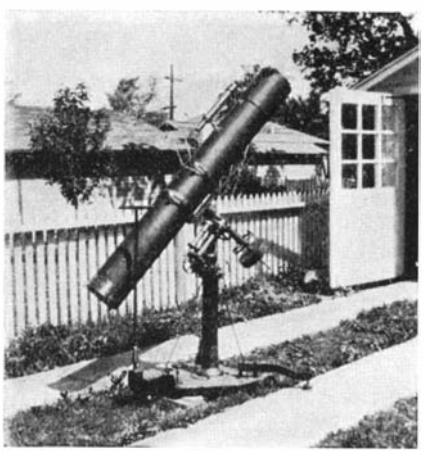


Figure 1: **The Archer scope**

"The photograph, Figure 1, shows the mobile mounting truck. The retractile (swinging) stabilisers are used for alining the polar finder upon Polaris, as explained later. The steering tongue is detachable. The brace rods were found materially to reduce the oscillation of the mounting, which is inherent in the slender pedestal shown.

"The worm gearing of the hand drive is made with a V-form thread, the wheel having been hobbed with a ⅝", 11-thread USS tap. The V-form gear tooth is satisfactory for this service, if an arrangement be provided for accurately adjusting the backlash or looseness of the worm and wheel.

"The equatorial mounting was made, partly, from parts supplied by Mr. Elias. It is provided with babbitted bearings, which are found to be superior, in point of performance, to the ball bearings installed in an instrument built previously by others. Ball bearings have so little inherent friction that the instrument will not retain a given setting unless the brakes are set with some force.

"The circle wheels were made from gear wheel castings. The outer rim (in which teeth are cut) was turned down and that surface given a ⅛-inch coating of hard (bronze) solder. This was again turned down until a smooth surface was produced. The circumference was divided in an engine lathe, using the lathe's gearing as an available indexing or dividing device.

"The polar axis finder, a new feature (Figures 2 and 3) designed by the writer, is arranged to compensate, semi-automatically, the angular distance of 1°07″ between the celestial pole and Polaris. The constellation Ursa Major is represented upon a disk, which is revolved until the position of its markings corresponds to the apparent position of the constellation itself in the sky at the time. If the main mounting of the telescope proper is then adjusted until Polaris is seen at the juncture of the cross hairs in the polar-axis finder, the polar axis of the mounting will be found to be almost precisely parallel with the axis of the earth. The finder is mounted in gymbals (Figure 2) at its upper end, and the eyepiece draw tube is passed through an eccentric hole in a disk, which is rotatably mounted upon the frame of the equatorial mounting. This disk is engraved with a representation of the constellation Ursa Major and Polaris.

"First, the mounting is roughly set into alinement with the celestial pole, and the triangularly placed handscrews on the base are turned down against the ground. By varying the relative adjustment of these hand screws, Polaris is brought to the intersection of the cross-hairs in the finder. As shown in Figure 4, if Polaris is seen at the intersection, then the polar axis of the instrument will be almost precisely alined upon the celestial pole. I made this finder from the lenses of an old Kodak, and it was found to be quite satisfactory for its purpose."

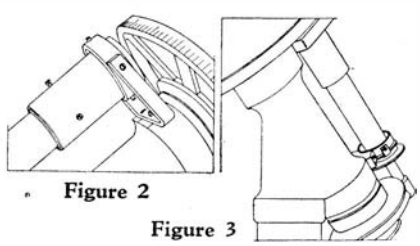


Figure 2

Figure 3

WALLY EVEREST, that famous landmark of Pittsfield, Mass. (15 Allengate Ave.), after being teased and teased (he is so shy) has kindly furnished us several pictures of "The Old Town Pump," also a noted landmark in that quaint New England hamlet. How did it come to be called Ye Olde Town Pump? Well, somebody thought the polar axis looked like a pump handle and, after that, that was that. Ye Olde Towne Pumpe has a Pyrex mirror, and look (turn the page) at those Ronchi bands! Everest had made 149 optical surfaces before he turned this one off, and this was his 150th. What we like about it shows best in Wally's "longitudinal cross-section" (as some genius recently described it): its *rigidity*. Study the details of that tapered polar axis. Then take a squint at the diameter of the declination axis. Then note the unusual setting circles—the indexing does not show, in the photograph, on either circle, as the light evidently caught them wrong. The declination circle is the light-colored streak, in line with the polar axis. Note also the worms and the rollers. A fine design. We also received some other photographs of Everest as an artist's model but this is not an arty magazine, hence they had to be suppressed even if Anthony Comstock is no longer an obstacle. Too bad—they were beauties.

AND now we learn that Mary A. (Mrs. A. W.) Everest, same address, has made the first feminine aplanat on earth, so everybody give three cheers and three times three! And here, in the photograph, is Miss Sylvia Petersen, 963 Tenth Ave., St. Petersburg, Fla., with a Newtonian telescope she made. The moon in the background, likewise the stars, are not the real ones. Miss Petersen was chosen "Miss America" in a recent beauty pageant.

SEVERAL have worked out ways—some rather complicated and mathematical, some less so—for making the Ronchi test quantitative as well as qualitative, and the first to be published was that of J. H. King, in the *Journal of the Optical Society of America*, Sept., 1934. We have been asked who was the first to work out a method, and the answer is, we do not know. Several evidently were at work on this problem at about the same period—Loren L. Shumaker of Dayton being one. Alan R. Kirkham of Tacoma, for example, sent us an outline of his method in March, 1934, and he has now, at our request, sent us the following succinct statement which is a paraphrase of the one he sent us then, and which we unjustly mislaid and overlooked at the time.

"The Ronchi test may be used to measure

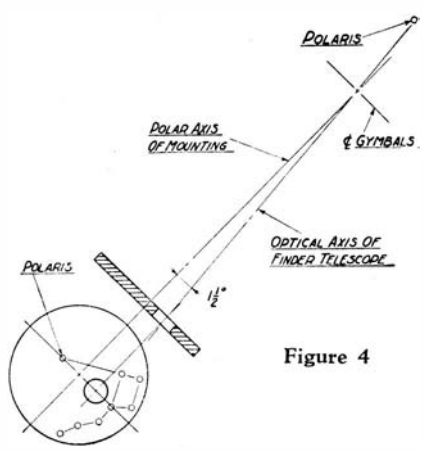


Figure 4

the overall correction of a mirror very simply, in the following manner: Adjust the grating so that two bands at the center of the disk are 1 inch apart (say) and mark the position. Now move the grating back so that the bands are 1 inch apart at the rim. The move should amount to r^2/R, if the correction is right." This statement should be substituted for the one on page 267 of "Amateur Telescope Making," where

Miss America, of Florida

it states that "the Ronchi test is not quantitative," and in the next corrected reprinting of the same book it will be so substituted.

THE following is our present list of clubs of amateur telescope makers. Prior to its publication elsewhere, we wish to obtain all corrections for this list, also similar data regarding telescope makers' clubs not now listed in it. We wish also to compile a separate list of purely astronomical clubs.

Telescope Makers of Springfield, A. D. Baker, President, Springfield, Vt.

Astronomical Society of the Stanley Club, A. W. Everest, President, 15 Allengate Ave., Pittsfield, Mass.

Tri-City Astronomical Club, Bernhard Nordblom, Jr., Secretary, 929 Grand Ave., Davenport, Ia.

Amateur Telescope Makers of San Francisco, Dr. Frances P. Epley, Flood Bldg., San Francisco, Calif.

Amateur Telescope Makers of Berkeley, Dr. W. T. Bush, American Trust Bldg., Berkeley, Calif.

Amateur Telescope Makers of the Golden Gate, a federation of the San Francisco and Berkeley clubs named above, with Oakland and other Bay cities clubs, addresses of the latter unknown.

Academy of Science and Art of Pittsburgh, Astronomical Section, Leo J. Scanlon, Pres., 1405 East St., Pittsburgh, Pa.

Infamous Poses of Famous Amateurs, Series A, No. 1. Alan R. Kirkham of Tacoma, in hiding

Amateur Astronomer's Association, Telescope Makers' Section, Ramiro Quesada, leader, American Museum of Natural History, New York, N. Y.

Amateur Telescope Makers of New York, Lew Lojas, 1510 White Plains Road, The Bronx, New York, N. Y.

Amateur Telescope Makers of Chicago, William Callum, Sec., 1319 West 78 Street, Chicago, Ill.

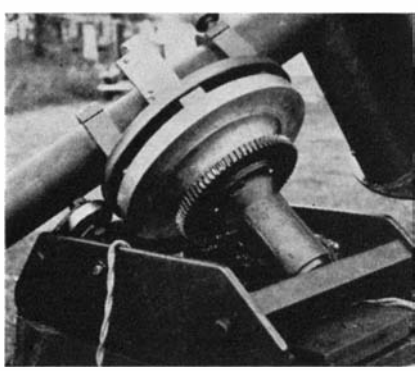
Amateur Telescope Makers of Cincinnati, W. Clemmer Mitchell, Sec., 2390 Wheeler Street, Cincinnati, Ohio.

Amateur Telescope Makers of Indianapolis, V. E. Maier, Sec., 1306 Parker Ave., Indianapolis, Ind.

Amateur Astronomical Society of Los Angeles, E. A. Letscher, 1016 S. Normandie Ave., Los Angeles, Calif.

Amateur Telescope Makers and Astronomers of Tacoma, George Croston, Sec., LaGrande, Wash.

Eastbay Astronomical Association, Telescope Makers' Section, Franklin B. Wright, Chairman, 155 Bret Harte Road, Berkeley, Calif.



Everest's polar axis—no shimmy

Amateur Telescope Makers of Buffalo, Thaddeus Czerniejewski, Chairman, 113 Franklin St., Lackawanna, N. Y.

Amateur Telescope Makers of Dayton, William Braun, Sec., 115 Bolton Ave., Dayton, Ohio.

Detroit Amateur Astronomical Society, Howard Morehouse, 4336 Dickerson Ave., Detroit, Mich.

Amateur Telescope Makers of Boston, Wagn. H. Hargbol, Pres., 600 Beech St., Roslindale, Mass.

Amateur Telescope Makers of Kansas City, Edward F. Bowman, Pres., 1406 Ewing Ave., Kansas City, Mo.

Westinghouse Astronomy Club, Fred C. Wilharm, Box 63 Homestead Station, Pittsburgh, Pa.

Astronomers' Guild of Jamestown, J. Elwood Johnson, Pres., 28 S. Main St., Jamestown, N. Y.

Amateur Astronomical Association, Joseph A. McCarroll, Pres., 521 Palisade Ave., Teaneck, N. J.

Louisville Astronomical Society, O. W. McCarty, Pres., street address unknown, Louisville, Ky.

WE are running to rather lighter stuff this month, as relief from heavier stuff, past and future. Here are two items from men who believe the world is flat. Whoever supposes that such people do not exist in this century should sit for a few days at the receiving end of an editor's mail.

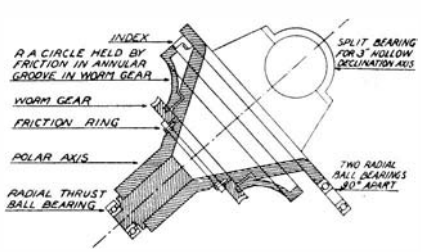
Arthur C. Bates, 322 B St., Marysville, Calif., who asserts that he is the only authority on the flat earth theory, claims that the earth is a huge island and says that the sphere theorists (that's the rest of us—or so we suppose) claim that the earth is round. But, he says, they cannot account for the fact that, if this is so, the River Nile must run uphill for over 30 degrees. Mr. Bates challenges all believers in the sphere theory of astronomy to prove their theory, and dis-

The Old Town Pump

prove his claims that "the earth is a huge island, flat, so-called."

Unlike Mr. Bates, who claims to be the only authority on the flat earth theory, Mr. H. M. Tozer, 8 Victoria Road, London, S. E. 19, England, says he is only a keen student of the same theory. He wonders, he says, how people can go on asserting that the earth is a ball, when there is so much evidence against it, and then proceeds to cite various evidences.

Come now, all ye who dare risk being proselyted to a flat earth theory, and write to Messrs. Bates and Tozer. But please, kindly, leave us out of it; we have our regular job to attend to, and to keep out of an



Longitudinal section of pump

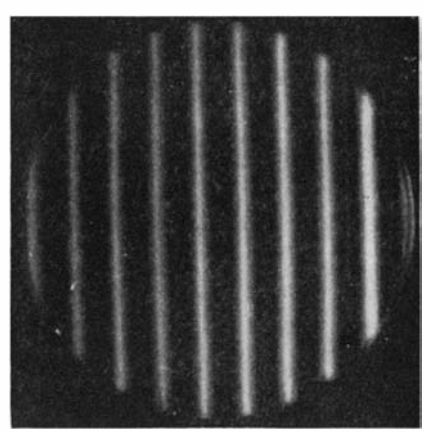
argument we would almost agree that the earth is a huge island, flat!

IN the February, 1934, number we published a discussion of photo-electric telescope guiding, by L. Jackson Bulliet, and followed this up in July and August, 1934, with contributions by Messrs. Silvertooth and Barkelew, respectively. Mr. Bulliet has been working on the problem, in the meantime, and while he does not claim to have solved it—a formidable task, we fear—he does send in an interesting progress report.

"Upon my return to Indiana University in the fall of '34," he writes, "I adopted this matter as the problem for my master's thesis, and immediately banged into the trouble predicted by Mr. Kirkham—star light is so exceedingly feeble that only the most sensitive photo-cell can be considered for use, and this must be supplemented by remarkably powerful current amplifiers. I soon saw that our research budget would not permit buying four cells and four amplifiers. However, I saw I could cut it down to one of each by confining the operation to drift in right ascension. This is permissible in stellar photography, since the north-south drift may be entirely cut out by careful orientation of the polar axis. Of course this precludes using the machine on comets and planets which drift appreciably in declination.

"Having decided to stick to right ascension (or clock inaccuracy) guiding, I saw that the drive clock could be deliberately set ahead or behind sufficiently to mask the irregularities of going, and thus always give a net drift in the same direction. Hence we can use one cell and have it energized whenever the star image drifts off a knife-edge in the focal plane—it won't drift the other way.

"Well, I built such a machine, using a special cell made by Dr. Kunz of Illinois University and General Electric's FP-54 amplifier tube—33 dollars each for these two pieces. It seems to be sensitive enough to respond to the very brightest stars, but there is always a little erratic current of about the same order of magnitude as the cell current. So the arrangement is not yet ready to use for photography. I am still



Sweetest Ronchi bands we've seen

hopeful of increasing the sensitivity, but find my time limited by my duties as assistant in the department. I have delayed writing, in hope that I might have definite positive results to report, but decided to let you know that I am still plugging away at what I still think is an important problem."

HERE is a hot one! It seems that R. W. Porter and Byron L. Graves (A. T. M., 136,358) were standing on a street corner in Los Angeles talking about telescope making and mirrors in general, and Graves was frequently using the expression "surface of revolution." The next thing that happened was a sudden descent on these two bewildered optical enthusiasts by a police radio car with a small riot squad. It appears that some woman, passing by while they talked, had breathlessly notified the police that "two desperate looking characters were plotting a *revolution*,—she had heard them—right on the streets of Los Angeles!" O, California! O, Los Angeles!

THE SCIENTIFIC AMERICAN DIGEST

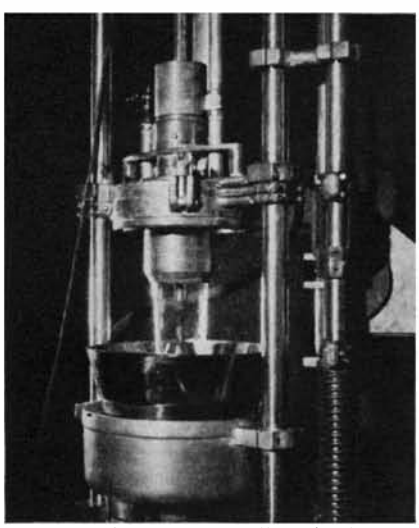
(*Continued from page 262*)

especially in the fall, winter, and spring months. An important prerequisite in the choice of food for incorporating vitamin D is that it be consumed regularly and in considerable quantity in the usual diet throughout the year.

Examples of foods not warranting fortification with vitamin D are sausage and ice cream and such accessories as chewing gum.—*From a general decision and report of the Committee on Foods, American Medical Association.*

Ultra-Violet Treatment of Milk

ULTRA-violet light is known to increase the vitamin-D potency in milk. Experiments have been made in this direction by giving dairy cows regular treatments of ultra-violet. Instead of irradiating the cow, however, the latest procedure is to irradiate



Set-up for treating milk with ultra-violet, showing the water cylinder

the milk, the process being accomplished very rapidly by passing the light through a thin film of milk as it flows through the device shown above.

The irradiator consists of a carbon arc, the carbons having a motor-controlled feed. Around the carbon arc is a cylindrical film of flowing water, about .008 of an inch thick. This film of water is gas-tight and serves as a chimney for the fumes of the flaming arc. Surrounding this water-film chimney, the milk film, also .008 of an inch thick, issues from a slot. The milk is thus exposed to the ultra-violet light for but a fraction of a second, as it flows swiftly by. Capacity is controlled by a positive feed pump, and for standard vitamin-D potency is 4000 pounds of milk per hour.—*A. E. B.*

Washable Elastic Webbing

YOU may expect to find your pet windbreaker or bathing suit or golf slacks styled with elastic webbing this spring for

extra comfort and perfect fit. "Stretch-Tex," a new and improved type of woven elastic webbing which can be dry-cleaned safely and can "take it" in the laundry has been developed by the American Mills Company. The web is made with cut rubber thread and processed to insure resistance to perspiration, salt water, and sun. It has been subjected, according to Norman A. Cook, to exhaustive tests for strength, ageing, resiliency, dry-cleaning and laundering by the Pittsburgh Testing Laboratories and American Laundry Institute. Considering the ingenuity of stylists and designers we will now probably find elastic webbing where we least expect to find it.

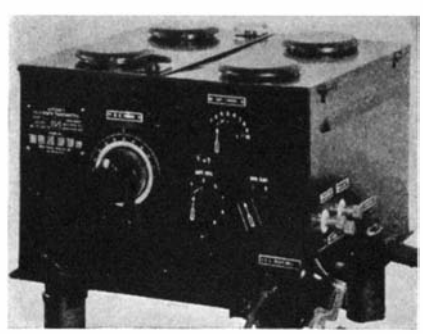
FIFTH PLACE

PAYING its way in a hurry, aluminum has attained in 44 years fifth position among metals in point of use and volume produced. The first four—iron, copper, lead, and zinc—have been developing for centuries.

15-Pound Aircraft Radio Transmitter

A NEW long distance radio telegraph transmitter weighing only 15 pounds and delivering a nominal 75 watts of continuous-wave radio-frequency power to the antenna, has been developed by Westinghouse. The new CH transmitter operates on frequencies ranging from 333 kilocycles up to 10,000 kilocycles by means of plug-in coil assemblies. This provides for operation with marine stations, including ships at sea, as well as operation on the aviation communication bands.

The set operates from the 12-volt battery system of the plane through a dynamotor. The plate supply voltage of 500 utilized for a transmitter of this power, as compared



Light-weight airplane radio set

with 1000 volts usually employed, is a decided advantage for reliable operation under various climatic conditions.

The dynamotor is purposely designed for aircraft service. It is unusually light in weight although ruggedness has not been sacrificed. The use of magnesium alloy castings combined with careful design has resulted in a machine of 13½ pounds weight capable of delivering 150 watts of 500-volt power to the transmitter.

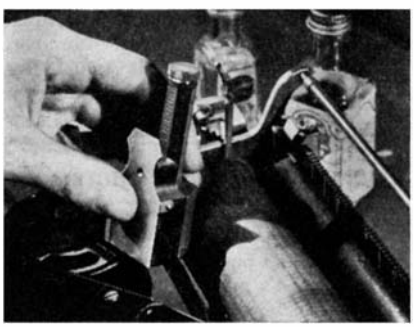
The equipment is of splash-proof construction. Provision for ventilation and cooling of the transmitter is by means of louvres in the sides, small openings in the bottom, and suitable drip-proof ventilators

at the top. The dynamotor unit is totally enclosed.

The shockproof unit for the transmitter consists of four molded rubber cylinders contained in removable aluminum cans, these units being attached to the under side of the transmitter sub-base plate. The shockproof unit is designed to screw or bolt securely to the mounting board in the plane. A plug-in power connector block is utilized to bring all input power and control circuits to the transmitter.

To Renew Typewriter Ribbons

ANY business man whose office force uses a large number of typewriters well knows the appreciable expense made necessary by the constant purchase of new typewriter ribbons. In the past, numbers of devices have been developed using various kinds of solutions to renew the brightness of color in old ribbons and thus prolong their life.



Renewing typewriter ribbons

A new one which has just come to our attention, and which, according to the records, has proved successful in extensive use already, was developed by the Ribbonew Corporation of America.

This new device consists of a small solvent container molded of Bakelite, through a side slot of which the typewriter ribbon may be passed while on the machine. It is only necessary to hold the device in position and wind the ribbon through from one end to the other once a week. It is claimed that such an application of the solvent will keep the ribbon in a soft and pliable condition, always ready to turn out sharp, bright, full color work.

300 Years of Chemistry

THREE centuries of chemical industry in America, dating from the early beginnings by John Winthrop, Jr., first governor of Connecticut, will be celebrated by the American Chemical Society at its 89th meeting in New York, April 22-26, 1935. The essential place occupied by chemical manufacture in the lives of the earliest white settlers on this continent, as well as in modern civilization, will be particularly emphasized. Chemical manufacture in the United States today produces in value more than 21 percent of that of all manufactures, and contributes to every activity of the people.

At this meeting, which is expected to be the largest gathering of chemists ever held in the world, will be presented more than 500 scientific and technical papers dealing with the latest advances in chemical science and industry. Co-operating in arranging for

this huge gathering are both scientific and industrial organizations in the field of chemistry. Many of the events connected with the program will be broadcast for the benefit of radio listeners.

Among the speakers will be such leaders of industry as Lammot du Pont, president of E. I. du Pont de Nemours & Company; William B. Bell, president of American Cyanamid Company; Thomas Midgley, vice president of the Ethyl Gasoline Company; such leaders of science as H. C. Urey and Irving Langmuir, Nobel prizemen in chemistry; and such leaders in public life as Senator Pat Harrison of Mississippi; Honorable James Wadsworth, Jr., Congressman from New York; and Francis P. Garvan.

NUMBER!

"Day Huey Bin She Ah," is what telephone operators say in China. It corresponds to our "Number, Please." Many people would like to "get the number" of our own Huey!

PUMPING BY ELECTRICITY FROM BOTTOM OF WELL

"IF we can't pull the oil out of deep wells, then let's push it out."

That, in few words, is the answer of Dr. Edward C. Ekstromer, of Los Gatos, California, electrical engineer, to petroleum engineers who seek to recover countless millions of barrels of oil deposited so far beneath the earth that present-day equipment cannot pump it economically to the surface. Producers have added length after length to their "sucker rods" until in many instances they were more than a mile long.

At that length, the rods represent a tremendous dead weight for the power plant to lift up and down at each stroke. Furthermore, the stretch in the rods wastes approximately half the stroke. The rods crystallize under the constant movement and in most deep wells have to be replaced at great cost and loss of time every few months.

Dr. Ekstromer set about to find a substitute for the "sucker rod" system. He solved the problem of putting the power at the bottom of the well by an ingenious arrangement of a series of small diameter, alternating current motors operating in unison, each delivering its quota of power. The number of units employed depends upon the depth of the well, which governs the power requirements. The motors and mechanical parts were enclosed in an oil- and water-proof cylindrical seamless-steel housing, approximately 35 feet in length with adequate lubrication for bearings for long periods.

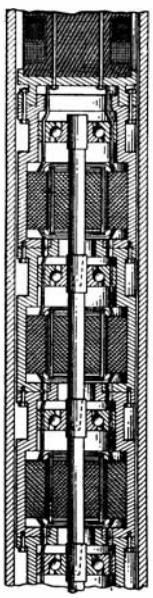
Within the assembly above the motor units is an epicyclic reduction gear mechanism for transmitting power from the motors to the driven worm-shaft at a lower speed. The complete unit will withstand and operate in high temperatures, a condition often prevailing at the bottom of deep wells. An ingenious ejector device expels unwanted liquid—water and oil—which, because of hydrostatic pressure, would otherwise leak through the packing gland into the chamber.

But even after a power unit had been pro-

duced which was sufficiently slender to be dropped to the bottom of the well, the whole problem was far from solved; the power thus created was centrifugal and no centrifugal pump has yet been devised to raise oil 5000 to 10,000 feet.

This seemingly impossible task was accomplished by converting the centrifugal power into reciprocal movement.

The motion changing device evolved consisted of a shuttle mechanism adapted to move with a reciprocating movement along a double threaded helix worm-shaft, as the latter is driven continuously in one direction. At each end of the worm-shaft, the movement of direction is automatically changed, with no perceptible interruption in torque being indicated on the electrical instruments placed in circuit. Thus, Dr. Ekstromer was able to deliver, at the bottom of the well, a reciprocating prime mover capable of furnishing a fixed stroke of the desired length to meet the requirements.



Right: **Compact motor unit assembly for use in pumping from the bottom of deep oil wells**

The submersible power unit makes possible recovery of billions of barrels of oil that cannot be lifted economically to the surface by standard rig equipment. The farther down the drillers go, the better the oil is, and the more there is of it. Oil experts say that within five years the shallow wells in this country will be a thing of the past. Then we will have to rely on the deep pools for our petroleum supply.

Non-Explosive Explosive

As explained in the article on Nitramon in our April issue, safety combined with high efficiency has been achieved in the development of this new blasting agent. According to informed opinion, it represents the most revolutionary advance of its kind since the invention of dynamite by Nobel.

Heating Nitramon with a blow torch to demonstrate safety of explosive

A rifle bullet tore through the Nitramon but did not detonate it

Oddly enough, Nitramon is not an explosive in the accepted sense of that term, even though it is capable of performing the same tasks as do high explosives. In fact, it has been conclusively proved that this particular blasting substance can be set off only by so powerful a primer as 40 percent, or stronger, dynamite; and at that it requires a dynamite cartridge of at least four-inch diameter and eight-inch length to detonate a cylinder of Nitramon four inches in diameter. In other words there is need not alone for intensity of shock, but also for volume. Of course, where a number of cans of Nitramon are loaded in a continuous column in a quarry bore hole, only one dynamite charge is necessary since the "explosion wave" will propagate detonation of all cans successively.

At the time we obtained material for our brief note last month, pictures were not available. Since then we have obtained photographs showing the non-explosive effect of a high-powered rifle bullet when shot through the can, and of "cooking" Nitramon with a blow torch. These are shown on this page as effective proof of the claims that no amount of rough handling can cause an accidental explosion of Nitramon and thereby endanger lives or property.

Already Nitramon has proved its value for such important work as quarrying, stripping rock from coal deposits and for some other industrial blasting operations in the open. It is not, however, intended for use in mines other than open pit.

Hunger Gets Less

Hunger is often more pronounced just before a regular meal than after a fast of 24 hours or more, Dr. Robert N. Sanford found in research at the Harvard University psychological laboratories.

Observing the reactions of the human mind under various degrees of hunger, he found that the "food habit," food appetite, and biological requirements of the body in many cases were more important factors

than the passage of time in determining a subject's attitude toward food.

According to the results of his experiments on more than 300 students from Harvard, Radcliffe, and Simmons, the passage of a long period of time tends to decrease rather than increase hunger, with most acute hunger present just before a regular meal. Two hours after the meal, hunger decreases about 50 percent, he found, and even from eight to 24 hours after eating, food interest is still less than just before a scheduled repast.—*Science Service.*

Du Pont Profits More in Peace than War

REPLYING to insinuations of magazine articles, newspaper comment, and Senatorial investigations, that the munition makers foment war for their own private gain, President Lammot du Pont of E. I. du Pont de Nemours and Company, leading smokeless powder manufacturer in the World War, has issued a statement pointing out the fallacy of such contentions. He states that "the du Pont Company does not want war and has vastly more to gain from peace. Not only the strong natural sympathies of its management, but also the plain business interests of the company lie overwhelmingly in the direction of the continued maintenance of world peace."

In support of this declaration, the company's remarkable expansion of its activities in recent years to include practically the whole range of chemical manufactures is pointed out. "In contrast to its original position as distinctly a gunpowder producer," states President du Pont, "the du Pont Company today is essentially and chiefly a manufacturer of products having no relation to war." "Duco," "Cellophane," "Pyralin," "Fabrikoid," rubberized fabrics, pigments and heavy chemicals, rayon, dyestuffs, and many other lines are cited among the examples.

In the company's annual report for 1933, its stockholders were informed that "its Smokeless Powder Department, in which are included sporting powder as well as the military propellants which constitute the great bulk of all military explosives, ranks now tenth and last among the ten manufacturing departments and subsidiaries which make up the company's business, both in amount of capital invested and in volume of sales." It is added in this statement that the "total profits earned by the du Pont company on military explosives of all sorts over the past ten years have amounted to only about 2 percent of the company's total manufacturing profits." Thus, the peacetime products of the company now outweigh its total military explosives business in the proportion of about 50 to one. —*A. E. B.*

FOREIGNER?

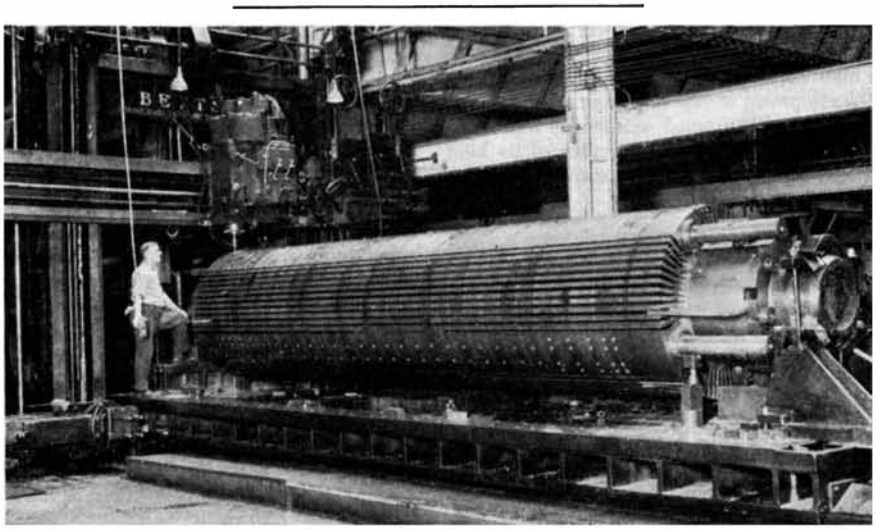
THE so-called French type of telephone was invented by Robert G. Brown of New York City and patented by him in 1880. France happened to adopt it before we did; hence the anomaly.

Germs Drift in Air for 48 Hours

A SCIENTIFIC discovery which holds promise of revolutionizing accepted theories on the possibility of certain respiratory infections being air-borne, has been made by William F. Wells, instructor in sanitation at the Harvard University School of Public Health. The discovery lies in positive evidence that minute droplets expelled in coughing, sneezing, or even in talking, do not fall immediately to the floor, but evaporate and may leave behind infective germs which drift about alive in the air for many hours.

According to previous theories, these droplets fell immediately, due to gravity, within a few feet of their source. Accordingly, the range of possible infection was assumed to be very small, it being believed that the germs must be inhaled directly as they fell for transmission.

Mr. Wells points out that the most significant feature of his work is the distinction between large and small droplets. The larger do, of course, fall to the ground, as has been known for the past 40 years, but the smaller ones, more minute than finely



This huge rotor, shown in the Westinghouse shop, will be part of the world's most powerful single shaft generator—rated at 183,333 kv-a, 13,800 volts, 3 phase, 60 cycles—to be driven by a 1800-rpm turbine. The 26-foot, 250,000-pound rotor is made up of 60-inch disks and end forgings held together by bolts, the 13-inch center bolt, of a strong alloy of nickel-molybdenum-steel, weighing six tons

Air-conditioning may be one reason why the N.B.C. photographer obtains such good pictures of radio stars. Despite the heat from the battery of lamps used to obtain satisfactory lighting, the Westinghouse unit (left) in one of the studios in Radio City, New York, keeps the air cool and the posing artists comfortable

granulated particles of sugar or sand, never reach the floor at all.

Evaporating almost instantaneously, they leave behind tiny "nuclei," so small they are easily carried about by the lightest air currents. Some types of germs, it was found, remained alive for several days, while others died in less than an hour. The infective danger from the spread of germs in this manner is, of course, limited by their respective rates of survival or viability.

Experiments on the longevity of various kinds of germs showed wide differences. Of special hygienic significance, says Mr. Wells, is the difference in viability between respiratory and intestinal bacteria. While none of the intestinal organisms was found alive after eight hours, four respiratory organisms were recovered alive after 48 hours' suspension in air, including the deadly carrier of pneumonia and the source of diphtheria and scarlet fever.—*Science Service.*

OIL

CONSUMPTION of petroleum in the United States is twice that of water. Each day enough oil is pumped from the ground to cover Manhattan Island—12 miles long and averaging a mile wide—to a depth of a foot and one half.

HYBRID POPLARS

IN a report recently published by A. B. Stout of the New York Botanical Garden, and E. J. Schreiner of the Oxford Paper Company, the following statement was made relative to the hybrid poplars discussed in our March issue:

"The work of breeding poplars reported . . . was conducted under the auspices and with the financial support of The Oxford Paper Company and with the co-operation of the New York Botanical Garden. The project was initiated by The Oxford Paper Company in the spring of 1924 chiefly through the interest of Professor Ralph H. McKee who was then in the employ of the company as the Director of Research. Professor McKee gave his hearty support to the plans and methods of work developed by the authors."

It is with pleasure that we give this additional credit for the work that has been done in hybridizing poplars. Incidentally, in response to numerous requests that have come to us for the names of commercial nurseries from which these poplars might be obtained, Dr. McKee explains that while the research was completely successful, sufficient stocks of the hybrids are not yet available for commercial distribution.

NEW BERYLLIUM-NICKEL ALLOY

A NEW beryllium-nickel alloy, recently announced, can be heat-treated to produce a Brinnell hardness of 460. It is said to be capable of holding a sharp cutting edge. The material is resistant to intergranular corrosion in contact with mineral acids. Fully hardened, the alloy has a tensile strength of 260,000 pounds per square inch, and an elongation of 8 percent.—*A. E. B.*

LEARN TO KNOW THE EDIBLE MUSHROOMS

NEWSPAPER accounts of poisoning following the consumption of certain kinds of wild mushrooms have called forth a warning from Professor F. C. Stewart, botanist at the State Experiment Station at Geneva, New York, and a widely recognized authority on mushrooms, that one should distinguish between edible and poisonous mushrooms as clearly as one does between peas and beans or other plants. This is not difficult to do, for most of the mushrooms found in the woods, pastures, and lawns of New York state are quite edible and might well form a welcome addition to the menu, declares this authority.

Prof. Stewart has prepared a brief circular entitled "How to Know the Mushrooms and Toadstools" in which he makes an effort to acquaint the reader with the

commoner forms of wild mushrooms found in New York, and especially to set forth the chief features by which the poisonous kinds can be readily identified in the field. A copy of Prof. Stewart's circular may be obtained upon request to the Experiment Station.

"The only safe way to utilize wild mushrooms is to learn to recognize the edible and poisonous kinds at sight, just as one recognizes peas and beans and poison ivy," says Prof. Stewart. "One must learn to recognize at sight each kind of fungus which he eats and never eat anything which he does not know." He also condemns the various edibility tests and "signs" indulged in by some so-called "authorities" on mushrooms as being wholly unreliable and likely to result in serious difficulties.

Preliminary Shelter-Belt Plantings

ONE hundred and fifty miles of shelter belt planting in the drought area, the *Forestry News Digest* announces, will be made by the United States Forest Service in the near future.

There will be 30 planting areas each about five miles long. These will be divided between six states—North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas.

Approximately four million trees will be required, one hundred thirty-nine thousand for each planting. These trees will be obtained from nurseries in the drought region.

It is estimated that 140 man days' work will be required for each mile, or a total of 21,000 man days for the entire 150 miles of planting.

The work will include nursery production, ground cultivation, fence construction, and so on.

There are now, in sections of the drought area, a great many windbreaks, some of them 50 years old, says Charles Lathrop Pack, president of the American Tree Association. These have demonstrated their usefulness for many years, and in many instances farmer owners of these windbreaks have gathered good crops on the lee side of them despite prevailing dry conditions.

It is roughly estimated that of the trees planted in the drought areas of the middle west including windbreak, shade tree, and general planting, about 50 percent have survived. It is believed that greater care in selection of species for such plantings will increase, considerably, the number of trees that will thrive and live. The Forest Service experts have secured the best information possible to enable them to determine the best trees to plant under different soil, wind, and rainfall conditions.

In sections of the middle west, swamps which have been drained in years past in order to increase farm areas are now being restored to natural conditions by construction of dams. After these swamps are again filled they will aid in increasing humidity and also be of further value in restoring feeding grounds for migratory birds.

Plans for the shelter belt planting are being completed rapidly, and it is expected to start as soon as the weather makes it possible.

Various species of trees and shrubs to be used in the shelter belt plantings will be approximately as follows:

On the outside rows will be planted caragana, choke cherry, haw (buckthorn), buffalo berry, sumac, willows, lilacs.

The rows next to the outside rows will consist of Russian olive, plum, willows, Russian mulberry, osage orange, and apricot (pistacia).

The rows half way between the outside rows and the center row will comprise willows, red cedar, Austrian pine, Chinese arbor vitae, and Arizona cypress.

The rows next to the center rows will comprise green ash, American elm, Chinese elm, burr (post oak), hackberry, willows, honey locust, black Texan walnut, black locust, chinaberry, and pecan.

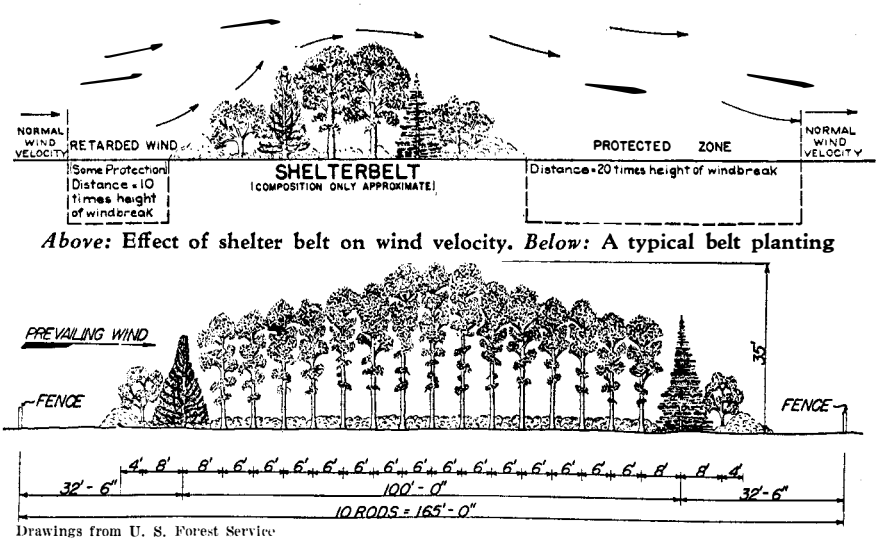
The center rows will be composed of cottonwood, willows, and black locust.

A Modern Jo-Jo

A SO-CALLED "dog-boy," like the famous Jo-Jo exhibited by Barnum many years ago, is living in the city of Kharkov, U.S.S.R.

The child is entirely covered, face and body, with long blond hair having somewhat the texture of goat hair, coarse and a little wavy. He is being studied in the children's hospital and clinic in Kharkov.

The child is now four years old and, according to the last report, is in good health except for a case of rickets for which he is being treated. He is normal mentally as well as physically. Both parents and the boy's older sister are normal in



Above: Effect of shelter belt on wind velocity. *Below:* A typical belt planting

Drawings from U. S. Forest Service

every respect and no similar condition has occurred in any member of the family on either side, so far as the parents know.

The condition is known to scientists as hypertrichosis universalis. It is a congenital defect like harelip and is thought to be due to an arrested development of certain structures of the body. The first hair coat, which covers the body of a child before birth and is usually shed soon after birth, persists in cases like this of the Russian lad. The development of nails and teeth may also be

Below: **Portrait of the modern Russian Jo-Jo.** *Right:* **Hairy covering of the body, a congenital defect**

faulty and one authority questions whether such persons ever get a set of permanent teeth.

The condition is very rare. Perhaps not more than 30 unrelated families having it are known. Most of the cases have been reported from Russia. In the Russian cases the hair was light, while in cases reported from India the hair was dark. Previous studies show that once the condition appears, it will very probably appear in the next generation.

The Kharkov boy's chances of making a living by appearing in circus sideshows is slim, because the Soviet Union does not countenance exhibitions of this sort.—*Science Service.*

Canned Beer

ALTHOUGH "rushing the growler" was a popular pastime in pre-prohibition days, it is a far cry from the old tin can to the modern can in which beer is being sold. Canned beer was introduced recently after several years of investigation by American Can Company, and has become a commercial possibility through two important can-making developments: (1) A can able to withstand an internal pressure of about 85 pounds per square inch; (2) a special inside enamel called "Keglining" by the can company. Other equally important parallel developments were the special beer-can-making machinery and the special method of opening the cans.

A wholly new type of body seam and can end has been worked out, to insure the strength of the beer can against the high pressure of carbon dioxide which is in beer under summer heat without refrigeration. Although the new can body has been ready for some time, the appearance of canned beer on the market had to await the development and testing of proper interior enamel which in character and appearance is a marked departure from traditional enamels.—*A. E. B.*

GALLONS AND GALLONS!

MORE water than is used in the cities of Detroit, Cincinnati, and Washington, D. C., combined is consumed daily in the River Rouge Plant of the Ford Company. The plant's consumption averages 525,000,000 gallons daily.

Photos on Aluminum

A NEW photographic process for reproducing pictures, designs, maps, wood grain, or anything of a similar nature on aluminum has just been announced from Germany. Both the process and the resulting products are remarkable in a number of ways. It is the first time since the invention of photography that an inorganic colloid, aluminum oxide, is used as a carrier for light-sensitive substances.

The SEO process, as it is called, consists of exposure and the development, fixing, and toning operations which are common in photography. However, there is no organic carrier-coating as there is in photography and therefore the SEO photos are more durable. At the same time the oxide coating which is achieved protects the underlying metal against mechanical and chemical influences. It becomes corrosion-proof.

SEO photos are light-proof, weather-proof, water-proof, and fire-proof; in fact, they are fire-proof to such an extent that, after the melting of the aluminum at about 1200 degrees Fahrenheit, the SEO coating does not melt and remains visible and readable. Alcohol, ether, benzol, and other

liquids cannot damage the surface of these photos.

It is suggested that this process may be used for signs and instruction-plates for machines and other devices, wiring diagrams, dials of all kinds, scales for measuring instruments and slide rules, for advertising purposes and for novelty articles; also for maps and plans in public buildings, railroads, or subways, as well as for imitation panels of wood, marble, and other materials.

Swedish Parliament Voting System

THE Swedish Riksdag, or National Parliament, which is 500 years old, has installed a modern electric voting system.

Thanks to this new device, designed and manufactured by the L. M. Ericsson Telephone Company, of Stockholm, the votes of the 150 members of the Senate, or First Chamber, are accurately counted in 20 seconds, and those of the 230 members of the House, or Second Chamber, in 30 seconds.

The voting procedure is as follows: After the Secretary has read the bill in question, the Speaker announces that voting will take place, and presses the button on a control apparatus on his desk. This clears the system. On the desk of each Riksdag member are two buttons, one for voting "Aye," and the other for "Nay." Depending upon the way he votes, the member presses one of the two buttons; if he does not want to vote he presses both buttons. Each button needs to be pressed only a second, and once it is touched the voting cannot be changed to anything but "Not Voting," by pressing the other button. In addition to these buttons, there is a small white lamp on each desk. This is lighted as soon as the member has pressed one or both buttons, indicating that his vote is properly registered.

On one wall of the octagon-shaped Chamber is a large panel, equipped with electric lights. This panel is, in effect, a chart of the room, indicating the seat of each member by means of a small square which bears his name. Above the name are four lamps of varying size and shades. The upper left lamp is large and green-colored, and stands for "Aye"; the upper right lamp is large and tinted red, and represents a "Nay" vote. The lower left lamp is small and white, and, if lighted, shows that the member has refrained from voting, while the lower right lamp is small and red, and stands for "Absent." According to the way in which each member votes, a corresponding light is immediately flashed in the square on the panel. Each vote can be clearly seen from any part of the room, even if the name of the voter cannot be read at a distance.

When the Speaker knows that the voting is finished, he presses the button on his control apparatus, after which no new votes can be registered, and no change made in already cast votes. He then touches another button, upon which the automatic tabulation of the votes begins. Almost instantaneously the result is shown in electric lights on two smaller panels, one on each opposite wall.

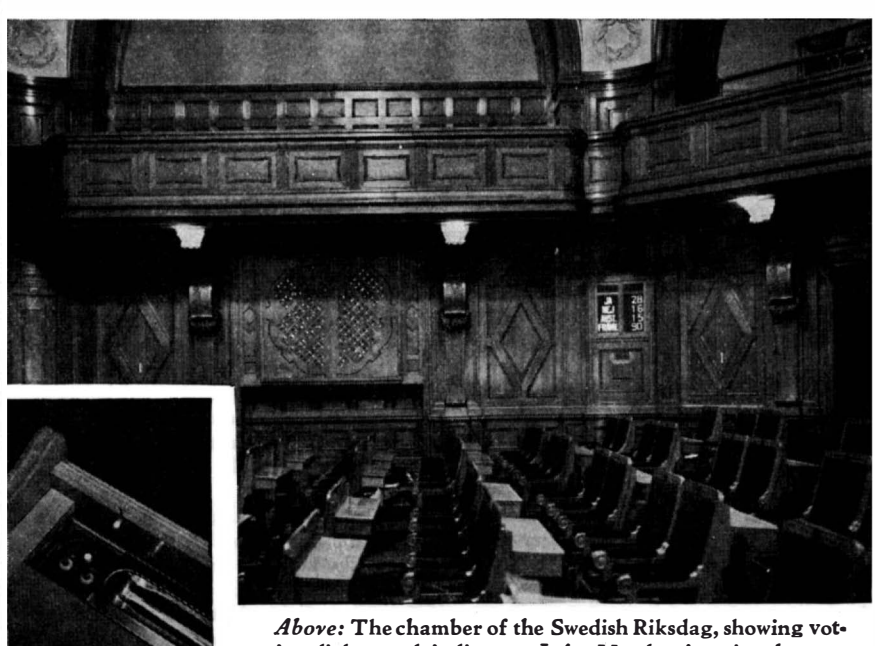
A permanent photographic record is made of each vote by means of yet another panel, a replica in miniature of the one which indicates the desk of each member and the way in which he votes. This is called the "Protocol Table," and is set in a cabinet equipped with a sensitive camera. On this panel all lamps are white, but their positions in their respective squares tell what kind of votes are cast. The film is exposed about one second, dated, and the subject matter of the bill written on a paper which is photographed simultaneously. The names of the voting Riksdag members are also recorded at the time. The film is then developed and the print is bound, serving as a basis for the official protocol.—*Holger Lundbergh.*

Key to Mayan Writing Discovered

THE key to the hitherto undeciphered Mayan writing, America's greatest prehistoric mystery, was handed to science by Prof. William Gates of Johns Hopkins University.

The Rosetta stone of the Mayan hieroglyphs now revealed is a 300-year old booklet by a forgotten Spaniard. In it are 40 Mayan signs translated into Spanish.

Now archeologists expect to go to the



Above: **The chamber of the Swedish Riksdag, showing voting lights and indicator.** *Left:* **Members' voting buttons**

A page from the 300-year old book that gives the key to Mayan writing

famous unread Mayan stela or calendar monuments that dot Yucatan and other Central American areas, and begin more successfully to unravel their unread history. Dates and figure signs have been known in the past, but the writing has remained stubbornly mysterious.

Among the 40 Mayan hieroglyphs identified by the Spaniard are: Light, life, hunger, treasure.

The booklet, just published by the Maya Society, is by a Spaniard named R. Gomesta who lived at the end of the Sixteenth Century in Yucatan. A statement in Gomesta's own handwriting in his book declared that he possessed ancient Indian hieroglyphic books and native friends who interpreted them to him.

The Gomesta manuscript explains another point moot among archeologists. A certain Mayan god, whom scientists have merely lettered as "God B," for want of positive knowledge of his identity, is explained to be the great Itzimná, God of Life, and not Kukulkan, the birdsnake.

The document directs important facets of light upon many other points, and contains some bits of strange and curious lore. There is, for instance, a recipe for making ointment from gum and tiger-grease to put on women sacrificial victims destined for the Sacred Well of Chichen Itza, in Yucatan. This unction was to keep their bodies from swelling afterwards in the sacred waters.—Copyright, *Science Service.*

Hundreds of 'Phone Calls on One-Wire Cable

A NEW cable containing only one wire, centrally located within the sheath, over which it is possible to transmit hundreds of telephone messages at one time, has been developed by the Bell Telephone Laboratories in New York City. This cable, which may profoundly affect future developments in long distance telephony and also provide a television channel "giving size and clarity of vision hitherto unknown," is known as the coaxial cable.

The wire and associated apparatus, it is said, permit the extension of frequency band widths up to and above one million cycles. This broad band of frequencies is divided into many bands 4000 cycles wide, each of which will provide a channel for satisfactory telephone communication. It can readily be seen that by means of this single coaxial conductor hundreds of voice channels can be obtained.

Since the cable can carry all the frequencies from zero to 1,000,000 cycles, or even higher, it makes possible a television channel of "reasonably high definition," communication engineers declare.

A telephone circuit requires two one-way channels, and since the coaxial cable will provide transmission in only one direction, two such cables will be necessary to provide for the customary two-way conversations. Sheaths ranging in diameter from three tenths of an inch to two and a half inches have been used in experimental work with the new invention.

ANTI-SCORBUTIC

CEVITAMIC acid comes forward to take the place of orange juice. This is the name coined for a new tablet used for treating babies with scurvy, and indicates an acid containing C vitamin.

Citrus Wines

WINE can be produced from citrus fruits at a cost of about 32 cents a gallon by a process developed by the Winter Haven (Florida) station of the Department of Agriculture. Made from culls, the wines are prepared by reaming the fruit on rapidly rotating burrs and then straining the juice and fermenting it with a pure culture of wine yeast. Corn sugar is added to increase the sugar content by about 25 percent.

The estimated cost of 32 cents is based on a price of 45 cents a field box for the fruit and a plant investment of 15,000 dollars.

The number of wines that can be made vary from light to heavy, and while these resemble sauterne, sherry, port, and other wines, they have their own characteristics and are not "imitations."—*A. E. B.*

Pepper Weevil Parasites

WHILE one division of the Department of Agriculture is trying to cripple Hawaii's sugar industry, another is receiving substantial co-operation from this same industry. The Hawaiian Sugar Planters Association is attempting to restrain Henry A. Wallace, Secretary of Agriculture, from applying the quotas set up under the Jones-Costigan Act on the basis that these quotas are discriminatory against an integral part of the United States. Under them, Hawaii's sugar sales to the mainland are seriously curtailed while the door is opened wide to Cuban sugar at a greatly reduced duty. But in spite of this situation, the experiment station of the Association is co-operating with the Bureau of Entomology and Plant Quarantine of the Department of Agriculture at Washington, D. C., in supplying parasites of the pepper weevil for experi-

mental purposes in connection with the cotton industry of mainland United States.

Entomologists for the Hawaiian Sugar Planters' Association discovered the parasite in Guatemala while searching for parasites friendly to the sugar industry, and sent several colonies to the Territory of Hawaii. The sugar industry had no particular use for the parasite, and the red pepper has no commercial importance in Hawaii, but following its general policy of extending aid to miscellaneous agriculture in other parts of the United States, the H. S. P. A. experiment station reported the discovery to Washington.

At the request of Lee A. Strong, chief of the federal bureau, colonies of the parasite are to be sent to the Riverside experiment station in California. The pepper weevil is related to the boll weevil, and experiments will be made on the theory that its parasite may possibly have some effect on the cotton boll weevil.

DIGEST OF AVIATION

(*Continued from page* 242)

formed by the compass bowl and the float respectively. As the float turns, a resistance bridge insures that a current proportional to the angular movement of the compass is produced. This current in turn controls a system of valves admitting oil under pressure on either side of a double acting piston. As the piston moves back and forth, it controls the rudder through a safety spring coupling. This coupling enables the pilot in emergency cases to over-ride the action of the automatic pilot. A similar system is employed for the ailerons, although here a pendulum unit with electric connections gives the initial guidance.

For the elevator control a pitot tube is connected to a diaphragm. When the pressure on the pitot tube increases unduly, the diaphragm so acts that the nose is raised and too steep a dive is prevented.

This, however, does not end the possibilities of the robot, which includes a course setter and a course indicator which are connected with the telecompass. It also provides a rate-of-turn selector which enables the aircraft to make turns of different radii automatically. There is also included an automatic engine speed control. This consists of a small electric motor actuated by a statoscope or rate-of-climb indicator. If altitude is lost, the throttle is automatically opened up by the controller until the altitude for which control has been set is regained.

The Siemens Autopilot has been flown for hundreds of hours, and while no information is given regarding the degree of efficiency in gusty weather, it is claimed that in calm weather the direction is maintained to within plus or minus 2 degrees, the speed within plus or minus 2 miles per hour and the altitude within a pressure range corresponding to only one millimeter of mercury.

A drawback, besides complexity, seems to lie in the weight of the apparatus, which is 275 pounds. The makers respond to this objection by saying that when there is an Autopilot on board there is no need to carry a second pilot, so that the weight of dual controls, a second parachute, and so on, may be avoided.

CURRENT BULLETIN BRIEFS

SUPERVISION EXERCISED BY STATES OVER PRIVATELY CONTROLLED INSTITUTIONS OF HIGHER EDUCATION, by John H. McNeely, gives specific information on the subject and analyzes laws in force regarding such supervision. Bulletin, 1934, No. 8. *Superintendent of Documents, Washington, D. C.—10 cents.*

"FLEX-SET" PREFORMED YELLOW STRAND WIRE ROPE gives information about a newly developed type of wire rope and shows how and why it is superior to other types of cable. Well illustrated and replete with test data. *Write for Bulletin 535A to* SCIENTIFIC AMERICAN, *24 West 40th Street, New York City.—3-cent stamp.*

THE PORT OF PORTLAND COMMISSION. Biennial Report 1933-1934. A book of interesting facts and figures regarding the present status of the Port of Portland and the development work which has been carried out. Several photographs and maps are of particular interest. *The Port of Portland Commission, Portland, Oregon.—Gratis.*

HOW GOOD ARE YOU AT TWISTING AND BENDING? is the title of a little booklet describing a new type of finish for metal which resists stresses of twisting and bending to a remarkable extent. Samples included in the booklet permit the reader to see for himself just how good this new type of metal finish really is. *Write for Bulletin 535B to* SCIENTIFIC AMERICAN, *24 West 40th Street, New York City.—3-cent stamp.*

ANNUAL REPORT OF THE CARNEGIE ENDOWMENT FOR INTERNATIONAL PEACE, by Nicholas Murray Butler, Director. This report, covering the work during 1934, is world-wide in scope and concludes with a final report of the Institution. *Carnegie Endowment for International Peace, 405 West 117th Street, New York, N. Y.—Gratis.*

"FULSCOPE" TEMPERATURE CONTROLLERS is something more than an ordinary catalog of indicators. It gives much information on various types of recording instruments for temperature and pressure, and illustrates several special purpose types. *Write for Bulletin 535C to* SCIENTIFIC AMERICAN, *24 West 40th Street, New York City.—3-cent stamp.*

PULLMAN ACCOMMODATIONS tells the story of the services rendered to the traveling public by the Pullman organization. Beautifully illustrated with color plates showing the various types of accommodations available. *The Pullman Company, 79 East Adams Street, Chicago, Illinois.—Gratis.*

RESULTS OF A PROJECT IN HYBRIDIZING POPLARS, by A. B. Stout and E. J. Schreiner. Here is an excellent follow-up of our article entitled "Poplars of Promise" which appeared in the March issue. Much technical data is given. Illustrated with striking photographs. *New York Botanical Gardens, New York City.—Gratis.*

Books SELECTED BY THE EDITORS

(*Continued from page* 227)

Cornell University, and for the average intelligent lay reader they will seem neither heavy (with a single exception, which is a bit tough) nor light-weight. This book has plenty of meaty substance, and is an outstanding work which presents a true Eddingtonian cross-section of the problems which are occupying the minds of the world's physicists today. —$3.20 postpaid.—*A. G. I.*

GEMS—HOW TO KNOW AND CUT THEM

By H. L. Thompson

THIS little book contains instructions for cutting gem stones in the home lapidary, and it is practical. All amateur gem stone hobbyists should own a copy of it.—55 cents postpaid.—*A. G. I.*

YOU CAN FIX IT
An Encyclopedia of Home Repairs

By John and Enid Wells

IS your cellar damp? Has your radio gone "haywire"? Does your heating system work properly? Is your washing machine out of "kilter"? Then you need this book. In fact, if any of the thousand and one minor or major troubles around the home fall to your lot for repair, you will find in this 480-page book information on how to fix it; and furthermore, not only how to fix it but, what is often more important, how to locate the trouble. A novel arrangement of chapters is of great assistance in locating any particular piece of information. In many of the chapters there is a "Manufacturers' Section" which gives information on specific types of household equipment. It is impossible in a short review to do justice to the vast range of material covered by this book. All we can say is that it starts out to do a job and does it well.—$2.70 postpaid.—*A. P. P.*

THE SPIRIT OF CHEMISTRY

By Alexander Findlay, Professor of Chemistry, University Aberdeen

"THIS book has been written as a text-book for those students, more especially, who, in the Universities of Great Britain and in the colleges of the United States, in increasingly large numbers, pursue a course in chemistry as an element of general culture rather than as a part of their professional or technical training. Its form and content, therefore, have been chosen so as to make appeal to the imagination and intellectual interests of those who are not destined for a scientific career, but who desire to understand something of the intellectual progress of recent years and to gain some knowledge of a branch of science on which much of our present-day civilization is based."

We find that the author's own description, quoted above from his preface, accurately describes his book, and that this is the kind of book which perhaps best suits the reader who wishes to study chemistry by himself. It is authentic, accurate, solid, meaty, not superficial, yet much more readable than the typical class-room text.—$4.25 postpaid.—*A. G. I.*

ALCOHOL AND ANAESTHESIA

By W. Burridge, D. M., M. A.

THIS little book contains discussions of the action of alcohol on the heart, brain and so on, and argues that alcohol, cocaine, and other drugs do not necessarily do harm even when used habitually. Its author is a professor of physiology. Readers who are physicians or psychologists will be able to grasp most of what he writes, others probably about half.—$1.00 postpaid.—*A. G. I.*

CANOEING WITH THE CREE

By Arnold Sevareid

A TRUE story of thrilling adventure on a 2250-mile canoe trip from Minneapolis to the Atlantic Ocean. Starting in June, two high school graduates made this trip, taking their obstacles as they found them; they battled many long stretches of winding river with the friendly Cree Indians, stopped at outlying Hudson Bay trading posts and for many, many days on end saw no one but themselves. The trip ended the following winter. This record of an amazing journey which had never been accomplished before is illustrated with a series of excellent photographs depicting graphically some of the trials and tribulations of the trip. This is a book which will be enjoyed alike by young and old—by anyone who responds to the thrill of outdoor adventure.—$1.65 postpaid.—*A. P. P.*

NEW LIGHT ON THE MOST ANCIENT EAST

By V. Gordon Childe, B. Litt.

THERE is a demand for a popular book which tells what is now known about the very early millennia in Egypt, Babylonia, Sumeria, and the remarkable new discoveries of an immense Sumerian civilization in India—all previous to the beginnings of written history—and this book by the professor of prehistoric archeology at the University of Edinburgh covers that relatively new ground. In some ways it is not a very satisfactory work. Whether due to the vagueness of our knowledge of these millennia, or to a casual kind of vagueness in the author's presentation of his material, or both, the reader may experience difficulty in deriving from the book a very clearly focused picture. Also, it is hardly a suitable book for "the man in the street," as the preface claims, unless the men in the streets have all previously studied the background of archeology; it reads more like lectures to specializing students. The subject matter dealt with is nearly all actual objects found; their historical interpretation is mainly missing in the book because still mostly missing from human knowledge. There are 301 pages and 134 illustrations. We recommend this book, in the absence of a better one.—$4.20 postpaid.—*A. G. I.*

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STARS

THE STARS FOR CHILDREN—*By* GAYLORD JOHNSON.

THIS book is a "sugar-coated pill" by means of which youngsters may be encouraged to learn a lot about astronomy without realizing it. The text is in story form but from end to end it is packed with solid facts. The illustrations are copious and attractive, as well as ingenious. Before passing this book to that boy or girl of 10 to 14, you will no doubt secretly read it yourself, and will pick up more practical elementary astronomy from it than you could learn from a textbook. We did.—$1.65 postpaid.

HOW TO IDENTIFY THE STARS—*By* WILLIS I. MILHAM, PH.D.

THIS little book gives practical instructions for learning the constellations. The method is the same as that used in the course in descriptive astronomy at Williams College, where the author is professor of astronomy. It contains 24 black charts of the principal constellations.—$1.65 postpaid.

PERSONALITY

WHY WE DON'T LIKE PEOPLE—*By* DONALD A. LAIRD

IT matters little how much you know, how good-looking you are, how much money you have, if you are out of tune with the people and things about you. If you are "maladjusted"—a social or business misfit—you can't go far in this world. The author has purposely written this volume in non-technical language so that the layman who has never had guidance in analyzing his own failures and shortcomings will find this book interesting and helpful. In the average case, will a man go farthest by (a) learning more facts, (b) working his head off or (c) discovering his own negative personality traits and extirpating them—in other words getting himself adjusted? Dr. Laird's newest book is based on the idea that (c) is the best bet.—$2.65 postpaid.

PHOTOGRAPHY

MODERN PHOTOGRAPHY WITH MODERN MINIATURE CAMERAS—*By* WILLIAM ALEXANDER

THIS book of 144 pages covers practically all branches of work that can be undertaken with the newer, modern, miniature cameras and accessory equipment. Those who use or who expect to use such equipment will find that it is full of ideas and suggestions that should be of great value when combined with the information given editorially in our pages recently. Besides chapters on the many fields in which photography may be used profitably by amateur and professional alike, there are technical chapters concerning chemical and optical problems of photography, exposure problems, cold weather troubles, rapid action photography, portraiture, enlarging and slide making, and the like. There is a chapter on accessories and their importance and one with the intriguing title, "By-Paths in Miniature Photography." This is an indispensable book if you consider following the vogue of the miniature camera. —$2.15 postpaid.

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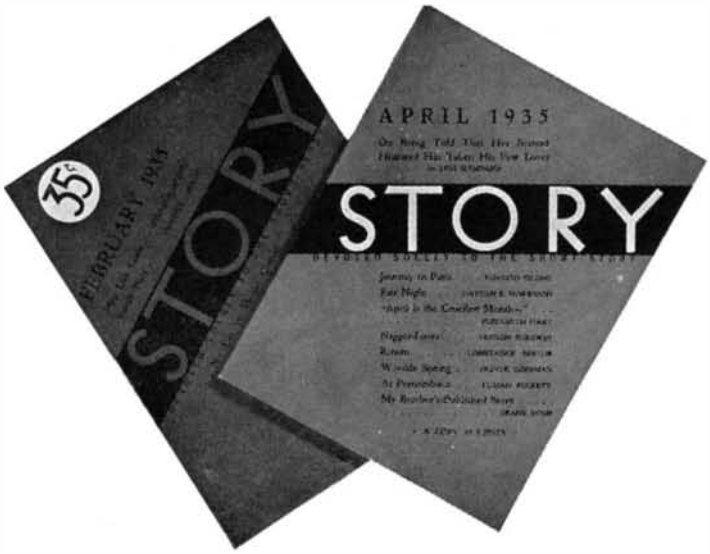

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