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SCIENTIFIC AMERICAN

September · 1937

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ROBERT YARNALL RICHIE

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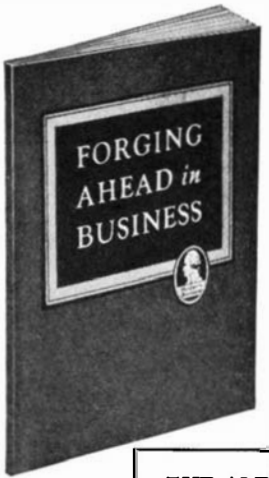

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SCIENTIFIC AMERICAN

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NINETY-THIRD YEAR • **ORSON D. MUNN, Editor**

CONTENTS · SEPTEMBER · 1937

SULFUR plays an important part in 70 industries. In the illustration on our cover, sulfur, 99½ percent pure as it is mined by the Freeport Sulphur Company, is being loaded on Mississippi River barges, ten miles from Grande Ecaille, Louisiana. Sulfur is melted out of limestone by superheated water under pressure, and forced to the surface in liquid form. To make production possible at Grande Ecaille, engineers perfected the "mudding" process, pumping 4,000,000 tons of mud into the wells to prevent the water from escaping through unusually porous strata.

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50 Years Ago in . . .

Scientific American

(Condensed From Issues of September, 1887)

BOONDOGGLE?—"It appears that the government is now employing three different scientific corps to investigate and report on one and the same matter, namely, the characteristics of genuine butter and its limitations. In the first instance, we have the division of microscopy of the agricultural department . . . then we have the division of chemistry of the same department . . . and lastly the office of commissioner of internal revenue, represented by a chemist and a microscopist."

CO_2—"The fiery, untamed soda-water tank, which has chiefly distinguished itself since the advent of hot weather this year by bursting and killing or maiming its attendants, has made a new departure, says *Fire and Water*, and now appears in the rôle of a most efficient extinguisher of fire. . . . Before a fire (in a drug store) could gain headway, the heat had melted the lead pipe connected with the newly charged soda fountain, and the flames were instantly extinguished."

LIGHTNING RODS—"If we are to believe an Austrian paper, says *La Lumière Électrique*, the first lightning rod was not constructed by Franklin, but by a monk of Seuftenberg, in Bohemia, named Prohop Diwisch, who installed an apparatus the 15th of June, 1754, in the garden of the curate of Prenditz (Moravia)."

SENEGALESE YACHT—"In these days of yachting we have thought it might be of interest to our readers to see what sort of a yacht they sometimes use in Ceylon. . . . The boats have in themselves no stability, having only about 8 inches beam, and are kept from capsizing by an outrigger. In the event of a heavy squall, when the outrigger is not sufficient for the preservation of stability, one of the crew acts as shifting ballast, and perches himself on the outrigger—this is called a one man breeze. A two man breeze is serious work. The construction of these boats enables them to run over the shallow reef water, and our sketch shows the passage of a river bar under sail, the boat being rushed through the 'white horses' at a rapid pace under the freshening gale. It is rather exciting work when, amid the green rollers on the bar, naught of the land can be seen in dipping save the tops of the cocoa nuts that fringe the shore. The Singhalese (*sic*) fishing boat has a graceful motion, but it is best admired from *terra firma*."

NAVAL MANEUVERS—"The recent maneuvers of the British fleet did little to encourage those who pin their faith to monster ships and heavy armor. Indeed, even the unbelievers in this type were scarcely prepared for the sorry spectacle presented by the mightiest fleet afloat, for in the Irish Channel, where Admiral Baird essayed to defend the shore line against the assault of Fitzroy, and again in the English Channel and North Sea, when Hewitt sought to pierce the line of Freemantle, the big ships proved at best both awkward and uncertain."

COIN PHONE—"The subscribers of the telephone line in St. Louis, says an exchange, do not pay a fixed subscription to the company, but merely the sum of five cents for each communication. . . . Above the transmitter there is a box containing a slit in the upper part. When the subscriber wishes to communicate with anyone, he places a five-cent piece in the slit and takes the receiver from its hook. The coin, in sliding, closes a circuit, a call is made at the central office, and the subscriber can talk as long as he pleases, either with the office or another subscriber."

RUBBER BELTS—"The high standard of efficiency which can be realized by the employment of strictly first-class rubber belts is now receiving merited recognition from users who have had them in severe service for many years, and whose experience cannot fail to be of value to all mill owners and furnishers of factory equipments. . . . In the picture may be seen a belt 2,700 feet long, recently made for the Pennsylvania Railroad Company, and in use in one of their grain elevators in Jersey City. This belt is used to convey grain from one end of the immense building to another, the grain being delivered upon the belt from another belt. . . . The belt runs on small rollers, and there is a simple form of tightener at the ends, by which it can be readily kept straight and even."

ICED FISH—"In the United States ice was first used for the preservation of fish about the year 1842, and in 1845 fishing vessels began to take ice to preserve their catch. At first they were careful to keep the ice separate from the fish, piling it in a corner of the hold, but they soon began packing the fish in broken ice. The inland trade in fresh fish had, up to that time, been very limited, but soon increased, and it was not many years before boxes of fish packed in ice were shipped far inland."

SCARLET FEVER—"Drs. W. Allan Jamieson and M. Alexander Edington, of Edinburgh, announce, in the last *British Medical Journal*, the discovery of a specific bacillus of scarlet fever. The micro-organism has been isolated, cultivated, and put through its paces generally, coming out, apparently, with a specific character."

ICE LENSES—"The London correspondent of *Le Moniteur de la Photographie* writes to that journal that in the middle of the winter which has just elapsed a student made a lens of ice, with which he lit the pipes of some of the skaters on the Serpentine by means of the solar rays, an experiment, he says, which was first performed in the polar regions by Dr. Scoresby, to the great astonishment of the sailors, for they could not understand why the ice did not freeze the beams of the sun."

BRICKS—"Enameled or glazed bricks, for outside or interior decoration, are made by applying to the surface a flux, which, during the burning, causes the silex to melt and form a vitreous covering. Such flux is easily colored, and thus very beautiful fancy bricks are produced."

AND NOW FOR THE FUTURE

¶Turbines: Most efficient steam power plants today. By Philip H. Smith.

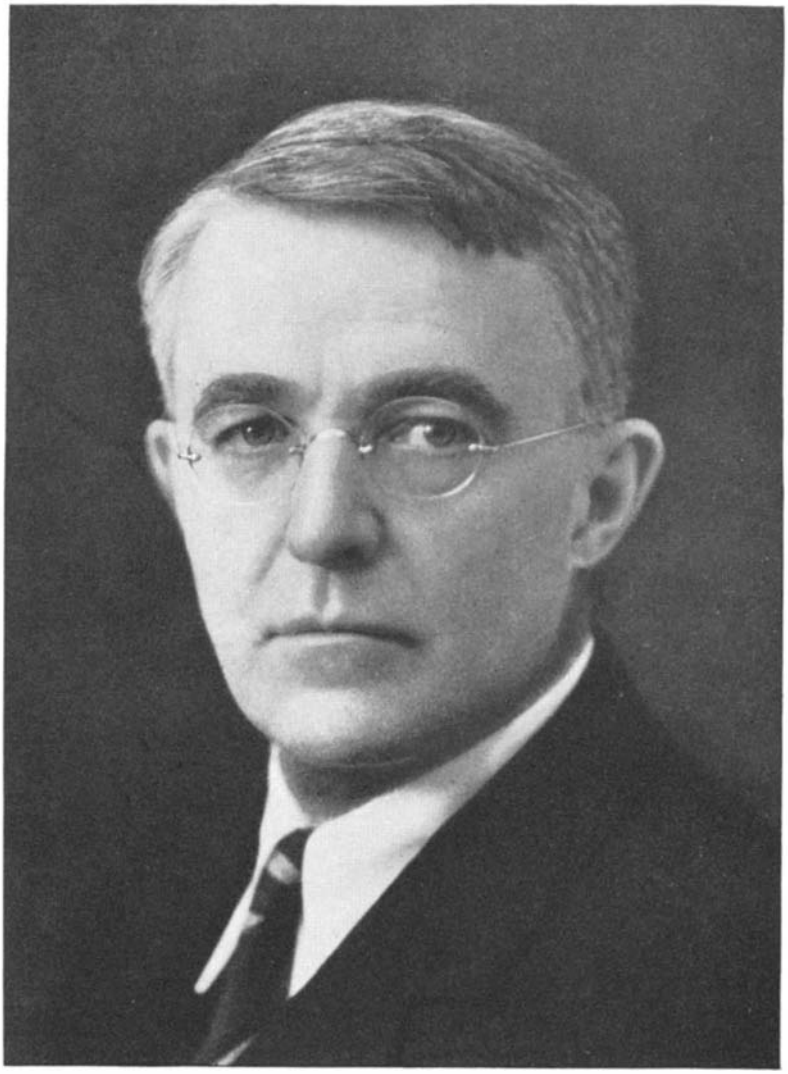
¶Peace-Time Preparedness: How radio has become a powerful support of the armed forces. By General J. G. Harbord.

¶Personalities of the Elements: Electrons—genes of the atom—the determining factors. By Sidney J. French, Ph.D.

¶Coal Carbonization: A new process that has advantages for the coal industry and the community. By H. Stevens.

¶How Climate and Weather Exert a Dictatorship Over Man and Many of His Activities. By Clarence A. Mills, M.D., Ph.D.

Personalities in Science



DR. IRVING LANGMUIR

ASKED by Colonel Lindbergh which he liked the better, flying or skiing, Dr. Langmuir caused the other dinner guests to gasp by the prompt frankness of his reply: "Skiing." Since Dr. Irving Langmuir, associate director of the research laboratory of the General Electric Company and Nobel Prize winner, owns his own plane which he pilots himself and enjoys hugely, it remains for Colonel Lindbergh to climb Mt. Marcy on skis with him before they can settle the question between them.

Dr. Langmuir is anything but the prototype of the average conception of a great scientist. A mental genius, he claims that the theory for some of his best work has come to him while motor boating at his camp at Lake George in the Adirondacks or skiing in Switzerland.

Dr. Langmuir's researches in surface chemistry, his studies of molecular films of a thickness of about one ten-millionth of an inch, and his discoveries in this invisible film world, resulted in his becoming the first industrial chemist in this nation to receive the coveted Nobel Prize in chemistry which the Swedish Academy of Science awarded him in 1932.

There is scarcely a person living today who has not benefited by his research and discoveries. His creation of the gas-filled incandescent lamp, which now saves the American people a million dollars a night in the cost of illumination; the high-vacuum electronic tube; and the atomic hydrogen method of welding, are a few of the reasons why Dr. Langmuir is recognized as one of the outstanding scientists of the world today. He has a rare facility for seeing beyond the horizon of already known facts.

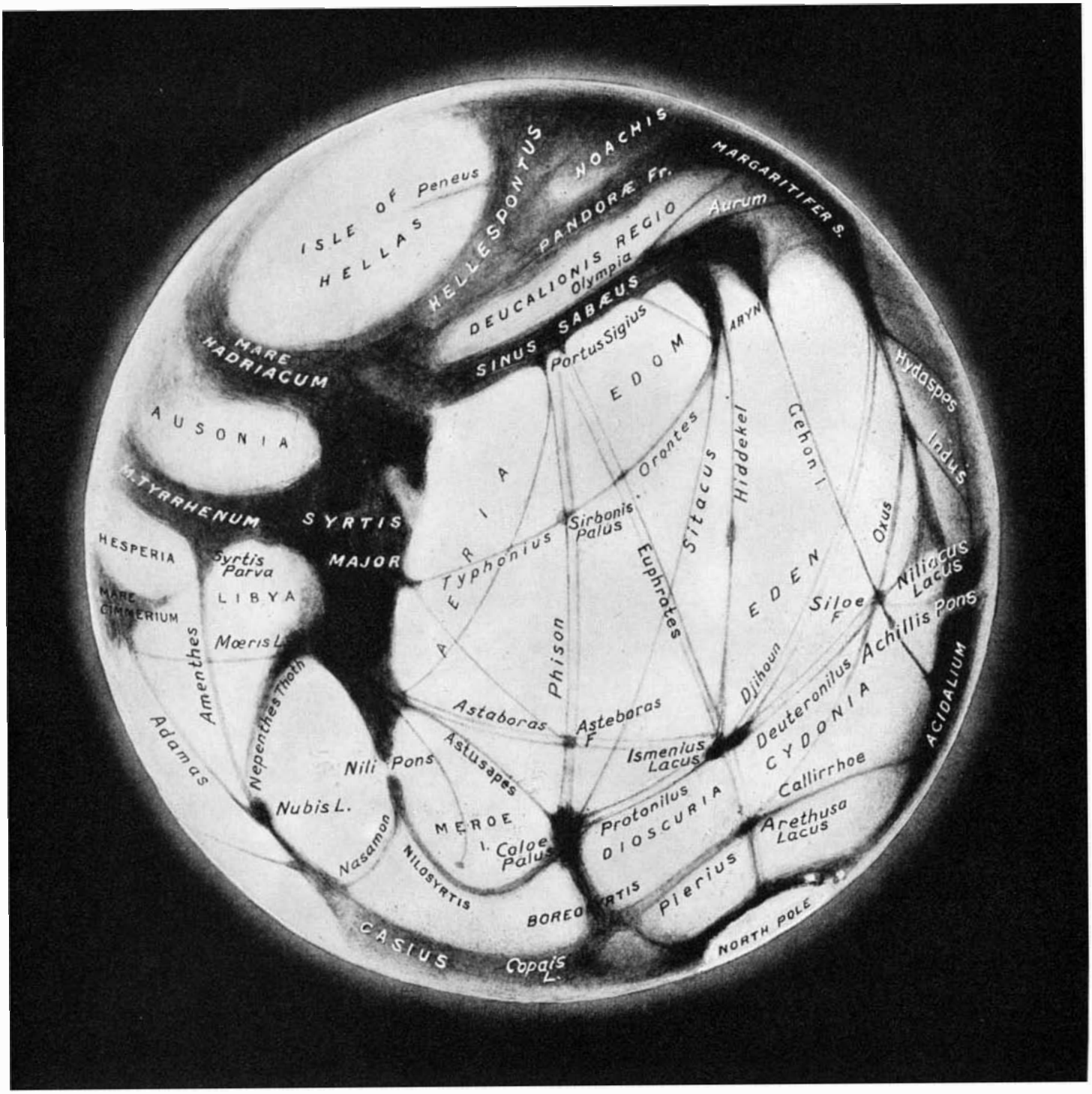
Born in Brooklyn, he attended the public schools there until his parents moved to Paris where he studied in French schools for three years, returning to the United States where he entered Chestnut Hill Academy at Philadelphia. He then attended Pratt Institute high school and upon the completion of his course there, entered the School of Mines at Columbia University from which he was graduated in 1903 with the degree of Metallurgical Engineer. He did postgraduate work at the University of Göttingen, being awarded his Ph.D. in 1906, his subject having been physical chemistry. Returning to America, Dr. Langmuir became instructor in chemistry at Stevens Institute of Technology, where he taught until he entered the research laboratory of the General Electric Company in 1909.

Dr. Willis R. Whitney, former director of the laboratories, referred to Dr. Langmuir as "one of the world's greatest explorers of the vacuum who continually embarks upon mental voyages in regions so nearly airless that only the mind can breathe in comfort."

Besides the Nobel Prize, he has won many other distinctions including: the Nicholas Medal in 1915 and again in 1920; the Willard Gibbs Gold Medal; the Hughes Medal from the Royal Society of London; the Rumford Medal; the Perkins Medal; the Chandler Gold Medal awarded by Columbia University; the *Popular Science Monthly* prize of 10,000 dollars with Gold Medal; and the Gold Medal of the Franklin Institute. The Royal Academy of Rome awarded him the Cannizaro Prize in 1925, and in 1934 the government of Japan awarded him the Fourth Order of the Rising Sun. He was elected president of the American Chemical Society in 1929, and the American Society of Mechanical Engineers awarded him the Holley Medal in 1935, the same year he was elected to membership in the Royal Society of London. He is the only American industrial scientist so honored in that Society, which limits its foreign membership to 50 persons throughout the world. The City of Philadelphia awarded him the John Scott award this year.

Many colleges and universities have awarded him honorary degrees and he was made honorary chancellor of Union College in 1934. He has published 167 papers and has been granted a multitude of patents.

We are privileged to announce that Dr. Langmuir has accepted an appointment to our staff of Contributing Editors. It is an honor to have him thus associated with us so that we and our readers may have the benefit of his advice and counsel.



MARS AS THE EXPERT DRAWS IT

THE above drawing was made by G. F. Morrell, F.R.A.S., F.R.G.S., and is reproduced by courtesy of the *Illustrated London News*. With reference to such drawings Professor Henry Norris Russell writes: "The novice, having seen these, and looking at Mars through the telescope, or at the best photographs of the planet, is likely to be seriously disappointed when he fails to see the conspicuous network of canals. It is not, however, practicable for anyone but a highly trained artist to represent pictorially such delicate shadings and fine distinctions of tone as are characteristic of the Martian surface. What is desired from the scientific viewpoint is as accurate a representation as may be of the surface features which may be observable—their positions, their mutual relations and connections, and their relative intensities. A drawing which exaggerates the absolute intensities of the features, but gives them accurately in position and relative strength, is quite satisfactory in the present state of the art."

A general view of the acropolis of Gawra 13, with the stone foundations of Level 14 in the foreground

New Finds at Tepe Gawra

The Fame of Gawra Grows Steadily as Sixteen of its Superimposed Settlements are Excavated . . . All Progressively Richer and More Significant

By E. A. SPEISER

Professor in the University of Pennsylvania and Director of the American School of Oriental Research in Baghdad

TO the neighboring villagers the site has been known traditionally as Tepe Gawra, "The Great Mound." A strange appellation, this, coming from unlettered peasants. Ordinarily they are little impressed by ancient remains. Even the vast ruins of Nineveh, 15 miles to the south, never have been similarly honored by the natives. Tepe Gawra must have appealed to them because of its height, enhanced by a regular and conical shape. The name thus reflected outward appearances. No thought was given to what may have lain buried inside.

Today the scientific world regards the designation as amply justified. But the greatness which archeologists have recognized in Gawra is linked only in an indirect way with the original height of the mound. It is the story revealed by its contents that has made the site, ignored on all maps as recently as ten years ago, one of the best known and most frequently cited centers known to archeology. Paradoxically enough, the fame of Gawra has been growing steadily with each successive decrease in its height. For the removal of a few feet of débris would mark the addition of yet another occupational level to the recorded history of the place. And, as one descends gradually in the process of systematic excavation from the top down, each new stratum proves more significant, because it brings us closer and closer to the earliest stages of settled mankind.

Courtesy University Museum Bulletin

Showing the location of Tepe Gawra in Iraq—in southwestern Asia

Height alone is no sufficient guarantee that a mound will prove of particular significance to science. The tallest heaps

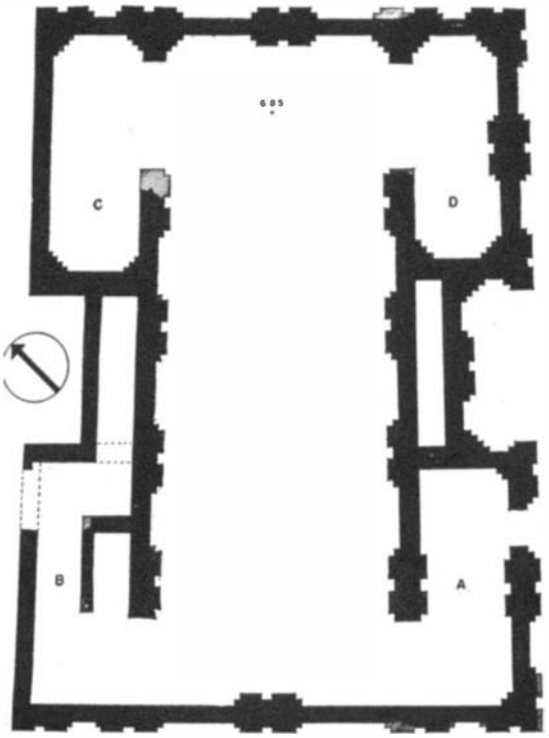
The Northern Temple at Gawra, dating from the Fifth Millennium before Christ, or more than 6000 years ago. Found in Level 13. Its architecture was far in advance of its time

of stratified ruins in ancient Mesopotamia are generally also the least interesting. The reason is not far to seek, for at the top of such an average mound you will find usually Graeco-Roman or Parthian remains, covering older occupations of the Persian period, which in turn are superimposed upon Assyrian levels. Now I would not deny for a moment the importance of every scrap of information bearing on Hellenistic or Assyrian settlements. But the fact remains that those periods are by now fairly well known in their main outlines. Consequently, excavation of such sites involves of necessity a great deal of duplication of knowledge. For this reason I had my misgivings when I first came upon Tepe Gawra in the spring of 1927. They were soon to be dispelled.

FOR a year I had been engaged in a systematic archeological reconnaissance of northern Iraq. In the course of that survey I had visited and examined more than 300 ancient sites. Tepe Gawra was one of the last mounds to be included in my investigation. It took only a few minutes to realize that here was no ordinary witness of ancient times. Surface remains, such as scattered potsherds and small implements of flint and obsidian, left no room for doubt that the site had not been occupied since 1500 B.C. In other words, when the younger Sargon of Assyria, a contemporary of the prophet Isaiah, built his capital Dûr-Sharrukên (modern Khorsabad) barely two miles to the west, Gawra had been a tall and mysterious artificial hill for some 800 years. A mound rising more than 70 feet above the level of the plain is certain to contain a number of buried occupational layers. If the uppermost one is older than the time of Moses, how far back would the lowest one take us? Excavation alone could answer this question satisfactorily.

We lost no time in getting started. A preliminary dig of two weeks' duration, undertaken in the autumn of that same year with the assistance of the Dropsie College of Philadelphia and the Guggenheim Foundation, fully bore out the astounding antiquity of the place; it showed that at least 20 settlements were buried here by successive layers of débris. Systematic work, on behalf of the American Schools of Oriental Research and the University Museum of the University of Pennsylvania, commenced in 1930 and it has been going on ever since. The first two seasons were under my personal direction and they saw the removal of Levels 1-8. When I returned to my regular work at the University of Pennsylvania, in 1932, Mr. Charles Bache took up the task, progressing as far as Level 12. Last season I was able to get back to the field and to carry the excavation down to Level 16, in addition to making trial soundings on the slope where six still older strata were probed.

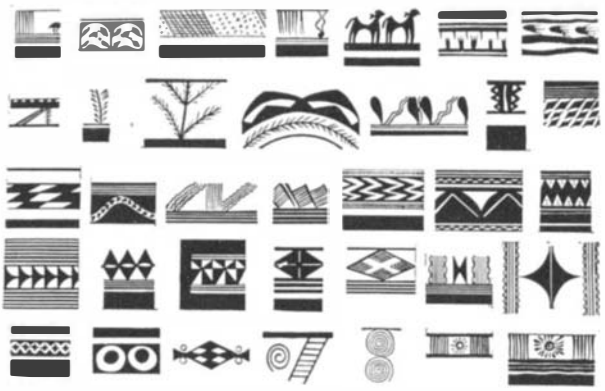
Throughout these campaigns Gawra has more than lived up to its name, getting progressively richer and more significant as century after century was being sliced off with the removal of each additional level. The results obtained in previous seasons are too well known to require more than a passing mention. In our downward course through the ages we reached, with Level 6, the time which is recognized as the Early Dynastic Period: a contemporary of the Royal Tombs at Ur and the early dynasties of Sumer and Egypt. A few feet below was the level which coincided with the beginning of recorded history, marked by the invention of writing. Another few feet brought us across the border that separates history from prehistory. In Gawra 8 we came on a late prehistoric city which yielded, nevertheless, convincing proof of civilized life: stately temples and evidence of a purposeful but leisurely existence. Below the remains of that period were discovered archaic tombs rich in objects of gold and electrum and wonderfully ground obsidian vessels. In Level 11-A was found the Round House, a temple-citadel of unique design. Gawra 12 proved to belong to the period of the so-called Painted Pottery Peoples. Its buildings were regular and well constructed, although the



A plan of the Northern Temple shown above. Its dimensions were about 42 by 31 feet

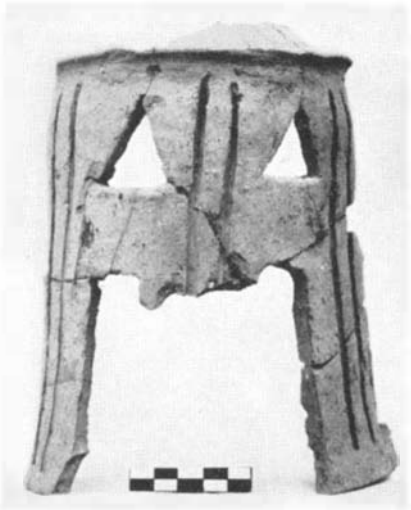
architecture could not be termed inspired. Apparently mankind had learned the art of building only a short time before. At that, the structures of Level 12 were among the earliest buildings of any kind known to archeology.

By that time we had advanced about 1000 years beyond the beginning of history. Definite dates are possible only where there are written records to check them. But since writing is known to have been created toward the end of the 4th Millennium B.C., any occupation earlier than that time must be anchored by means of merely relative dating. We can be sure that Level 11 is older than 10 and later than 12. Hence the inestimable value of Tepe Gawra which contains so many prehistoric strata. Absolute figures have to be avoided in these circumstances. On general considerations, however, Gawra 13 may be placed towards the end of the 5th Millennium B.C.



Selected pottery motives from Gawra 13. The decoration represented real talent and not mere skill

An engraved seal stamp from Gawra 13. The seal cutter knew how to impart a feeling of movement that is not found in much more recent artistic work



An incense burner from Gawra 13

Below: Bone musical instruments

Beads of gold, lapis, carnelian, obsidian, and shell, from late Gawra 13. The jeweler had learned how to cut and fashion his materials

A painted kettle from late Gawra 13. The shapes of the pottery were unusually graceful and pleasing

OFFHAND one would assume that the civilization of Gawra 13 was more primitive and inchoate than that of the immediately succeeding levels. That is what we thought, mindful of the normal curve of human progress. But we were due for a stunning shock, and the experience is unforgettable because it echoes, of necessity, the experiences of early mankind. Those inhabitants of Level 13 were neither primitive nor normal; they were an abnormally gifted and wonderfully balanced people. And they left ample evidence of their achievements in more than one aspect of communal life.

Pottery constitutes almost invariably the most articulate message transmitted to us by an archaic civilization. We were prepared therefore, in a way, for competent ceramic work in Gawra 13. But it was to prove more than that. The shapes were unusually graceful and the decoration was always appropriate to the particular shape in question. Furthermore, the designs betrayed that delicacy of touch and wealth of imagination which marks the difference between real talent and mere skill. The same could be said of the stamp seals cut in stones of various degrees of hardness. The seal cutter may not have achieved the perfect naturalistic representations of animals which were to appear many centuries later, but he had the ability to impart to his scenes a sense of lively and graceful movement that is absent from the best Sumerian work of the early 3rd Millennium B.C. The jeweler had learned to cut his lapis and carnelian, to grind his obsidian and fashion his gold, the oldest datable gold known, into beads of varying shapes. Music enjoyed a tradition of long standing. The instruments which have been recovered are made of bone, and they consist of single tubes, not unlike the modern flutes, or of twin-tubes similar to the shepherd's pipes of today. One such specimen, happily complete, was found in the burial of a child less than ten years old, an ardent and nameless music lover who had played his tunes more than 4000 years before the musical affectations of a Nero were to become proverbial. From these and countless other little details, too numerous and specialized to be mentioned here, we obtained a fair idea of the culture of Gawra 13.

But perhaps the crowning glory of the period was reflected in its architecture. Again it is necessary to emphasize that very few settlements of comparable antiquity had ever been touched by the spade of the archeologist, none linked so clearly with what had lain above and what was to come up below. Our knowledge of contemporary buildings and building methods had been scant indeed.

A painted terra-cotta figurine of the "mother goddess" type, from a cut in the eastern slope of Gawra. It came from the earliest settlements

Flimsy mud hovels were about all that could be expected at this stage.

Instead, Gawra 13 presented us with the type of architecture that would have been a revelation at a far more recent date. Some of its details were not to be duplicated for centuries, and the harmonious arrangement of those details into complete buildings and building compounds was not to be paralleled for thousands of years. We were fortunate enough to uncover not mere secular buildings, but temples; a group of three forming an acropolis of unusual appeal. All these temples embodied certain architectural building principles common to this amazing level. But each temple had also a design, a character, and an individuality peculiarly its own.

A good example is furnished by the Northern Temple, the smallest of the three. Its dimensions are roughly 42 by 31 feet. The design may be said to revolve around a central Cult Chamber, which opens into four side rooms, two at each end. The walls of the Cult Chamber were subdivided by four piers, each of which had double pilasters, so that recessed niches were formed between the piers. The principal inside corners had corner piers with quarter pilasters, and the same was true of the main outside niche in the front wall. The combined decorative effect is easy to appreciate. The underlying functional purpose of the piers and pilasters, namely, that of supporting the roof and possible upper structures, is equally apparent.

The other two temples, the Central and the Eastern, differed from the Northern Temple in many respects. They were larger and differently designed. Moreover, they were painted on the inside in bright solid red and on the outside they were covered with a thick layer of white plaster. But all three are examples of monumental architecture, the oldest remains of that type which archeology has yet brought to light. All three had their piers and pilasters and niches, and all faced upon the Main Court which they helped to make a truly inspiring sight. Lastly, the acropolis as a whole betrays the same daring in conception and sureness in execution, the same spirit of inventiveness and freedom from the shackles of tradition; in short, the same harmony of shape and material and decoration that we have seen in the work of the contemporary potter and seal cutter. Yes, those people of remote prehistoric times were not at all primitive, but rather a singularly gifted and active group. And the prodigious effort which the construction of an acropolis presupposes testifies to a high degree of communal organization and to an advanced stage of religious development.

OF the finds from lower levels I shall single out but one. In Stratum 16, the lowest reached by us in regular excavation, we found an explanation for the remarkable glaze-like finish that is present on some of the earliest known examples of painted pottery. In this occupation was discovered an irregular building with a circular shaft in one corner. That shaft proved to lead to underground corridors which opened into chambers filled with ashes and fused clay. Here was obviously the kind of closed kiln, the earliest known so far, which enabled the potter to maintain the necessary control over his furnace and to obtain the temperatures desired in his ceramic art. Indirect firing did the rest.

What was the total depth of the deposits which had accumulated at Tepe Gawra until the site became too tall for practical occupation? In other words, how many occupations or levels had the mound buried? The lowest stratum reached from the top is now the 16th. But we can go a bit further in answering the above question. On the eastern slope we cleared a large section of the site and reached virgin soil 30 feet below the present level of the plain. Six levels were discovered in this cut, with pottery, terra-cottas, and ornaments of the so-called Tell Halaf period. Now the topmost one of those six settlements is older than our Level 16. The gap may be closed when excavators have descended to the 17th level, but then it may not be. It follows that Tepe Gawra contained originally, in its 70 feet above the plain and in its 30 feet below, not less than 23 settlements. The place has not revealed to us its entire history by any means. Much labor still remains to be done.

But all the work accomplished to date and the effort that lies ahead can be translated into building units in the general structure of archeology. They will be fitted and placed in position in due time. One set, however, is bound to loom large in the future. The rich and well-balanced civilization of Gawra 13, representing as it does one of the earliest and hitherto least known stages of early mankind, cannot but constitute a cornerstone in our restored edifice of ancient times.

A closed pottery kiln with shaft leading to underground chambers. This old building is from Level 16, the lowest of the 23 levels thus far excavated

OUR POINT OF VIEW

Is Our Age Lop-Sided?

DURING the present troubled times all over the world, many thinkers have felt that mankind has indeed reached a cross-roads and that, for the duration of our lives at least, world conditions are not likely again to reach the static calm that middle-aged persons recall with pleasure. Security is the one thing the individual instinctively seeks, and today it is the thing least apparent in the immediate future. People who think tell one another they feel as though they were sitting on the edge of a volcano, and the whole world suffers from an anxiety complex.

Whatever the immediate causes of this existing state of mind and nerves—whether the aftermath of a great war or the ushering in of social changes that already were on the way—science, in the final analysis, is the real cause that lies back of all such causes. It is *science* which, in four short centuries, but mainly in one, has so greatly accelerated the normal course of human events that present-day observers of those same events scarcely can keep abreast of them. So rapid is the tempo that there is no wonder that breathless, exhausted people cry for a vacation from further scientific advance lest the tempo turn into so rapid a crescendo that the whole machinery will burst from its own gaining velocity.

What man has done thus far in this age of science is essentially to discover and release a host of new raw forces into the world and then leave them to react, largely unguided, on each other. All these forces are the parts of a vast picture puzzle which has not yet been put together and unified. They lie heaped up in disorderly confusion.

Possibly, therefore, it is time to call a halt on the discovery of new forces such as the too-much-hoped-for energy within the atom (thousands of times more potent for good or evil than that in TNT), until man has grown up and learned to control himself. One sometimes catches oneself in imagination conducting Aristotle, Leonardo, Galileo and, say, Benjamin Franklin—all keenly interested in science and invention—about the world and proudly showing off to these astonished men our modern mechanical attainments, our uses of electricity, our airplanes, our knowledge of matter and perhaps a high-speed modern printing press. At the end of the tour one eagerly awaits the final summing up by these men—their uncontrolled enthusiasms. Then comes the report: "You moderns seem to have accomplished wonders in the control of nature but, tell us, have you yet made much headway in a thing that is still more important—the control of yourselves?" And then our heads droop as we reply a bit sadly, "No, we haven't yet, as a whole, even learned to think: we've probably spent too much time trying to make ourselves comfortable."

Perhaps it is time mankind began putting more of his time on sorting out that tangled picture puzzle, on arranging the whole—on learning to think.

Engineers Barge In

ENGINEERING is an exact science. Politics is—let's not be too harsh—no science at all. How, then, shall the two become bedfellows? Engineers who encroach upon the sacred preserves of the politician would seem to be attempting the impossible. Yet some are on the point of doing so if we credit the report of Frank R. Innes, western editor of *Electrical World*, that a recent poll among engineers indicated a desire to take an active part in current matters of national interest.

Mr. Innes suggests immediately an investigation of the federal water power program. He is not concerned with the politics but rather with the hard engineering facts and the long-view economics of the program, for he would have engineers study markets for federal power, competition with existing utilities, the argument that water-power electricity is practically obsolete as compared with steam-generated power, aggravation of unemployment by construction of large power plants, the question of financing federal hydro-electric projects in the face of the fact that many of today's most efficient machines may be obsolete in five to ten years, and several other related subjects.

The schedule sounds too good to be true—too good to go through without being blocked. Politicians will not look kindly upon this effort to throw the cold light of scientific truth upon projects which they have, in the main, planned as gestures to hold the votes of "the folks back home." Yet such an impartial searching out of the truth is vitally needed lest we be handed, in return for our taxes, more white elephants such as the costly 'Quoddy experiment. Three million dollars were spent on that project before Congress stopped it by refusing more money. Did that august body see the light as a result of its own study or because of Dr. K. T. Compton's remarks as to the extreme costliness of 'Quoddy power as compared with steam-plant power? Frankly, we don't know, but . . .

If the engineers will keep right on barging in—splendid! It is a great responsibility they've shouldered but the results can be enormous. Let's hope they're not afraid of the politicians.

Antarctica

BRITISHERS take a lugubrious sort of pride in their reputation for "muddling through." And well they might for the word "through" connotes completion, and that, after all, is the thing desired. But for a ponderous inertia, and mass indifference to vital current problems (rarely permitting discovery of the solution until far past the climactic moment) we of the United States take first place, with no runners up.

Britain, in her best muddling-through manner, has just made official, by Act of Parliament, her claims to certain parts of Antarctica explored by Britishers. Hers is a *fait accompli*. We, however, with a legitimate claim to other vast areas of the same great continent because of the explorations and long residence of American explorers—notably Admiral Byrd's two expeditions—haven't even talked of making our possession official by Act of Congress. Why not? The Antarctic is believed to have huge beds of coal which, in future years, may be needed and could be hauled out by some modern contrivance.

Is our failure to take the matter seriously just plain indifference? Is it cynicism? Knowing that present sources of coal won't be exhausted for 1000 to 5000 years, do our people simply shrug their shoulders, dubious of the continued existence of a race of human beings on earth? Are they so sure that the disasters of modern war will stop our muddling for good and all?

Perhaps. Yet our indifference does not become us and is short-sighted. We will need new sources of petroleum in the next few decades and there may be pools of it in the Antarctic which could be made available. We don't know; we're only saying: "for example." For whatever we may get from that cold region in future years, it is certainly worth the slight effort necessary to establish our claim. Let's overcome our inertia for once.

TAILORED RADIO WAVES

Concentrating Broadcasting Service Where it Will be Most Effective . . . "Field Patterns" Determined by Design of Antenna System

By ALEXANDER MAXWELL *

IN physics class it was taught that radio waves travel in an ever expanding circle, like the ripples created when a pebble is tossed into still water. They do, when left to their own devices, but not being satisfied with anything as simple as that, engineers have devised ways to make the waves radiate in the form of a fan, a shamrock, a four-leaf clover, a spatula, a double watermelon or an airplane propeller. These are only a few examples of what are called field patterns that are determined by the design of the transmitter antennas. An engineer named Southworth went to the bottom of the subject, and when he came up he had over 60 possible patterns for two antenna tower installations; not stopping there he kept on until he had worked out the possibilities of all combinations up to 48 towers. The patterns were startling and glorious to behold, for they ranged from starfish to daisies and then ended in one long, lean design no wider than a highway and stretching out for thousands of miles. That seemed to be what he was seeking—virtually a wireless telephone line. It worked like a charm and is now in use for trans-oceanic service.

Months before construction starts on a new radio transmitter, the engineers start to solve problems of design. It frequently requires 15 pages of equations to compute the antenna system

Broadcasting station engineers pricked up their ears at the news. Here was something that looked interesting, for radio reception conditions were unbearable in congested locations. Government regulations curtailed activity; competition was intense. In short, the time was ripe for any improvement which would relieve the situation. The early history of all enterprises is practically identical. There is a pioneering period, one of floundering expansion, sudden regulative interference, then things settle down to serious business. Radio was no exception.

In 1920 the enterprising pioneers were already at work. It wasn't broadcasting then; it was fun, masquerading as experimental work. Existing commercial stations and amateurs both dabbled, and everybody had a good time. 8XK, the station of Frank Conrad in Pittsburgh, became the first commercial broadcaster under the call of KDKA. In 1923, broadcasting became popular and swept the nation by storm. Stations materialized over night, every able-bodied man who could read a blue print and handle a soldering iron built a radio receiving set. The thrill of hearing a voice a thousand miles away held most listeners spellbound. The favorite pastime became sitting in front of the radio, picking up one station after another and sending each a postcard. It was indeed the era of pioneering. It was new to broadcaster and listener alike; they both got a thrill out of it and everybody was happy. Pioneering, however, is always a transient stage and the end came rather abruptly.

In 1927 the Government decreed that the situation had got out of control, so a department was created to regulate radio broadcasting. All licenses were called in, new wavelengths were assigned and maximum power was specified for each station. The assigned bands were classified as clear channel, regional, or locals, depending upon their purpose and coverage. Many, which could show no real reason for existing, were dropped from the list.

The problem was settled, as far as the Government was concerned. The stations were placed so that no two occupying the same wavelength were within conflicting distance of one another. This was 100 miles for locals and up to 700 for regionals; a clear channel sta-

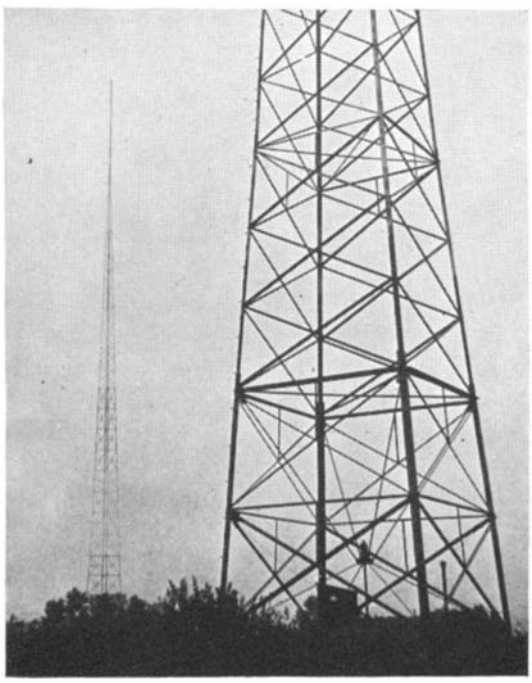
Checking the results of tests against the computed field pattern, which seldom varies more than a mile or so from that found in practice

*Amateur radio W9BRE

tion had its own wavelength all to itself. To make this system work out in practice many of the less prominent stations were granted daytime hours alone; others were permitted to use full power before sunset, but, for example, only one fifth as much in the evening. Station requirements were tightened and, to be permitted to use the air at all, the transmitter and program policy had to come up to rigid specifications.

WHILE the situation was decidedly improved, many station operators felt that they were not covering their territory as completely as they should. Suppose, for example, that it took 1000 watts consistently to put a satisfactory signal into a certain neighboring city, and the station was allowed to use only 500 watts. Increasing power was out of the question, for the station would then interfere with the others that shared the same wave. The only way out was to use a more efficient antenna, and so the engineers turned to the charts Southworth had prepared as the next logical step. They talked controlled radiation, plans were drawn on the table cloths in restaurants, and conventions and meetings were given over to discussion, but those who held the purse strings were still reluctant. Twenty thousand dollars was the very least it would cost to make the change. How did the hard-headed business men who directed the destinies of radio stations know that the idea would work? Let George do it first. If it works for him, then will be soon enough to talk.

And sure enough, George did it. A small and practically unknown station on the west coast of Florida, WFLA-WSUN, put in the first two-element directional broadcast antenna. Radio engineers and station executives alike figuratively held their breath; when tests were made, hundreds of receivers were tuned in. It worked; the field pattern was no longer a perfect circle; it was warped into exactly the shape the engineer specified.



The twin towers of a directional transmitter, from which energy is directed toward two cities

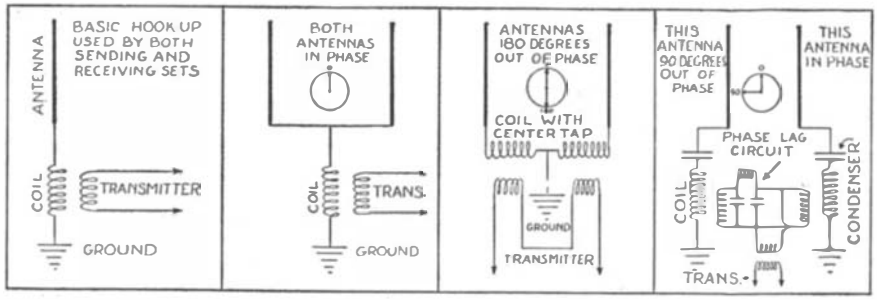
WIND, at Gary, Indiana, was the second station to try the experiment. The radio world at large was still not convinced that the idea was practical. In the fall of 1933 the re-designed station was ready to go on the air. The purpose of the directive system was to concentrate as much energy as possible in Chicago, and not waste it covering the uninhabited expanses of Lake Michigan. A second time the system worked. Engineers breathed easier and, with the consent of station owners, went to work to settle their own problems in the new way. Today there are 39 stations on the air having directive antennas, and more are being built.

How does it work? The principle of the directive antenna is simple and quite old. In fact, the first antenna ever used was directive. Hertz, father of radio, used a parabolic reflector, 'way back in the '80s, to direct his radio energy toward another antenna in a second parabolic reflector. That is the whole story. The placing of the reflector governs the shape of the field pattern.

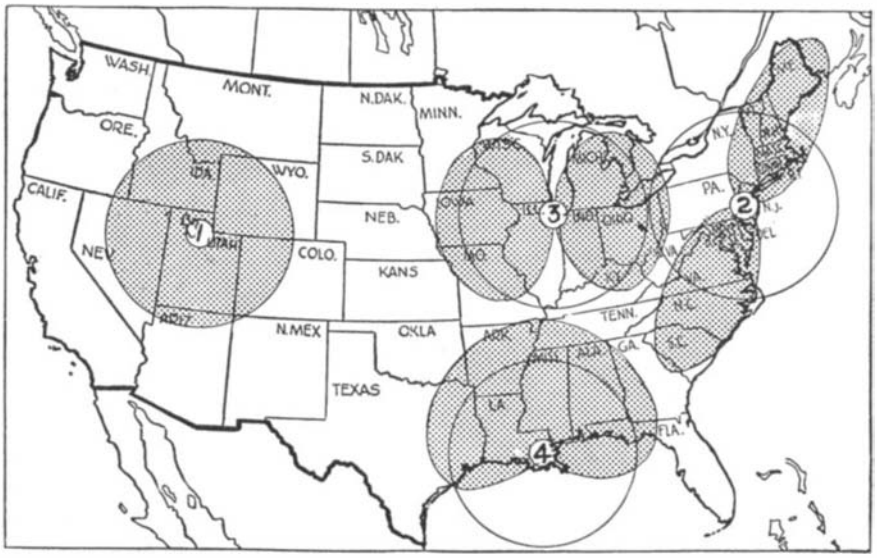
Hertz, himself, discovered that a wire parallel to the antenna had the same effect as the reflector and was much easier to handle. Commercial systems using wire reflectors have been in use for a number of years, particularly in point-to-point transatlantic code stations.

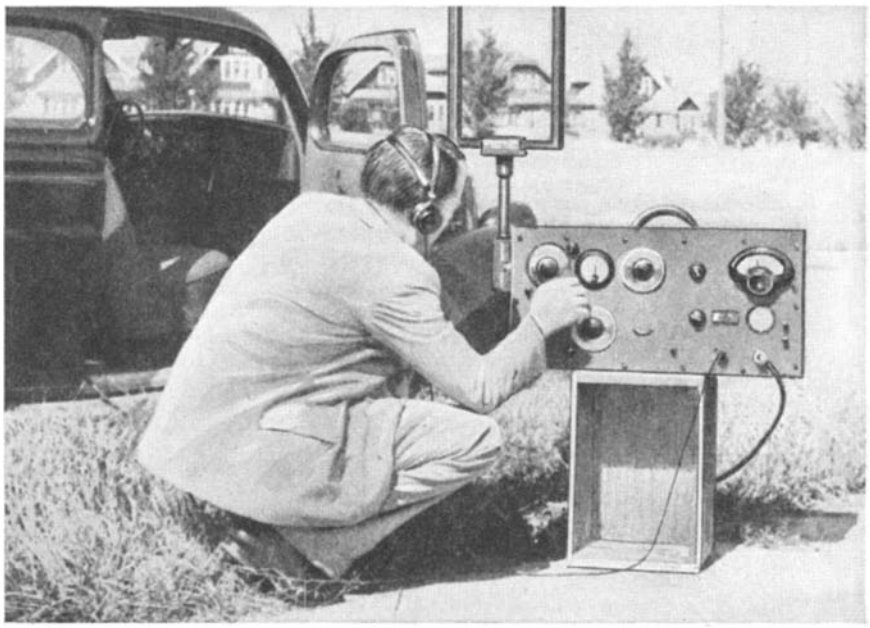
THE basic circuit consists of an antenna, a coil of wire wound on a form, a ground connection, and either a transmitter or a receiver coupled to the coil. The diagram is quite familiar. It is the one used in your present radio, the one you struggled with 12 or 14 years ago when you built your first receiver; in fact, it is the same as is used in almost every wireless or radio set in the world, large or small, sending or receiving. Hertz used it, Marconi used it, and no one has ever found a better one. A station using this antenna system would radiate in all directions, like the expanding circle of ripples set up when a pebble is tossed into still water.

The extended or directed pattern has but slight resemblance to a circle. A



The basic circuit at the left above produces a circular field pattern as at 1, below. The twin antennas in phase produce pattern 2, while antennas 180 degrees out of phase give a pattern such as 3, below. If the systems are 90 degrees out of phase, as at the right above, the resulting pattern is like that at 4, below





After a new station is placed in operation, the engineers spend weeks exploring with portable receivers such as this one, in order to check their calculations

station located in Philadelphia, for example, which with a single antenna would cover the territory bounded by a circle, could, by using a two-element system with both antennas in phase, cover the Atlantic Coast from New Brunswick to Georgia, and at the same time be completely inaudible out on the ocean or west of the mountains. With this system, the two antennas are connected to the top of the coil mentioned above. The antennas must both be exactly alike, and the lead-in wires must be the same length down to an inch. When both antennas are connected to the same end of the coil they are in phase. The distance between the antennas governs the length of the pattern. The non-directive antenna produces a circular field pattern. When the second antenna is connected the pattern lengthens out. With the towers spaced 3/8 of a wavelength apart, the pattern is one third longer than it is wide. Put the towers 5/8 wavelength apart and the pattern is just twice as long as it was originally. With this latter pattern tiny side lobes form. Pulling the towers still farther apart will lengthen these lobes and shorten the two long ones until a four-leaf clover results.

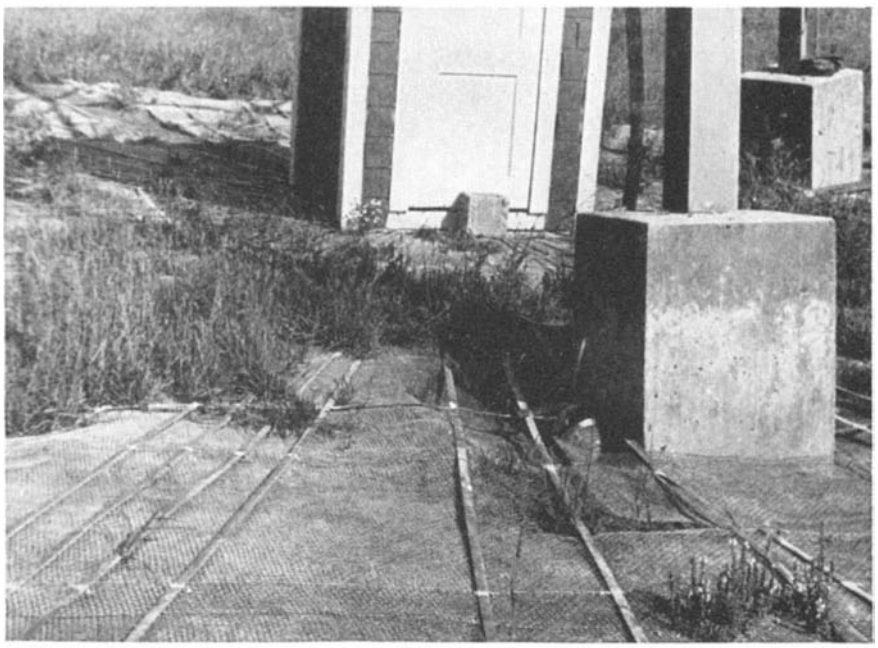
AT first glance one is apt to get the impression that this is a fine way to get something for nothing. Such is not the case, for no matter how fantastic the final pattern, the total energy radiated is never greater than that which would go into a circular pattern from a non-directional antenna. What actually happens is that the energy is directed toward a pre-determined destination and suppressed elsewhere. Much good can come from turning the energy loose in New England, while the results of catering to the Atlantic Ocean are dubious.

The next complication which arises in the design of odd-shaped field patterns involves antennas which are out of phase. Alternating current, of which radio energy is composed, is first positive, then negative. In the house-lighting current these changes take place rather slowly, usually only 60 times a second, so we call it 60-cycle current. In radio the alternations are much faster, but the principle is the same. So, with an antenna system that is 180 degrees out of phase, when one antenna is positive, the other is negative, and they are one half cycle apart. This sounds very complicated, but all that needs to be done is connect an antenna to each end of the aforementioned coil and the ground to the middle, as shown on the preceding page.

Complexity begins and the engineers work for their money when one antenna is tuned to the desired wavelength, and the other is deliberately thrown a quarter cycle out of phase by means of a phase-lag circuit. The resulting field pattern is a fan, or it can be made into a heart or a spade by varying the tower spacing, and is used where it is intended to concentrate all energy in one hemisphere and suppress it completely in the other. The *pièce de résistance* of the phase-lag circuit is a choke coil. A choke coil causes an alternating current to lag; a condenser makes it lead. By juggling the chokes and condensers, the exact amount of lag desired is obtained. This need not be 90 degrees; it can be anywhere from 1 to 359, depending upon the pattern desired.

ONE engineer worked for months designing a four-element antenna system. His problem was exceptionally complex, for the station was located at the base of a peninsula. One narrow beam was to cover the tongue of land, and a wide fan was to cover three important cities on the mainland. In addition, a local station was to use one of the four towers simultaneously on a higher frequency, operating non-directionally. The engineer designed the station, built it, tuned it in mid-winter, with the temperature below zero and the snow up to his armpits, and when at last the job was completed and the station working, he threw up his hands and said, "I don't know why it works but it does."

The actual building of a station is the least of an engineer's worries. Months before the construction starts he must make his plans. A map is drawn showing the present primary service area. If these figures are not available, or the



A good ground is as essential as a well designed antenna system. This one is composed of wire screening and copper strips, with all of the joints soldered

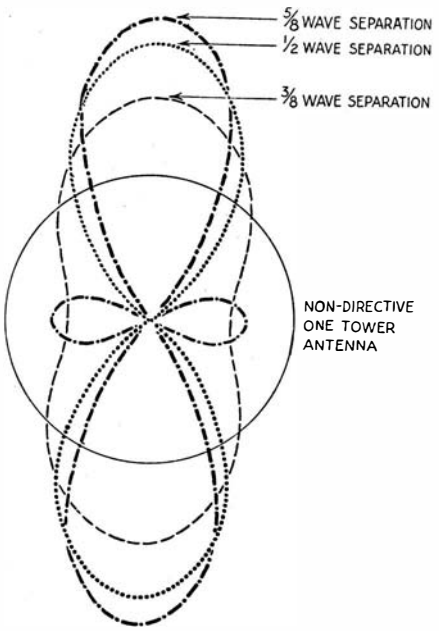
station is new, a test transmitter must be erected and the service measured in the field. This task alone takes two or three weeks. When the map is made, if the area covered does not include all the points desired, a directive field pattern is selected which will warp the energy into the proper shape.

The patterns are available in printed form, but each station is an individual case, and all the details must be worked out carefully. A very slight error is often enough to throw the whole array out of balance. To make certain, the formulas compiled by Southworth are fitted to the case and then worked out. Fifteen pages of equations are not uncommon in the figuring of a single station. Balancing this against an expenditure which may top 50,000 dollars, the effort is well worth while. So accurate are the equations that it is possible to know the exact size and shape of the field pattern long before the station goes on the air. One engineer makes a practice of deliberately underestimating the anticipated coverage in his first report, so when the actual range of the station is measured it is consistently ten miles more than figured. This pleases the owners.

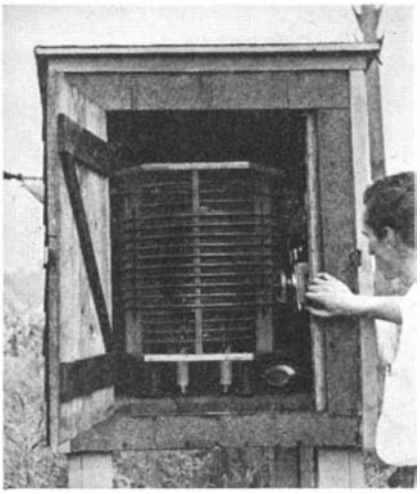
THE present antennas themselves are another contradiction to accepted practice of a decade ago. At that time text books went to great length expostulating upon the relative merits of the umbrella, the fan, and the flat-top, inverted L and the T. Today, save in isolated cases, they have all vanished. Gone, and in their place have risen needle-like slivers of steel, rising to great heights. No wires at all are used. The tower itself is the aerial. For the short-wave amateurs, police, and other stations, the situation is still further simplified. A 40-foot length of gas pipe stuck in the ground is all that is needed. Often it is not even insulated. How times have changed!

When one understands the circumstances, the reason for the change is obvious. A ⅛-wave antenna, which included most of them prior to eight years ago, emits a signal which rises high above the earth, and carries only a short distance. As the signal goes aloft at a steep angle it strikes the Heaviside layer and is reflected back to the earth. Thus there are two waves to consider—the ground wave and the sky wave. As the Heaviside layer of ionized gas is not always at the same level, the variations cause the sky wave to fluctuate in intensity. When a receiver is tuned in, the volume of the signal rises and falls, often disappearing completely.

By raising the height of the tower to ⅜ wavelength, the signal hugs the ground more and covers a greater surface area for the same power. Making the tower ⅝ wavelength high, which amounts to six or seven hundred feet, the signal skims low along the earth and reaches out almost twice as far as the old flat top. At this point the upward angle is so flat that the sky wave has a long distance to go before reaching the Heaviside layer, and when it does bounce back to earth it is so far beyond the effective range of the station that reception becomes merely a freak and is treated as such by the average listener. It is not practical to make the antenna higher, for a sky loop begins to form. At a full wavelength in height, the entire signal shoots upward.



The broken lines show how the field pattern from a twin antenna changes as the towers are moved

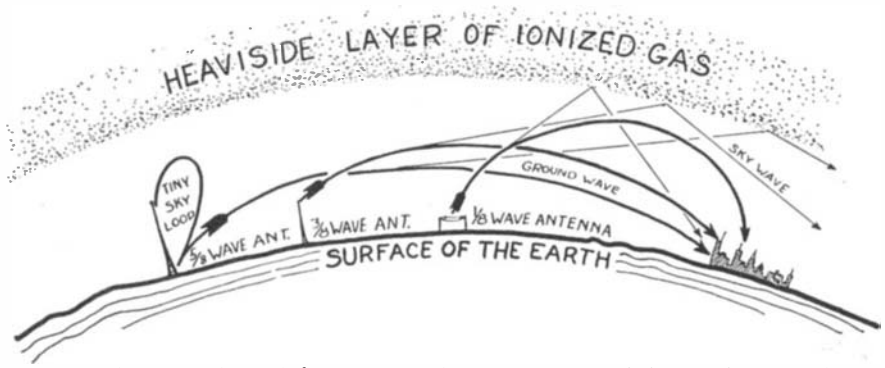


The antenna tuning inductance is, in modern transmitters, frequently located in a shed near the antennas, often far from other equipment

At the present time no broadcasting station uses more than four antennas. Point-to-point stations, both phone and telegraph, however, have found an array of multiple antennas to be both economical and advantageous. A typical radio-telephone station consists of a double row of vertical antennas, carefully spaced and situated so that their broadside is "aimed" directly toward the destination. Each pair of antennas is called a couplet and they are so connected as to be 90 degrees out of phase. In reality they are only a modern version of the old antenna with its reflector which Hertz used almost 50 years ago. Twenty-four couplets make the standard array—a total of forty-eight antennas. This combination produces a beam which is compressed into a pencil of energy, placing the full signal at the receiving end, and is inaudible a few miles on either side. It is practically a telephone line without wires. By using it on the eastern coast of the United States, five kilowatts places a strong signal in England. By the conventional non-directional method it would take 130 kilowatts to do the same work and the phone message could be picked up just as easily in San Francisco.

Radio beacons on shipping lanes, and radio range systems on airlines are also modified forms of arrays.

So, by scientific use of the power available, the broadcasting stations which felt they were being discriminated against ten years ago are now in a position to offer better service than was then possible by the best. Interference is almost a thing of the past and, by careful planning, a number of channels have been made available for new stations—all because broadcasting has ceased to be broadcast and is now a scientific distribution of radio energy, to serve the most in the best way possible.



How radio waves from different types of antenna systems behave. The ground wave is most important to broadcasting. See complete explanation in the text

The New Martian Puzzle

Mars' Current Apparition Reveals to Astronomers a Remarkable Phenomenon . . . Unprecedented Clearing in the Planet's Atmosphere . . . Signifying What?

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington. President of the American Astronomical Society

MARS has recently been more favorably situated for observation than for a dozen years past. When the earth, in its "stern chase" around the sun, caught up with him, it found him in the part of his orbit nearest the sun, so that the distance at opposition was not far from its smallest possible value. In consequence, the planet appeared unusually bright, decidedly surpassing Jupiter, and was the most prominent object in the midnight sky, although he was far south of the equator, in the head of Scorpio.

With the telescope, he showed a disk large enough to permit the recognition of abundant detail, though his low altitude at northern stations seriously increased the optical unsteadiness of the air which is known as "bad seeing." Only one report of this season's observations has yet come to hand; but this is of unusual interest. Dr. E. C. Slipher at the Lowell Observatory has secured photographs of the planet, taken with blue light, which show conspicuous surface detail. To understand the full significance of this, we must recall the conditions which affect planetary photography in general, and that of Mars in particular.

THE planets are so small, in proportion to their distances from us, that their telescopic images, even with large instruments, are tiny. Mars, for example, is 4200 miles in diameter. A distance of 38,000,000 miles—which is not far from the nearest possible—is 9000 times as great. Hence the image of the planet produced by an objective of 30 feet focal length is only one millimeter in diameter. A visual refractor has a rather small focal ratio—about $f/15$ in the ordinary notation used by photographers. To get a good exposure in a short time with such an instrument, one must use a fast plate. Fast plates—even the best of them—have none too fine a grain, and the small direct image of the planet cannot bear much enlargement. It is possible to do better by introducing, at a moderate distance in front of the plate, a negative lens combination, which enlarges the focal image—at the obvious cost of increased exposure time. In perfectly steady air, this would be no great loss, for the guiding of the telescope could be arranged for. But the air is never perfectly steady and, in a prolonged exposure, the dancing of the image will blur the picture. Too great an enlargement, with too long an exposure, is therefore harmful; but experience shows that a moderate enlargement—something like four or five times—gives the best results.

To make the best of the moments of good seeing, the observer customarily secures dozens of exposures on one plate—moving the telescope so that the successive images of the planet fall well clear of one another. Many of the images on such a plate will be blurred, owing to bad atmospheric conditions during the few seconds of exposure; but these can be ignored in favor of the few for which the conditions were better, and the images sharper.

The visual observer has here a great advantage, for the photographer is necessarily "going it blind," and trusting to good luck, while the trained eye can take advantage of single seconds of steadiness, as often as they occur. Nevertheless, the selected good exposures from a long series suffice to show a remarkable amount of detail, and record it permanently and impartially.

There is a remarkable difference, however, in the nature of the detail on different bodies. This has long been known by direct visual observation. The hard, black-and-white details of the moon's surface are more conspicuous and more contrasty than those upon Jupiter, and these, again, are much more prominent than most of the markings on Mars, which, except for the polar caps, are weak half-tones, with little contrast, and much harder to see definitely. Photography, as might be expected, tells the same story. Magnificent photographs of the moon, showing a wealth of detail, are easy to get (with a large telescope, of course). Under good seeing conditions, the surface markings of Jupiter photograph strongly, and, with appropriate photographic treatment, display more contrast than to the eye directly. But Mars again is a more difficult object. The planet's disk, even at best, is so small that the finest details, such as can be seen visually at the steadiest moments, are lost in the grain of the plate. Less difficult markings are definitely recorded—as may be clearly proved by comparison of the good images secured on a single plate—but the effects of plate-grain and of bad seeing smooth them out—very slightly in absolute amount, but enough to make it impossible to decide, from the photographs, whether they are as sharp and clear-cut as some visual observers see them.

BUT the photographs tell us other things which the eye fails to reveal. With the aid of color filters, and of the great variety of plate-types now available, we can work with light of very different colors; and, indeed, with infra-red and ultra-violet rays which lie beyond the range of ordinary vision.

Tried on the moon, this method tells us little that is new—though Professor Wood, many years ago, found certain spots on the surface which photographed very dark in ultra-violet light, and in this alone, and showed that terrestrial rocks thinly stained with sulfur behaved in the same way.

Mars, however, gives amazingly different pictures with light of different colors. With deep red light the large surface markings show strongly, with much more contrast than to the eye. With yellow light the contrast is less, with green light the details become very faint and, with blue and violet light, the permanent markings are usually quite invisible. Diffuse and irregular markings, however, appear in the blue photographs, but change from night to night—though the agreement of exposures taken on the same evening shows that they were really there at that time.

The polar caps are an exception. They are well shown in the red and yellow, but are often larger and more conspicuous in the blue.

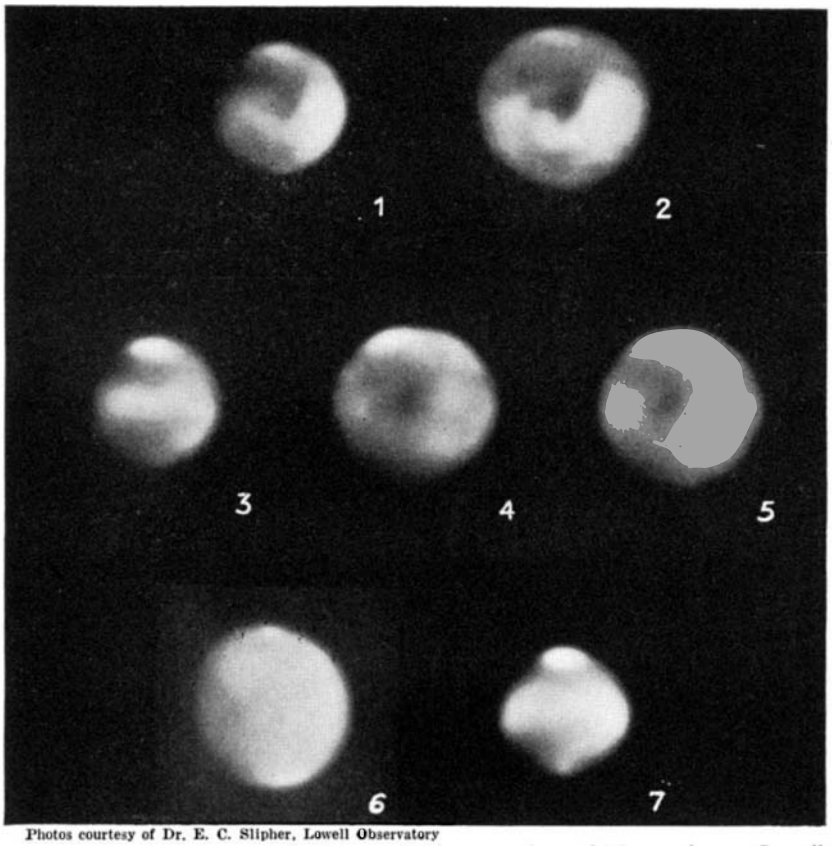
There can be no doubt about the main lines of interpretation of these facts. Permanent markings must belong

to the planet's surface—as do also those which show slow seasonal changes, like the polar caps. Fugitive markings, which are a thousand miles across one day and gone the next, must arise in the planet's atmosphere, and be similar to clouds or haze. Normal clouds, which are white, reflect light of all colors about equally well, and should appear with yellow light. Such objects are occasionally observed on Mars; but most of the markings show only in the blue, and must be of the nature of bluish haze. The extension of the polar caps on the blue photographs can be naturally explained by haze surrounding the snow, the latter alone being observable with red light.

But the disappearance of the surface markings on the blue photographs is less simple—there are two possibilities at least. One is that the actual colors of the reddish surface of the planet, and the greenish-gray markings on it, are such that, in red light, the first is much brighter than the second, while, in blue light, the red has lost most of its brightness and little contrast remains. The other is that the atmosphere of Mars, though transparent to red light and fairly so to yellow, is very thick and hazy to blue light, and hence obscures the surface details.

NO definite decision between these alternatives has hitherto been possible. But Dr. Slipher's observations of the present year are conclusive. On May 20 and 21, the Syrtis Major—one of the most prominent markings shown in the drawing on page 132—was near the center of the disk. Photographs made with blue light show it conspicuously, so that, as Dr. Slipher remarks, "were one not aware of what spectral region was utilized in making the photographs, he might easily mistake them for ordinary yellow images of the planet." On other blue photographs made on May 23 and 24 the Syrtis is seen, though less distinctly; but on photographs taken on April 20, with the same telescope and color screen and with plates of the same emulsion, no recognizable trace of the Syrtis appears—while the usual hazy patches are conspicuous. Visual observations, and photographs with yellow and red light, show that no notable change had occurred in the dark markings themselves, and there is no room for doubt that, in the interval of a month, the atmosphere of Mars changed from its normal blue-hazy state to unprecedented clearness.

It may be concluded then, that, if we could see the unobscured surface of Mars, the markings upon it could easily be photographed at any time with blue light—though probably with less contrast than in the yellow and red. The atmospheric haze, which is usually pierced only by yellow and red light, reminds one of the haze-piercing value of red photographs in terrestrial aviation. But the opacity of the Martian atmosphere is greater than that of the earth's. Using the same spectral region, Slipher has photographed terrestrial landscapes "through an air path equivalent to several times the earth's homogeneous atmosphere" (that is, the amount of air between us and the zenith). It is very unlikely that there is actually a much greater quantity of atmosphere above a square mile on Mars than there is here. More probably, the Martian atmosphere is full of some sort of finely divided matter which is "capable of an amazing amount of scattering and absorption of the short wavelengths." What this stuff is we do not know; but we now know that at times most of it is cleared out of the Martian air. Slipher reports that, on previous occasions, the transparency for blue light has increased, though never in so striking a fashion as on this one.



Photos courtesy of Dr. E. C. Slipher, Lowell Observatory

Seven examples of photographs all of the same face of Mars, taken at Lowell Observatory. Photographs taken in yellow light (yellow filter) reveal the main surface features of the planet, as in Nos. 1 and 2, taken respectively April 20 and May 20, 1937. Ordinarily, however, those taken in blue light (blue filter) reveal only the polar disk: for example, No. 6, taken in 1926. This is because the waves of blue light, being shorter, do not penetrate atmospheric haze, just as on earth. However, on May 20 and 21 of the present year exceptional conditions existed on Mars, for even the blue short waves penetrated his atmosphere almost as well as the longer yellow ones, thus making possible Nos. 4 and 5, taken with blue filters. They clearly show the great dark area of Syrtis Major (see page 132). The reason for this exceptional condition is believed to have been an unusual clearing up of the Martian atmosphere. In the *Publications A.S.P.*, Slipher writes: "Our photographic record of the planet at Flagstaff maintained for many years fails to reveal a change quite so remarkable."

Thus the blue-light photographs show three distinct states of Mars' atmosphere: Nos. 3 and 7, extensive cloudiness; No. 6, no cloudiness but great opacity; Nos. 4 and 5, the most transparent condition yet noted by astronomers.

What this haze is—or, at least, what it may be—and how it gets cleared off at times, are problems which may well interest the physicists and physical chemists—to whom we may look hopefully for a solution.

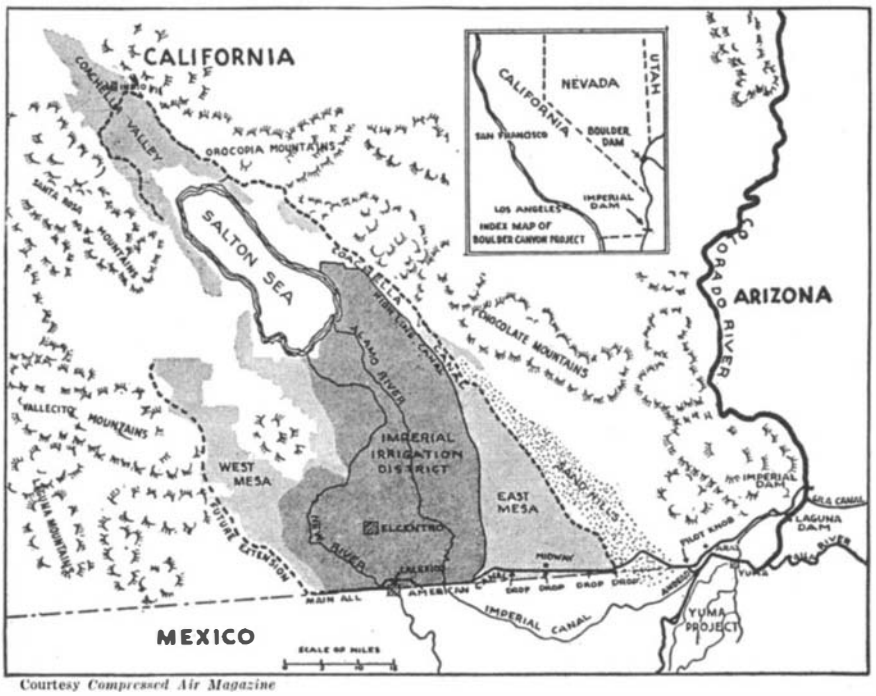
Of the reality of the canals, there can be no doubt. The writer, for example, saw some of the strongest ones, which are shown on page 132, when on a visit to Flagstaff last May, despite a night of poor seeing. Conditions were not good enough to show whether they were fine narrow lines; but their faintness, compared with the typical drawing, was obvious. It may be hoped that these few words of explanation may show why the drawings afford nevertheless a more appropriate and useful method of recording the observed facts than a more "realistic", though no more accurate, representation.—*Jamestown, Rhode Island, July 1, 1937.*

FINISHING THE

New Canal Replaces Old One that Goes Partly Through Mexico . . . Water for Two Rich Agricultural Valleys . . . A Monumental Undertaking

WORK on the All-American Canal is going forward so rapidly that the great 80-mile ditch and its appurtenant features will be ready to deliver irrigation water to the Imperial Valley in southeastern California some time during the first half of 1938. The waterway is being dug across a normally desert region that once formed the water bed of the prehistoric northern extension of the Gulf of California, as we know it today. Paradoxically, that far-flung section of the Gulf was transformed into a generally barren and arid region by the very river that is to be tapped to assure the continued agricultural productivity of soil that can be made amazingly fruitful by irrigation.

To understand the reasons for the All-American Canal, one must have some knowledge of the physical conditions of the basin in which the Imperial Irrigation District is located, of how the territory was transformed from an arm of the sea into a semi-tropical waste land, and, finally, made to blossom by man and to yield marketed crops having a current annual value of more than 50,000,000 dollars. The Salton Basin in which the Imperial Valley lies is located partly in Mexico and partly in the United States. When it was the upper continuation of the Gulf of California, its water surface had an expanse of around 2000 square miles, and the northernmost reach of that body was nearly 150 miles above the present northernmost limits of the Gulf of California.



Courtesy *Compressed Air Magazine*

Once part of the Gulf of California, the depression, Salton Sink, is over 300 feet below sea level at its deepest. Two rich farming valleys lie within its area

PROBABLY not less than 500 years ago, the Colorado River discharged into the ancient gulf in the vicinity of Yuma, Arizona, and therefore close to the existing international boundary. The river today discharges into the Gulf of California approximately 60 miles, by air line, farther southward. In the past, as now, the Colorado River dredged from its watershed annually an enormous quantity of soil and carried much of that material onward to its mouth where it gradually built a ceaselessly lengthening and widening fan-shaped delta. Even now, there is deposited on the delta each year an average of 170,000,000 cubic yards of silt—that is, as much as all the earth that was dug in excavating the Panama Canal. The apex of that delta is near Yuma, and widens out as its axis extends southward. That delta has a somewhat arched surface; and more or less upon that crest, like a drunken person, the river has staggered in its flood stages and frequently changed its course to a pronounced degree within the memory of the white man on this continent. This is understandable because the soil of the delta is soft, while the river is violent when in flood.

When in one of its recurrent capricious moods, the Colorado started building an arm of its delta directly outward from what was then the eastern shore of the gulf, and the river progressively extended that barrier until the opposite shore was reached—thus bisecting the gulf and isolating its northern area so as to create a vast land-locked lake. The strong sunshine characteristic of the region and very scanty annual rainfall led in time to the evaporation of most of the water in the basin, leaving in the end only the water that has been variously known since the close of the 18th Century as the Salton Sea or Salton Sink, which occupies the deepest part of the basin, in California. It is said that the lowest point in the bed of that body of water is 320 feet below the normal level of the Pacific Ocean.

Furthermore, the bed of the Colorado River is about 100 feet above sea level at the northern limits of the delta. Therefore, flood water overflowing the western bank of the delta has a descending slope of about 400 feet down which to rush toward the Salton Sink. According to Indian tradition, the Colorado has invaded and even filled the Sink on numerous occasions. Since 1900, the river has ruptured its banks and entered the basin several times—the flow once continuing for well-nigh a year. At that time, the excess flood water cut a path 1000 feet wide and as much as 80 feet deep as it surged onward to the Salton Sink and raised the level of that body of water nearly 73 feet.

This peril has been an ever-present one since water was first deliberately let into the Imperial Valley early in 1901, primarily to irrigate the fertile but arid soil of that part of southeastern California. In the meanwhile, communities have developed upon the American area where now there is an aggregate of about 75,000 inhabitants; and of the total of 586,000 acres in the Imperial Irrigation District that are susceptible of cultivation, something more than 450,000 acres are actually being farmed. The American expanse of the entire basin, including the Coachella Valley and two potentially productive mesas, embraces close to 1,000,000 acres of land that can be irrigated, by gravity or pumpage, and made to yield rich returns under skillful handling. The growing season is virtually the entire year.

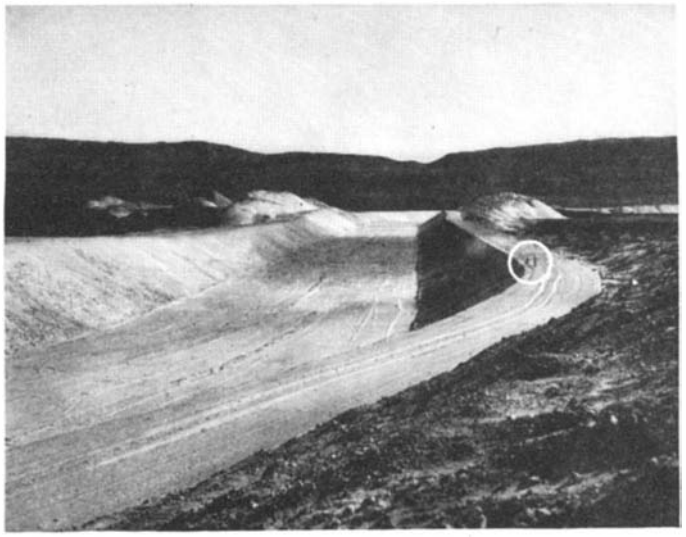
Since 1901, about 200,000 acres in the

ALL-AMERICAN CANAL

By R. G. SKERRETT

Mexican part of the basin have been made productive by water from the old canal originally constructed to serve American farmers. To save money and to dodge obstacles reared by nature on American soil near the river, the first intake was dug in California a mile and a half above the international boundary, and from that point the canal was run southward and parallel with the Colorado until it soon met the old and dry channel of the Alamo River —one of the former courses by which the Colorado penetrated the basin. The use of the old water-bed obviated much expensive excavating but it led the canal by a devious path, 50 miles long, through Mexican territory before re-entering the United States. Not only that, but the promoters had to agree to give Mexican farmers in the region traversed half of the water whenever they desired it. In the beginning this did not cause friction, but the development of agriculture in the Mexican section of the delta entailed the withdrawal of increasing volumes of water, and this hampered and even imperiled the American farmers when the river was low.

The flow of the Colorado at the canal intakes—there are now three—ranges from an average maximum of 200,000 second-feet to a minimum flow of 3000 second-feet at ordinary low stages. At times, the minimum flow has been a great deal less, and the maximum recorded flood has been of much larger volume than that just mentioned. The diminished water reaching the farms in the Imperial Irrigation District has on occasions imposed crop losses amounting to more than 5,000,000 dollars in the course of a single year. This situation explains some of the reasons for the construction of the All-American Canal, which is designed to deliver to southeastern California much more water than now can reach that area by way of the Imperial Canal; and the new canal is also counted upon to supply the neighboring Yuma Project with enough water to irrigate some tens of thousands of additional acres there. Not only will the canal be able to distribute a vitalizing flood of ample capacity to an immense agricultural area, adjacent to the lower basin of the Colorado River, but the water will be better suited to help the farmer than heretofore. That is to say, the Boulder Dam, the Parker Dam of the Colorado River Aqueduct, and the enormous desilting plant at the Imperial Dam will conjointly remove from the river water all but 20 percent of the silt that has been entering the Imperial Canal. The silt has clogged laterals and irrigating ditches and called for dredging which in recent years has necessitated an outlay of about 1,500,000 dollars annually. The intrusive silt, moreover, has overflowed on to nearby lands where it has damaged crops and impaired the agricultural value of the soil.



Section of the new canal where it passes through barren desert. In the circle, the two men serve as a size-comparison

The three outstanding features of the All-American Canal Project are the diversion dam across the Colorado by which the river water will be impounded and directed into the headworks on the California side of the river; the immense desilting plant which will remove 70 percent of the solid matter in suspension in the water; and the canal, itself, which will have an initial length of 80 miles and deliver most of its water to the lands lying within the well-known Imperial Irrigation District, located to the east and south of the Salton Sink. Later on, the canal will deliver water to the Coachella Branch Canal. It will from the start supply the Yuma Project with 2000 second-feet of water. The Coachella Branch Canal, which will be 130 miles long, will draw, in time, 2300 second-feet of water from the main canal now under construction. The main canal, where widest throughout that part of it that connects with the headworks at the river, has sloping sides that assure a channel width of 160 feet at the bottom of the waterway and a water surface width of 232 feet when the water in the canal has a depth of 21 feet.

The canal, at the depth mentioned, will be capable of receiving and passing onward 15,000 cubic feet of water every second—five times the average volume of water flowing in the Colorado past Yuma at the minimum low-water stage. This flow can be maintained because of the capacity of Lake Mead and the regulatory facilities at Boulder Dam. The cross-section of the All-American Canal will be reduced in area as that waterway lengthens and gradually approaches its westernmost end in the vicinity of Signal Mountain, close to the international boundary and the far side of the Salton Basin.

The intake of the canal now building is about 15 miles upstream from Yuma and five miles above the Laguna Dam that diverts water to the Yuma Project. From the Imperial Dam southward to a short way below the Laguna Dam, the canal route follows closely the Colorado, and then turns westward and southward until it again nears the river at Pilot Knob, where it takes up its long run westward, generally paralleling the international boundary a little to the northward of that line. At Siphon Drop, on the Reservation division of the Yuma Project, the All-American Canal delivers water to the Yuma Canal. West of Pilot Knob, the new canal crosses a sand-hill region for 10½ miles—the obstructing area that caused the builders of the old Imperial Canal to keep to the eastward and to go south into Mexico.

IN crossing the sand-hill area, broad cuts have been dug right through some of the hills to a depth of as much as 115 feet. The canal section through these hills will not be lined, although the flanks are being compacted; but measures are to be taken to check the blowing of sand into the canal. These measures may take various forms, such as vegetation grown on each side of the canal in a wide zone and irrigated from the canal; the spraying of the sand

In some sections, it was possible to do the necessary excavating for the canal with mule-drawn scoops. However, three tractors are shown assisting at this spot

Sand and gravel in the hotter desert sections called for the use of draglines operated by powerful engines. Here, the problem of drifting sands is a big factor

with crude oil; or the covering of the light sand of the neighboring dunes with coarse material excavated from the canal prism and too heavy to be disturbed by the winds.

The entire undertaking will involve the excavation of approximately 65,000,000 cubic yards of material, of which not more than 4 percent will be rock. The vast bulk of the digging has been done with gigantic power shovels and draglines, having bucket capacities of from 12 to 16 cubic yards. Bulldozers or plows of unusual power, and also large scrapers, have battled with the broken soil in smoothing it and distributing it to subscribe to the specified forms and surfaces. In short, all this work has gone forward on an unprecedented scale, and tremendous volumes of material have been thus disposed of in digging the canal, in modeling its floor and slopes, and in rearing the flanking berms that are further bulwarks against drifting sand.

PRIMARILY, the new canal on American soil will feed into the existing branch canals and laterals that have in the past obtained their water from the old Imperial Canal. But the present system will be extended and eventually other branches will be dug to distribute the water to areas not yet farmed but susceptible of irrigation either by gravity or pumpage.

None of the water flowing through the All-American Canal is intended for use in Mexico. At necessary points along the canal there are drops of 24, 26, and 51 feet, where installations will be provided in time for the generation of hydro-electric energy ranging at the several points from 6200 to 24,000 kilovolt-amperes. These stations will lie westward of the sand hills and within a stretch of 25½ miles. The power will be put to a variety of services.

The Imperial Dam, by which the river water is to be diverted in the first place, is a concrete structure, now building, that will have a total length of about 2990 feet, exclusive of the rock-fill dike, about 470 feet long, at the Arizona end of the barrier. The central part of the dam will serve as an over-flow weir, which is to have a length of 1200 feet and a maximum height of 31 feet. This weir section is of the hollow concrete "floating" type, resting on a silt or sand foundation, and is to be partly filled with sand and gravel to give it the added deadweight necessary to assure its stability when resisting the thrust of the water arrested by it.

Probably the most spectacular feature of the headworks is the immense desilting plant consisting of six settling basins, arranged in pairs, with each basin 269 feet wide and 769 feet long. The silt-carrying water will be handled by 72 Door thickeners, having a spread of 125 feet each, which, by rotating slowly, will concentrate the suspended solid matter and cause it to sink. The plant will be counted upon to remove daily from the water from 50,000 to 70,000 tons of the suspended solids. The precipitated silt will then be sluiced away into the river below the dam. The desilted water after this treatment will be discharged into suitable channelways, connecting with the canal, that permit of complete flow regulation.

The total estimated cost of the present main canal and its appurtenant features is 38,500,000 dollars. The Government is to be reimbursed by the Imperial Irrigation District within a period of 40 years. The Government is well secured because the present value of the cultivated lands in the district is said to be 100,000,000 dollars, while the value of the crops shipped from the district is now steadily mounting and probably exceeds 50,000,000 dollars annually. The principal crops are alfalfa, cantaloupes, barley, milo maize, and small fruits; but many other products are being raised and will be grown in large quantities as soon as a sufficiency of irrigating water is assured. Each season approximately 30,000 carloads of cantaloupes and lettuce are sent to remote markets. The average annual crop yields of alfalfa are from seven to ten tons per acre—that is, a ton to a cutting; and an acre will produce 96 crates of cantaloupes. No wonder the Imperial Valley is looked upon as an amazing region, especially when its present fruitfulness is contrasted with its arid barrenness less than four decades ago.

The construction of the All-American Canal is under the direction of the United States Bureau of Reclamation; and when the undertaking is finished, it will mark the completion of the third and last of the main features of the Boulder Canyon Project.

Imperial Valley lettuce, grown on irrigated land

PRE-CERTIFIED LUMBER

By MARY BRANDEL HOPKINS

THE seemingly incredible feat of determining the grade and value of lumber which will be yielded by trees still standing in the forest has been achieved. In the future, if pruning is practiced scientifically, the extent of knots—the cause of irregularities in lumber—will be known definitely, and foresters will be able to "certify" in advance of cutting the grade of lumber to be obtained.

This ability to peer behind the veil of uncertainty is afforded the lumber industry by the United States Forest Products Laboratory at Madison, Wisconsin.

To the lumberman the beauty of low-branching evergreens framing a spacious lawn is only skin deep. When he gazes skyward 60 feet along the symmetrical trunk of a veteran white pine before encountering the first branch and says, "That tree is a beauty," he is speaking frankly in terms of lumber grades. He is looking under the skin. He is visualizing beneath the bark a sheath of "clear" or knot-free wood (increasingly hard to find), thickest at the tree base and gradually diminishing in thickness to a point about 15 feet below the green crown, where stubs of former branches show through the bark. He visions a second zone, inside the clear wood, characterized by "loose" black knots from dead branches, and still farther within he sees a core of "tight" knots remaining from branches that functioned when the tree was young, perhaps 350 years ago. His study reveals that the three and a half century old pine spent the first 100 years of its life—the period characterized by the dead and living branch zones—merely getting ready to produce the clear wood, whose growth consumed the next 250 years.

Above are typical unpruned forest trees, the future knots waiting to be enveloped in wood. The picture below shows how this takes place, to the detriment of clear lumber

MOTHER Nature's method of producing knot-free or clear wood is exceedingly slow. This has meant in the past that knotless wood was formed only in the outer layers of the branch-free lower part of tree trunks, and that from 200 to 500 years have been required to grow the clear lumber, cut principally from virgin growth timber, which is turned out of American sawmills today.

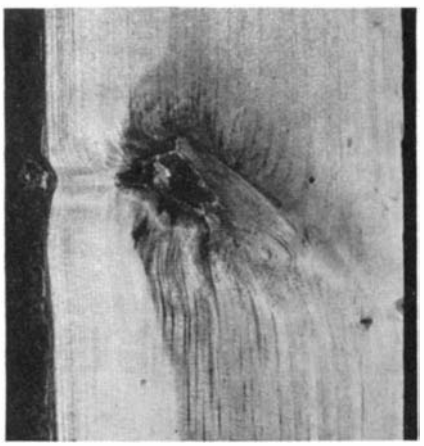
Man can not wait two to five centuries to renew the supply. He is impatient now to produce in second-growth forests, but in much less time, the same quality of timber found in the virgin forest. Yet by clearing, he has so changed forest conditions that future growth of knotless wood will be delayed a long time, because of the tendency for trees in more open places to assume the habits and appearance of widespreading, low-branching lawn trees, which contain only very knotty lumber.

In the virgin forest, side branches are removed through a snail's pace process called natural pruning—the result of gradual dying because of the exclusion of sunlight. With most of our native species that grow in fully stocked stands, the side branches are soon killed because they cannot endure shade. It is in trees in understocked areas, which do not receive shade on all sides and therefore retain indefinitely their green branches almost to the ground, that the "tight knot" or core develops most extensively.

Then, through a process of disintegration and decay frequently stretching out to exceed the lifetime of a man, the dead branches gradually weaken. Unable longer to bear their own weight, they drop to the ground, leaving irregular stubs that often cling to the trunk for 50 to 100 years before they are enveloped by new growth layers, much as a fence post is enveloped by layers of drifting sand. Later, when the trees are cut for lumber, these persistent branches appear as knots and cause serious degrade.

Only by pruning is it possible artificially to reduce the time that elapses during the formation of the knotty zones, and consequently their extent. The wound surface should be smooth and the cut made close to the trunk without tearing the bark.

Above is a sample of forest that has been pruned, and below is the kind of lumber that later results. As the years go on the new growth, all clear, will increase in width



RADIUM—
NATURE'S ODDEST CHILD

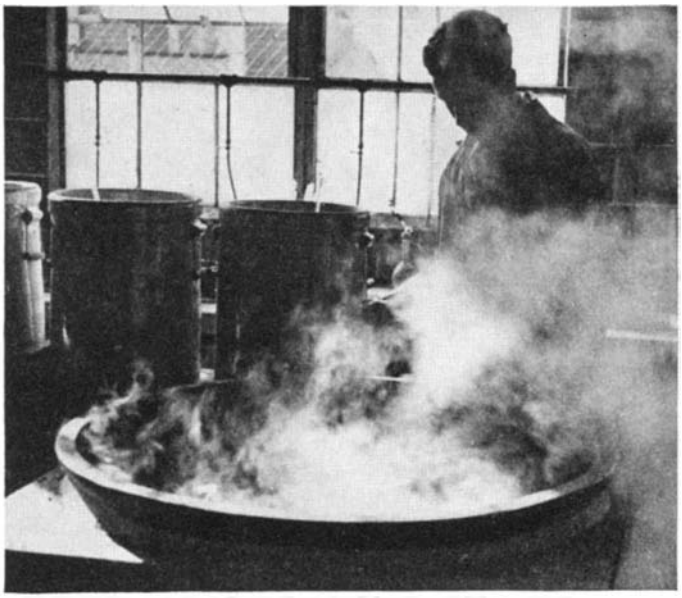
Fruitless Early Expectations of Vast Power from Radium Atoms . . . Namombo Startled the White Men . . . Canada's Notable Contribution to Healing

By JOHN A. MALONEY
The Museum of Science and Industry, Chicago

(*In Four Parts—Part Three*)

THE discovery of radium and the phenomenon of radio-activity turned the course of history for 20th Century physics. With its discovery came the knowledge that the atoms of certain heavy elements were not permanently stable but broke up with explosive violence. The inner structure of the atom, which had defied the mind of man since the days of the atomists in ancient Greece, the discovery of isotopic elements—elements identical in their physical and chemical make-up but differing in their atomic weights—these, and many other secrets of matter were solved by the discovery of radium.

Men were excited about the possibilities of this new substance. The energy that it gave off was staggering to the imagination. It was natural that the question should arise as to how this energy could be harnessed and put to work. Flannery and the others thrilled with the possibilities. Were not such eminent physicists as Sir Ernest Rutherford writing essays on harnessing the energy of radium and its future as a source of power? All of them realized that what was needed was a catalyser that would speed up the rate of disintegration of radium so that, instead of dissipating half of its energy in 1690 years, its power could be drawn off to turn a dynamo or push a piston in an instant. It may appear now that they were anticipating and were far ahead of their times.



All Illustrations Associated Screen News, for Eldorado Gold Mines, Canada

The first evaporation of barium radium liquor in the Curie process for separating radium from barium, at the Eldorado refinery. The starting liquor is about 500,000 parts barium to one of radium. Over 23 evaporation processes are required before the final salts, with 90 percent radium, are secured

To conclude our story of American efforts to gain a foothold in the radium market, we must shift our scene again—this time to a sweltering jungle near Elizabethville, in the Belgian Congo. The year is 1919. Dr. Jan Schoep and his expedition of Dutch scientists are laboriously making their way through the wilderness. Suddenly a painful scream that is undoubtedly human rings out through the jungle. In a few minutes the party came upon a lion mauling a native boy. The lion was shot and Dr. Schoep found that the boy's leg was broken and his whole body was horribly scratched. While Schoep set the leg, a runner was sent back to the nearest village to locate the boy's people.

His father arrived on the scene and escorted the party back to the village. Dr. Schoep recognized the father as Namombo, a powerful tribal chieftain in that vicinity. The chief thanked the doctor and his party and offered them gifts. When these formalities were completed, Namombo startled and horrified the white men by ordering his assistants to remove the bandages and splints from the boy, and to encase his leg in mud, plastering the open wounds with thick, oozy poultices. To men who were trained in modern methods of healing, such a procedure could be only an invitation to hordes of bacteria and a quick case of infection. They vainly protested against this savage treatment. But Namombo asked them to wait for a few days and see the results. In three days the mud casing was removed and, to the astonishment of Schoep's party, the boy's wounds were practically healed.

AFTER finishing their trip the party returned to Europe and Dr. Schoep presented the strange tale of an African mud-pack to the Royal Scientific Society of Brussels. An expedition was sent to the Congo to trade rifles and other commodities for samples of the mud. It did not take long after that to discover by chemical analysis that the mud which was being used by African natives to cure flesh wounds was also the richest radium-bearing deposit of pitchblende in the world. This discovery came just at the time when the radium industry in the United States was getting on its feet. But the enormous deposits in the Congo made it possible to cut the price of a gram of radium almost in half, and the American efforts at production ceased almost overnight.

Up to the time of the discovery of radium in the Congo, Flannery's organization had produced more than half of the world's stock of refined radium—a feat that is all the more remarkable when we remember that carnotite, unlike pitchblende, occurs as a binder between the grains of sand and involves the extraction of tons of worthless rock. To secure 1000 pounds of radium

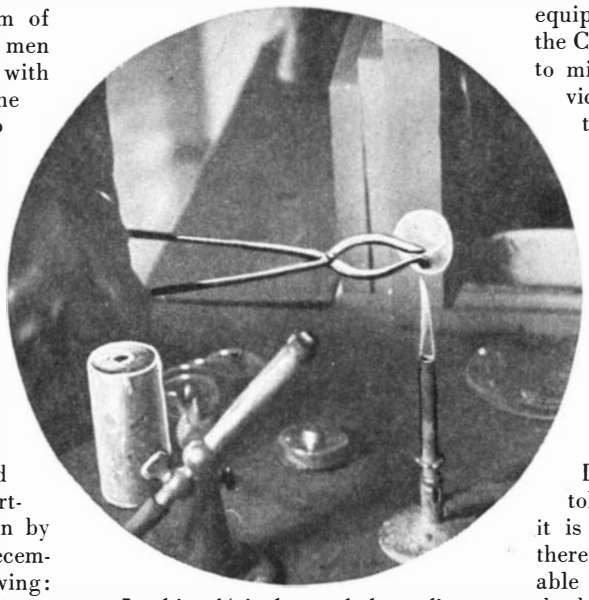
chloride that may contain a gram of radium, it was necessary for these men to treat 500 tons of milling ore with 300 tons of chemical, to use the power of 1000 tons of coal and to use more than 1000 tons of distilled water and the labor of 150 men for six months.

The exploitation of the pitchblende deposits of the Belgian Congo has been in the hands of a group known as the Union Minière du Haut Katanga. This organization has held practically a world monopoly on radium production (with some production in Czecho-Slovakia) since the cessation of operations in the United States. In a United States Department of Commerce bulletin written by Frank L. Hess and published on December 14, 1931, we find the following: "Particulars regarding the Belgian Congo deposits, owned by the Union Minière du Haut Katanga, are still heavily veiled in secrecy, and no word of reserves, or tenor of ore, is allowed to reach the public." Governmental figures for shipments of minerals from Belgian Congo include 944 metric tons of uranium ore in 1928 and 1296 metric tons in 1930. Sales of radium as given in the company's annual reports have been as follows:

Year	Grams
1923	20
1924	22
1925	20
1926	20
1927	26
1928	42
1929	60
1930	60

THAT the section of wild country around Great Bear Lake, on the Arctic Circle, is rich in mineral deposits, has been known to prospectors for at least 20 years. With the advent of the airplane as a tool of the prospector, the desire to devote closer attention to this region has grown by leaps and bounds. There is little reason to believe, however, that there will be a general exodus to this district simply because of the encouraging reports that have come in regarding rich deposits of silver, copper, and pitchblende. The trek across the United States in the days of '49 was a gay excursion in comparison with a trip to Great Bear Lake. The ice in the river and small bay breaks up sufficiently by July 1st to permit navigation, but the main body of the lake cannot be navigated until after July 15th. Night frosts set in again about August 15th, and by the end of September winter has asserted itself to such a degree that navigation is again an impossibility.

The end of this rainbow, with its pot of radium instead of gold, offers slightly



In this 1¼-inch vessel the radium from 20 tons of ore approaches final concentration stage. The final work is done by a physicist, who is protected by rubber gloves and lead shield. At left is a lead cartridge in which tiny tubes of radium are shipped. Total world's production of radium to date is 2½ pounds, worth 22,500,000 dollars

more encouragement to the prospector who comes by the air route. Aircraft on skis can usually operate from waterways from December until early April. On Great Bear Lake itself pontoons must replace the skis from the break-up of the ice in July until the freeze-up in September. Darkness, at this gateway to the land of the midnight sun, seriously hampers winter flying.

Taking it for granted that even these conditions will not deter those rich enough in the world's goods from

Radium-barium crystals produced during the final stages of the Curie fractional crystallization processes in the Eldorado refinery at Port Hope, Canada. In this flask is one gram of radium valued at 30,000 dollars. Radium is seldom reduced to metallic form: it oxidizes. It is left as a salt—usually sulfate

equipping themselves for travel by air, the Canadian government takes occasion to mingle a few words of friendly advice with those of welcome. Read this, from a recent bulletin describing the region and issued by the Geological Survey of Canada: "Parties entering should not depend in getting supplies of any kind at Great Bear Lake. Natives or dogs are probably not procurable at the lake. The trading posts carry limited supplies but cannot meet large, unusual demands. In March temperatures below 50 degrees and stormy weather are probable." In a subsequent report we are told that some timber is found but it is nowhere of much size, and that there is just about enough of it available for initial mining operations and the building of cabins. Game is scarce, fish plentiful, and flies are a plague. Surely this is not a region that would appeal to the tenderfoot.

THE airplane has played an important part in the discovery of radium in the Great Bear Lake region of Canada. The conservative element of the mining profession has always scoffed at the idea that riches were to be found far up in this wild country—"the great beyond," as it is affectionately referred to in mining circles. Strange characteristics of geology and archeology have been brought to light when the aerial route has been substituted for the beaten path. The explanation is simple. From the vantage point of an airplane, watch a farmer, on a brisk autumn morning as the sun strikes the frost of the fields and turns it into sparkling dew-drops. The farmer's footprints as he crosses the fields are plainly visible, although from the ground they could scarcely be distinguished. Just so have the achievements of the departments of public works of the ancients as well as nature's geologic heavings escaped the searching eyes of the archeologist and the prospector until they took to the air. Then they are revealed as if by magic. [See "Archeology from the Air," by Stanley Casson, Scientific American, September, 1936, pages 130-132.—ED.] The prospector has not been slow to adopt the airplane as an aid in detecting strata which reveal in striking clarity veins of material which can be charted and marked for further and closer scrutiny.

Thus it was that Gilbert La Bine, a Canadian mining engineer, and Leigh Brintell, chief of the Western Canada Airways, in the summer of 1929, flew over the Great Bear Lake region, hunting in this ship of the neotechnic age for outcrops and formations that were evolved by nature long, very long, before even the paleotechnic age began. Their first reward came in the discovery

Filtering purified radium bromide at the Eldorado refinery before starting the evaporation of the barium content. The uranium, silver, manganese, and other by-product materials are separated during the earlier stages of the recovery

of iron and quartz, revealed by a rusty stain 200 feet wide. Closer inspection revealed copper, silver, and cobalt deposits, some of the copper occurring in mass boulders 60 tons in weight. Having glimpsed this storehouse of nature's treasures, they returned to civilization, where La Bine immediately prepared for a return trip. Despite the fact that it was the month of February, he flew to Great Bear Lake and, after four months, discovered the radium-bearing pitchblende deposits and named the site La Bine Point.

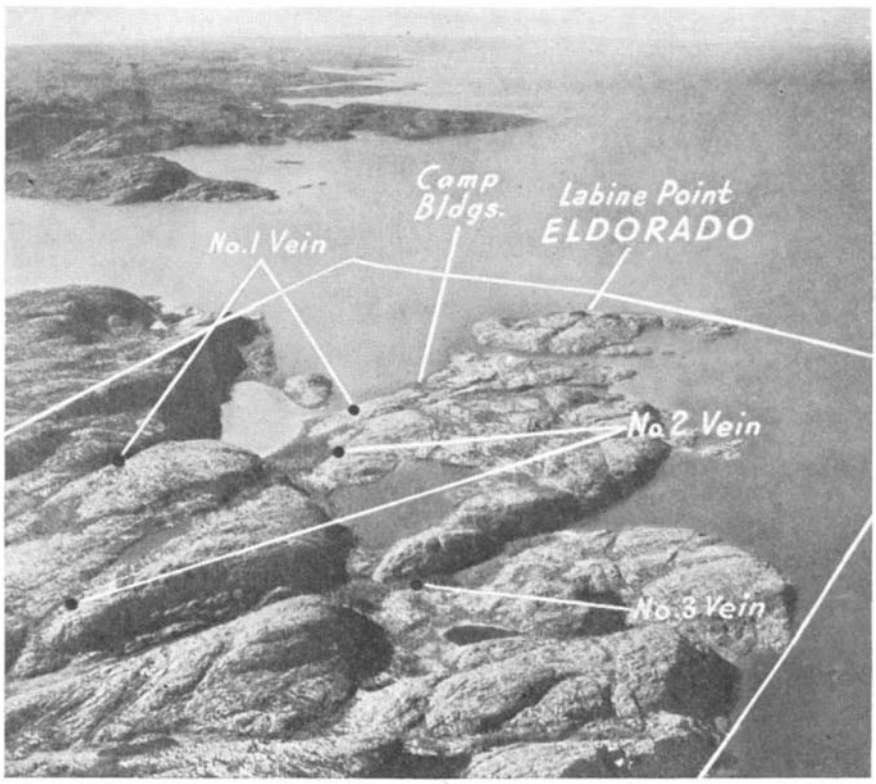
GREAT BEAR LAKE is about as large as Lake Ontario and is but one of the frontier spots in the Canadian Northwest Territories which consist of over 3,000,000 square miles of wild country. The rugged fastness of the whole region is broken only by stations of the Hudson Bay Company, the Canadian Northwest Mounted Police, missions where the priest may be able to put in an appearance but once in the year, and by the cabins of trappers and foresters. Transportation, such as there is, consists mainly of horses and canoes in summer and dog-sleds and snowshoes in winter. The dogs are part wolf, and tales that make the blood run cold have been told of their ferocity when the awful grind of toil fails to keep their semi-savage brains dormant and docile. The airplane, a godsend in one sense, is a hazard in another. La Bine and his party found the wreckage of another prospector's plane on the shore of Hunter Bay. It was easy to reconstruct what had happened. That prospector was an experienced flyer, but in the Far North nature does not provide landing fields and it is not an easy feat to judge one's distance. The plane had crashed and the pilot drowned—all due to a few feet.

So rich (90 milligrams per ton) were the radio-active ores which La Bine brought back to civilization from this second trip that it would even be profitable to transport the ore by airplane freight 1000 miles to the end of steel at Waterways, Alberta, and pay the $1.30 per pound charged for air freight. Radium history again runs in parallels, for it will be recalled that the Congo ore was transported to Belgium for refining, although in this case it was brought by steamer at a rather low freight rate. Eldorado Gold Mines Ltd. sank a shaft into the Great Bear Lake vein and built a mill for crushing and concentrating the ore at the site of the mine. The mine and the mill are electrically operated and 100 men produce 75 tons of ore daily. Three thousand miles away, at Port Hope on Lake Ontario, the refinery was erected and is in operation. No secrecy surrounds the activities, and information is readily and courteously given by the mine operators. The Canadian Bureau of Mines conquered the ore treating problem and Dr. Marcel Pochon, a noted French scientist, who began his radium career in the Curie laboratories, took charge of the processing and adapted to large scale production the methods originally worked out by Madame Curie. In Canada radium has achieved the status of an industry, and at the present time the refinery capacity is being tripled.

Silver is also produced from the vein in the Sub-Arctic and this goes directly into a smelter. The pitchblende is shipped in neat, small bags, and the bags themselves are burned at the refinery and treated as radium-bearing ashes. Strictly speaking, no pure radium—that is, metallic radium—is produced. In fact, there is practically none in existence. Radium bromide, the final product at Port Hope, is about 90 percent radium, looks like common salt and is sealed in glass tubes about the thickness of a match. From Port Hope the radium goes to the National Research Council at Ottawa, where its official strength label is affixed, and then usually to Great Britain where it is changed to a sulfate and sealed in needles, plaques, or bombs.

The medical world has watched with keen interest the development of the radium industry in Canada during the past few years. Because the Canadians could obtain no aid from foreign radium interests, they were forced to solve the intricate chemical problems themselves. They have succeeded admirably —so much so that Dr. G. E. Richards, internationally known radiologist, said recently that he considered this Canadian achievement in making radium more plentiful and cutting the cost in half "the greatest contribution to the treatment of cancer in the lifetime of anyone now living."

(*To be concluded*)



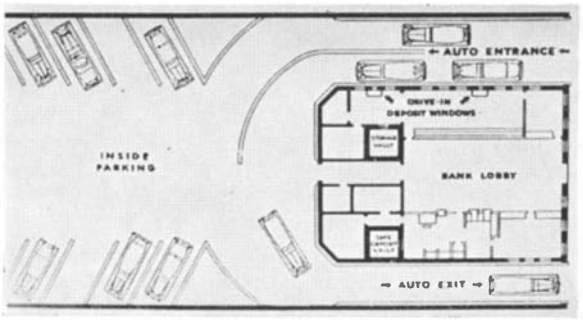
The scene of Gilbert La Bine's pitchblende discovery where, during the last six years, a modern mill and electrified mine plant have been built on the Arctic rim. The location of three of the veins is shown. Note sparse forest

Banking By Automobile

WHAT is reputed to be the first drive-in bank in the world has recently been opened at Vernon, a suburb of Los Angeles, California. When he wants to do business at this bank, the motorist need not search for a parking place for his car; he merely drives into the bank building and transacts his business without even moving from his seat. Convenience for patrons is coupled with safety by bullet-proof glass and an automatic gateway, shown below.

Mirzaoff Photos

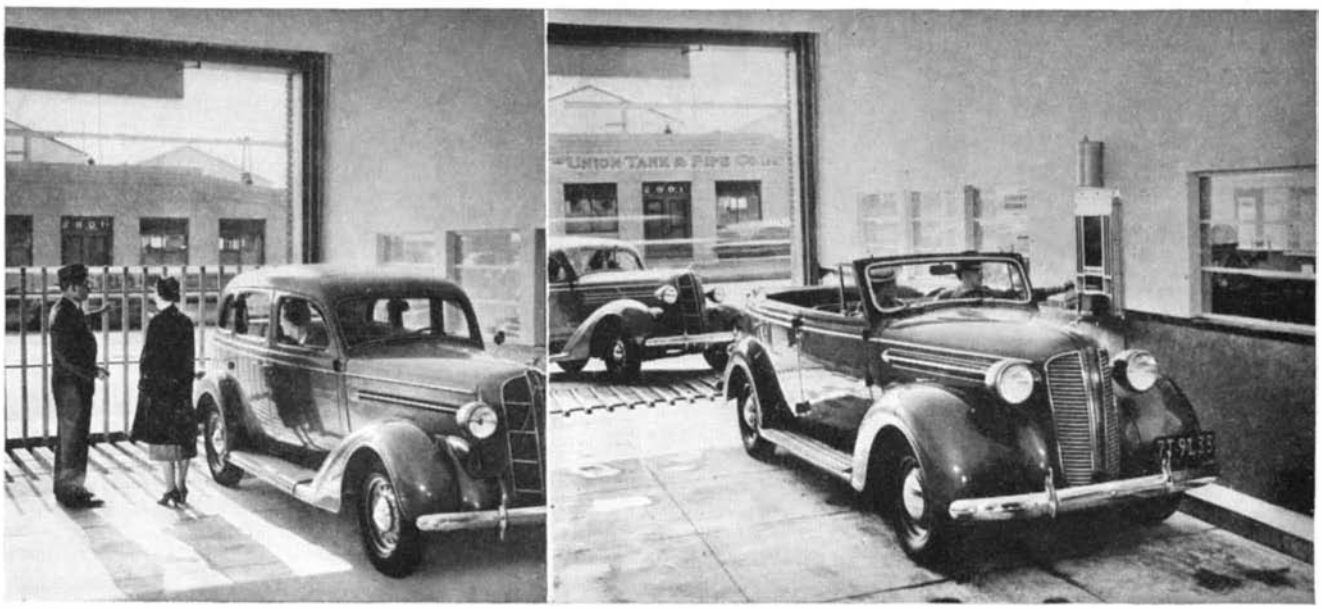
Above: The motorist places his pass-book in a rotary container which is actuated by the teller. *Right:* Floor plan of the auto-bank, showing driveways and parking space in the building



Above: Interior of the bank teller's cage, showing the means by which he operates the rotary container in which are deposited pass-books, checks, and so on. The window is bullet-proof and outsiders cannot gain access to the cage through the container

Below: The electrically operated gateway closed after a car has entered the bank. It is automatically operated by the approach of another automobile

Below: A motorist concluding a transaction at the teller's window, and another car entering



HEALTH ASPECTS of Air Conditioning

TODAY in scores of research laboratories over the land the complexion of the air-conditioning industry is undergoing fundamental changes that will alter the public conception of this art and launch it into new fields of public service or direct it up avenues that were unthought of a few short years ago.

Working with known facts developed over the past decade, engineers and scientists see the industry on the threshold of developments likely to have a profound effect on sociological, public health, and medical problems. In short, air conditioning is beginning to broaden its own base and become a powerful factor for the general good instead of an expensive luxury for the comparatively few.

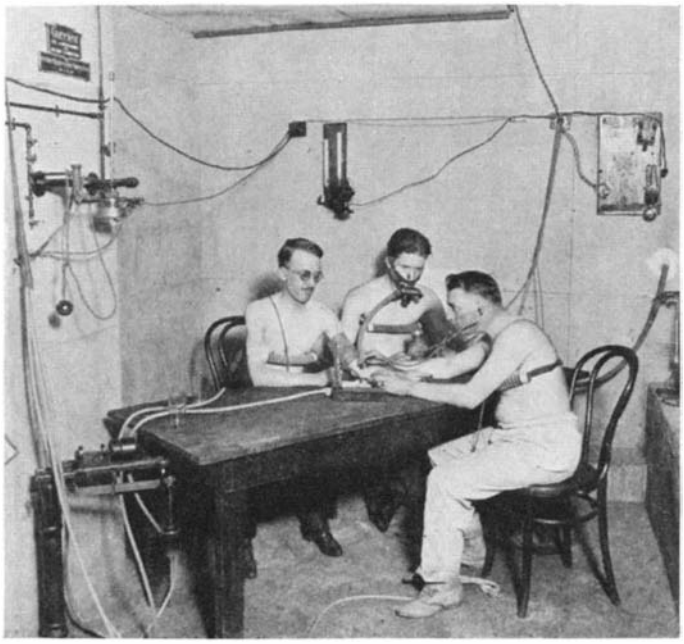
Let us, for the moment, dismiss the familiar examples of present-day air conditioning as experienced in the department store, your favorite restaurant or movie theater, and the scores of other places where air conditioning has become almost commonplace. The future in such fields is already well mapped out.

The more fascinating aspect of air conditioning lies, not so much in a speculation of its more accepted applications, which will take place more or less as a matter of course, but in examining the underlying trends that are taking definite shape in the research laboratory out of which entirely new applications may be born. The field that is being given most consideration today by scientists who are looking ahead a decade or more, is the medical field. Air conditioning, they believe, is on the threshold of a major advance in the treatment of the sick which is destined to develop into an important tool of the medical profession.

BOUND up in this subject, a new phase of air conditioning is appearing—air sanitation. In the not-so-distant future, air conditioning will contribute importantly to hygiene, and promises to assume a significance second only to that of food and water. Thus, intensive work is going on to find out what beneficial effects air conditioning will have on health and how it can be used in the treatment of disease.

That it has already found a place in certain phases of fever therapy was attested to at a recent gathering of distinguished physicians who met in New York to discuss the advantages of the so called "fever box," in which air conditioning has been found to be the most reliable and safest method for artificially raising body temperatures with complete protection against burns.

Following the work of the distinguished research scientist, Charles F. Kettering, in the development of fever-box equipment, the American Society of Heating and Ventilating Engineers announced at its last annual convention that its Research Laboratory in Pittsburgh had worked out the design of an air-conditioned fever box and gave a résumé of the results accomplished with it during the course of a long investigation, undertaken in co-operation with physicians of St. Francis Hospital in Pittsburgh.



Two doctors and a medical student observe their physiological reactions to atmospheres of high temperature and humidity. Body temperature and rate of respiration and metabolism are electrically recorded also by observers outside the room

Drawing upon the data collected over a period of years—relating to the physiological effects of high temperatures and humidities on the human body—equipment was developed with which it is now possible to subject patients to temperatures from 105 to 110 degrees, Fahrenheit, in a saturated atmosphere.

It has recently been re-discovered that certain diseases, notably syphilis and gonorrhea, react favorably to elevated body temperature. Extraordinarily interesting results followed the development and use of the air-conditioned fever box in the Pittsburgh tests, indicating that air conditioning will play an increasingly important part in fever therapy toward the treatment and cure of the so-called social diseases.

Speaking as head of a group of researchers engaged in studying other organic effects of air conditioning on humans, Walter L. Fleisher, consulting engineer of New York, says that recent studies of air conditioning for the benefit of the abnormal are leading to better understanding of adapting air conditioning to the needs of the normal person. This is leading to the exploration of new avenues of research relating to the greater field of general human comfort.

"THE immense possibilities on the medical side of the picture today are hardly realized, even by their most ardent supporters," says Mr. Fleisher. "Consider what can be accomplished—indeed, what is being accomplished—by the co-operative approach of two great professions (the engineer and the physician) to national problems of health protection. Research is now going on which may uncover the causes or reasons for the curative quality of the air in tubercular centers, such as Arizona, and enable us to duplicate this air in air-conditioned sanitariums in the East. The effect of high temperature and high humidity air on the insane, instead of the commonly used high-temperature water baths, is another field which holds much promise. Hospitals today are taking a greater interest in air conditioning than at any time in the past. Much constructive progress is now being made in practical researches for determining the technical and medical benefits of air conditioning in the operating room,

laboratory, clinic, and recovery wards."

Air conditioning, combined with ultra-violet treatment of entering air, has been responsible for marked improvement in the post-operative infection rate —lessening post-operative shock, greatly shortening the period of convalescence, decreasing the rise in temperature and showing a marked sedative effect, according to Dr. Robert F. James of the Westinghouse Lamp Company, who is bringing the physician's viewpoint to air-conditioning research.

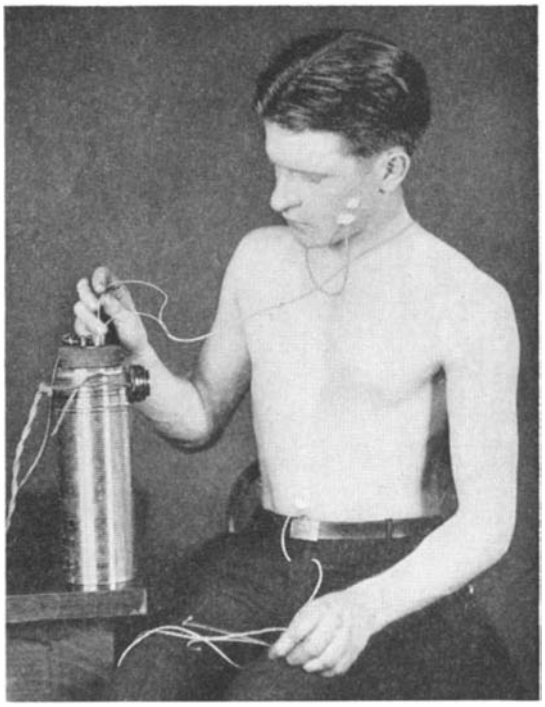
Much Research Broadening Base of Air Conditioning . . . Sociological, Medical Problems Studied . . . Greater Health, Comfort, Satisfaction the Aim

By BREWSTER S. BEACH

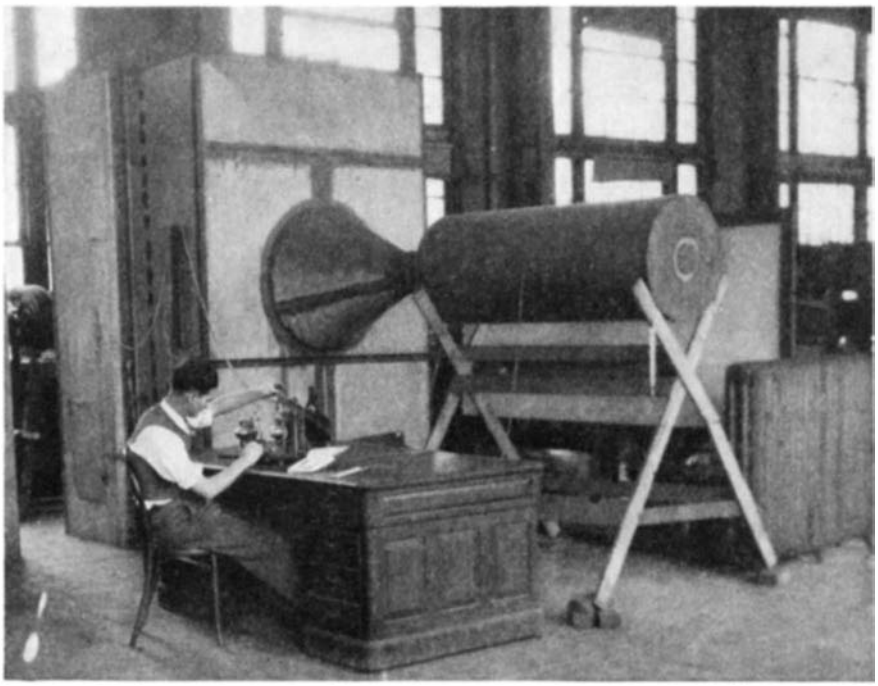
THE possibilities which seem to lie ahead of air conditioning in the field of air sanitation and air sterilization have been responsible for the determination of the industry to find out what there is about natural outdoor air that, on a brisk winter morning or a balmy spring afternoon, gives it a tang and zest that makes us exclaim: "Isn't the air great today!" To find, if possible, and to imprison this sparkling quality of outdoor air within enclosed spaces, is the present task of a distinguished committee of engineers, physicists, physicians, public health authorities, and chemists headed by Professor C. E. A. Winslow, Director of the Pierce Laboratory of Hygiene of Yale University. It is called the "Committee on the Treatment of Air with Electricity," and is actively functioning as a technical advisory committee to the Committee on Research of the American Society of Heating and Ventilating Engineers. Should success crown its efforts—and there seems to be good reason to believe that a solution can be found—there may follow profound changes in air-conditioning practice.

Air conditioning will have taken a very big forward step when it is able to duplicate nature's air at its very best. The problem is concerned with three major questions: (1) Ionization of air; (2) Ozonation; (3) Ultra-violet sterilization of air. The first action of the committee has been to try to find the real cause of so-called "bad" or "stuffy" or "stale" air.

According to Dr. G. R. Wait, physicist of the Department of Terrestrial Magnetism of the Carnegie Institution, Washington, a member of the committee studying this question, such a condition may be caused by the exhalation of minute particles in the human breath, known as ions, which run as high as 200,000,000 particles per breath, and which sometimes remain suspended in the air for considerable lengths of time.



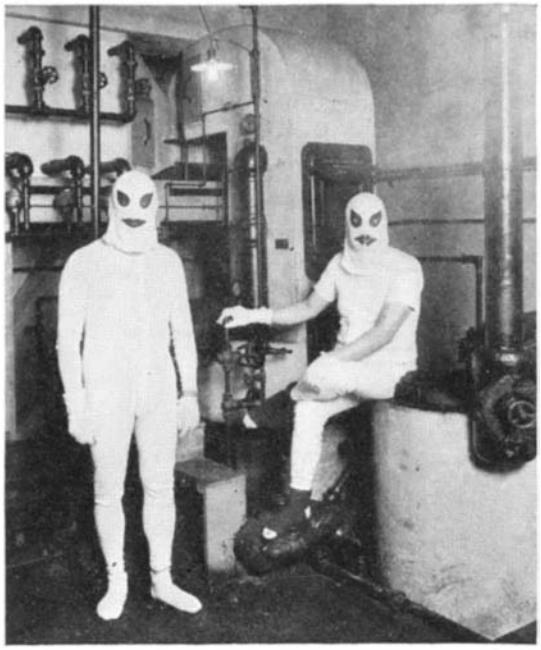
Observing skin temperatures with thermocouples in a study of physiological reactions to various indoor atmospheric conditions



Measuring air leakage through a wall resulting from wind pressure on the outside. An eight-inch brick wall, with furring lath and plaster, forms a partition between two compartments in the sheet metal enclosure shown. A wind velocity pressure against the outside of the wall results in air leakage through it. This is measured as it passes through an orifice in the wall of the metallic enclosure

"These particles," says Dr. Wait, "tend to accumulate in the air of a closed room occupied by people and, consequently, will, to some extent, be taken into the lungs of other individuals in the room. Since experiments have definitely shown the fallacy of earlier assumptions that the accumulation of carbon dioxide in the air of occupied rooms was responsible for the gradual development of 'bad air' in the room, no logical cause for the 'bad air' is now known. However, it is altogether logical to believe that a possible cause for the development of 'bad air' is the accumulation of the small breath particles in the air of an occupied room.

"ASSUMING this to be the real cause for the development of 'bad air,' the solution is to be sought in the elimination or removal of these small breath particles from the air of the room. Since further investigations have shown that the majority of the breath particles are charged about equally positive and negative it should be possible to remove them by means of an electric filter. On the above assumption as to the cause



The head-dress served as a frivolous touch to an otherwise serious day's work of two eminent leaders in the development of air conditioning: Willis H. Carrier and E. Vernon Hill. One served as a "wet-bulb" and the other as a "dry-bulb" in determining a person's "feeling" of warmth. As a result of these studies, the Effective Temperature Index of warmth now receives almost universal acceptance as the basis for air conditioning design

for the development of 'bad air,' such filtering process should immediately revitalize the air.

"The amount of energy involved in the particles is small, but can conceivably have some influence on the action of the membrane surfaces of respiratory passages and lungs, if it were increased or decreased by changes in the concentration of these particles in the occupied spaces.

"The particles are not dust particles. They act as condensation nuclei and are hygroscopic in nature. It is not possible at present to say exactly what they are physically. It is possible that the 'disease' (bad air, staleness, and so on) in occupied spaces is related to the accumulation of these nuclei. If this were true, the proper course would not be a remedy in terms of the addition of ions to a ventilating system, but rather their removal. Ordinary filters would probably not be effective, but filtering could be accomplished by electro-static means.

"It also seems important to investigate more completely the possibility of an electric charge being delivered up to the air or, in other words, that the lungs retain an electric charge, and consequently require an electric current, even though minute, to flow to the point from which the charge has been ejected from the lungs. Undoubtedly, many of these charged breath particles are bacteria, some of which may be harmless to those breathing them, yet many may be malignant. A determination of the percentage falling into each class should prove to be an important study."

Another phase of this investigation into the intangible qualities of air, revolves about the subject of filtration of air by electrical means. Dr. L. W. Chubb, of the Westinghouse Electric & Manufacturing Company, another member of the committee and a contributing editor of Scientific American, reports on the interesting results of tests made in a Pittsburgh telephone exchange to free the air of minute dust particles which frequently interfered with the proper operation of sensitive electric relays. A highly efficient method of mechanical filtration was first tried, consisting of passing the air entering the room through moist blankets. When this did not accomplish the results hoped for, electric filtration on the precipitation principle was installed. Not only was the dust that had been harmful to the electric apparatus removed, but the experimenters found, much to their surprise, that the air thus filtered was given an added quality that might be termed "re-vitalization." In addition, the telephone operators working in such air responded in a favorable manner and remained free from colds and influenza. In fact, the operators were quick to detect whether the mechanical or the electrical system of air filtration was in use by the "feel" of the air in the room.

The comfort which you now experience when you enter a store or theater on a sizzling summer day, harks back beyond the development of the mechanical equipment that makes this possible. It began almost 20 years ago in the fundamental study of the physiological reaction of people to their atmospheric surroundings. Out of this basic research came the determination of the comfort zone on the psychometric chart which enables the air-conditioning engineer to foretell with extreme accuracy within what given range of temperature, humidity, and air motion the majority of persons will feel most comfortable.

IF you are one of those persons who think you catch cold from the shock of entering an air-conditioned theater, it will interest you to know that research is trying to do something about it. All this summer tests have been going on in different parts of the country to determine exact and scientific requirements for summer cooling. This may have the salutary effect of curbing the zeal for advertising "20 degrees cooler inside," and result in fewer cricks in the neck and more satisfaction to the air-conditioned customers whose loud squawks are not infrequently to be heard in the market places. As the result of the initial co-operative research on this subject undertaken by the Texas College of Agriculture and Mechanical Engineering, and the Ontario Research Foundation, effective temperatures ranging from 71 to 73 degrees have been found to approximate most nearly the maximum comfort zone for the majority of people.

Parenthetically, it should be stated that "effective temperature" is not what you read on your thermometer. It is rather a composite indication of dry-bulb temperature, wet-bulb temperature, relative humidity, and air velocity.

Studying effect of wind on heat losses from buildings. A wall section was set up on moving truck and Pitot tubes measured wind velocities while running

But what about drafts? Some persons, facetiously or half in earnest, are wont to complain that air conditioning to them "is nothing but a draft in the back of the neck." The subject of drafts is being taken rather seriously by the researchers. What to do about them, how to eliminate them? The first problem is to find out what a draft actually is, then track it to its lair, and figuratively put salt on its tail. Just that sort of research is now starting with the expectation that by studying the physiological reaction of people to the common draft, enough will be learned about them to prevent undue exposure to drafts by improving upon or developing better scientific methods for distributing air.

OUT in the Pittsburgh laboratories of the American Society of Heating and Ventilating Engineers, scientists under F. C. Houghtin, director of research, are discharging drafts of air of known temperatures, humidities, and velocities at various parts of the bodies of a number of human guinea pigs to determine what really constitutes a draft. Is it, for example, a question of temperature, humidity, and air velocity, or merely a matter of where a draft strikes you—or both? The answer is in the making. When the solution is found, one may expect to receive even greater comfort and satisfaction from air-conditioning systems than is now the case. Thus the inquiring minds of the scientists range over the air-conditioning scene, seeking to attack problems at their source, taking a long-range look.

One of these long-range looks is related to the interesting subject of water on roofs. Sounds curious, doesn't it? But predictions are freely heard that one of the features of the air-conditioned home of the future will be a flat roof containing two or three inches of water, stored there the year round to help keep the house cool in summer and warm in winter.

The insulating value of water is very considerable. In the liquid state in summer it exerts an even evaporative cooling effect; in winter, if it freezes, the ice adds an extra layer of insulation. And water is also considered an excellent protection for the roofing material.

Lieutenant Colonel W. A. Danielson, chairman of the A. S. H. & V. E. Committee on Research, calls it "a development of major economic importance," and cites instances where water insulation has been able to save as much as 25 percent in cooling costs. To find the insulating value of water-covered roofs is the primary purpose of the investigation just getting under way.

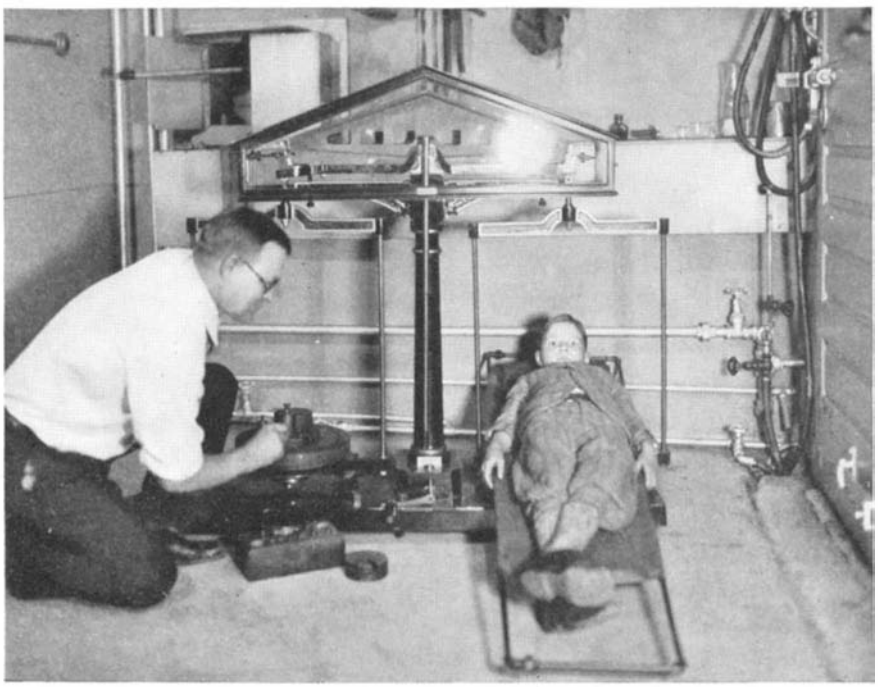
So many and so varied are the problems with which the heating, ventilating, and air-conditioning industries are struggling, that space permits touching upon only a few of them. The industry's research program for 1937-1938 includes new or continuing studies of:

To keep buildings cool in summer and warm in winter, water insulation on roofs is the latest in air conditioning. Its usefulness is being carefully studied

Air-Cleaning Devices, Air Conditioning in Relation to Comfort, Air Conditioning in the Treatment of Disease, Air-Conditioning Requirements of Glass, Atmospheric Impurities and Resulting Safety and Health Requirements, Climate and its Relation to Air-Conditioning Fundamentals, Comfort Requirements for Summer Cooling, Corrosion in Heating and Air-Conditioning Systems.

Direct and Indirect Radiation with Gravity Air Circulation, Effect of Entering Temperature and Velocity on Temperature and Distribution of Air Within an Enclosure, Frictional Resistance to Flow of Air in Ducts, Insulation, Psychometry, Refrigeration in Relation to Air Treatment, Sound in Relation to Heating and Ventilation.

A further idea of the work that is going on may be gained from the statement that some 30 or more universities, at least four government bureaus, seven technical societies, an equal number of trade associations, and no less than 22 private industrial laboratories are engaged in investigating 247 subjects directly and indirectly related to heating, ventilating, and air conditioning. The services of upwards of 2000 persons are involved. Yearly expenditures compared with other kinds of research are small, probably running in the neighborhood of 1,000,000 dollars per year.



Balance for studying heat exchange between body of a person and his atmospheric environment. He loses weight—a gram or more a minute—from perspiration evaporation, moisture exhalation, oxidation of carbon in food eaten

STATUS OF THE CARRIER

Aircraft Carriers a Permanent Element of Fleets . . . Most Navies Have Them . . . Evolution of Their Design . . . World Carriers Built and Building

By WALTON L. ROBINSON

OF the seven leading naval powers of the world, all but Italy and Russia have adopted the aircraft carrier as an indispensable type of naval vessel. The admirals of the United States, British, Japanese, French, and German navies are fully cognizant of the great value of aircraft, and of the necessity of providing floating bases for the planes so that these may operate to the best advantage with the fleet. Between them, these five nations possess 17 completed carriers and 13 under construction, appropriated for, or definitely projected. Although the Italian and Russian navies have no carriers, they are not neglecting their air strength; their lack of interest in the carrier is simply due to the fact that their naval strategic problems do not demand this new type of warship, for the relatively narrow waters of the Mediterranean and Baltic permit effective employment of naval aviation from shore bases.

Like its older companions—the battleship and cruiser—the aircraft carrier has been limited both in regard to tonnage and gun caliber by the several naval treaties signed since the end of the World War. The first—that signed in Washington in 1922—set the limits at 27,000 tons and 8-inch guns (not more than 10 in number), while the most recent, the London treaty of 1936, reduced these limits to 23,000 tons and 6.1-inch guns. These last figures are those at present in effect. There is no longer any limit to the number of carriers a nation may possess. Under the Washington and 1930 London treaties, both of which expired December 31, 1936, total tonnage limits were fixed for each of the five contracting powers as follows: (1) United States and Great Britain, each 135,000 tons; Japan, 81,000; and France and Italy, each 60,000 tons. The only navy at present in any way restricted to the number of carriers it may possess is the German; by the Anglo-German agreement of June 18, 1935, the Reich's navy is limited in this class of warship, as it is in all the other classes save submarines, to 35 percent of the British tonnage.

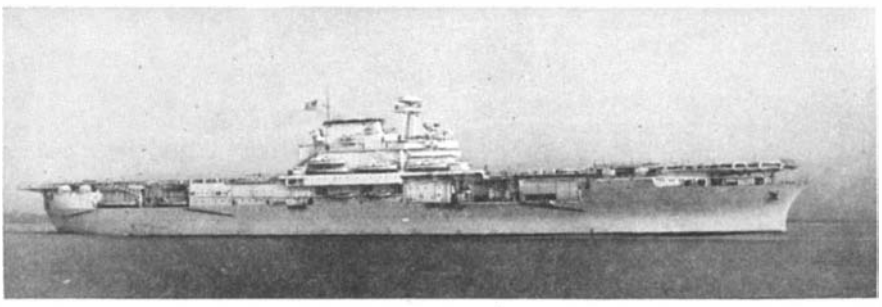
OF the 17 completed carriers of the world's navies, only six were originally designed as such. They are: U. S. S. *Ranger*, *Yorktown*, and *Enterprise;* British *Hermes;* and Japanese *Hosyo* and *Ryuzyo*. The remaining 13 are ships which have been re-designed as, and converted into, aircraft carriers. The British *Eagle*, Japanese *Kaga*, and French *Béarn* were begun as battleships; the U. S. S. *Lexington* and *Saratoga* and Japanese *Akagi* as battle cruisers; the British *Courageous*, *Glorious*, and *Furious*, as a hybrid type of cruiser which might be classed either as a lightly protected battle cruiser or a huge, heavily armed, scantily-armored cruiser; and the British *Argus* as a transatlantic liner; while the U. S. S. *Langley* was originally the old collier *Jupiter* which Congress, in 1921, gave authorization to be converted into an experimental aircraft carrier. Many of these conversions were carried out for economic reasons and it is likely that had new ships then been originally designed as aircraft carriers, they would have had very different characteristics from those of the transformed ships. This refers principally to the displacement and armament and not to the methods of handling and storing the planes.

WORLD'S AIRCRAFT CARRIERS

	Completed	Displacement in Tons
UNITED STATES		
Langley	1921	11,500
Saratoga	1927	33,000
Lexington	1927	33,000
Ranger	1934	14,500
Yorktown	1937	19,900
Enterprise	1937	19,900
GREAT BRITAIN		
Furious	1917	22,450
Argus	1918	14,450
Eagle	1920	22,600
Hermes	1923	10,850
Courageous	1928	22,500
Glorious	1930	22,500
JAPAN		
Hosyo	1922	7,470
Akagi	1927	26,900
Kaga	1928	26,900
Ryuzyo	1933	7,100
FRANCE		
Béarn	1927	22,146

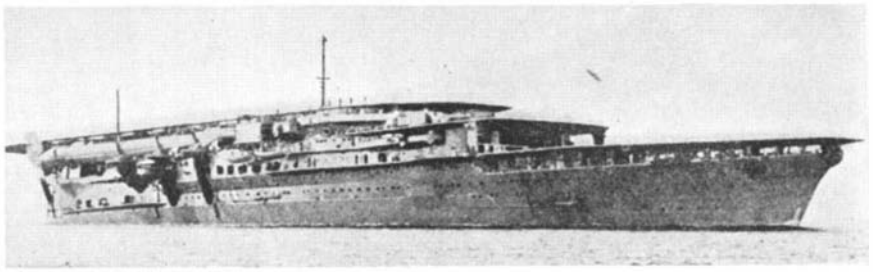
IN 13 of the carriers—all six of the American, three of the British, three of the Japanese, and the solitary French one—there is a flight or landing deck which extends the entire length of the ship, or nearly so, while in the other four the flight deck terminates at an appreciable distance from the bow. This latter arrangement permits a short flying-off deck below. Whether there are one or two decks depends upon the methods used in handling the planes. Ten of the carriers have what is known as "island" superstructure; that is, the funnels, masts, navigating bridge, and so on, are located on the starboard, or right, side of the flight deck; the other seven have their landing decks entirely clear of such obstructions. The U. S. S. *Ranger*, originally designed to have this latter arrangement, was converted during construction to the "island" type. In those carriers with clear decks the smoke is disposed of in such manner as not to cause difficulties to the pilots as they alight on the deck.

The *Langley*, our first aircraft carrier, has two small funnels on the port side. During landing operations, they are lowered into a horizontal position in order



One of the six of the world's 17 carriers originally designed as such: The U.S.S. *Yorktown*. It is an "island" type of 20,000 tons with full length flight deck

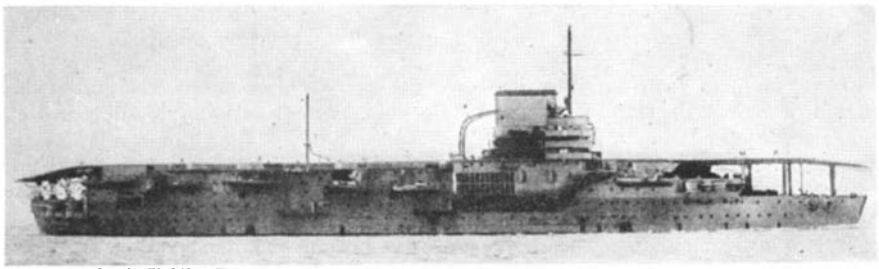
to leave an entirely unobstructed flight deck. The three somewhat larger funnels (on the starboard side) of Japan's oldest carrier, the *Hosyo*, operate in the same manner. This ship has a light mast which also is lowered outboard when planes are about to land. The British carriers *Argus* and *Furious* have internal horizontal smoke-ducts which expel all furnace gases and smoke abaft the after hangar. The Japanese *Kaga* had a somewhat similar arrangement, but her funnels or smoke-ducts, one on each side, were external and therefore plainly visible. The two funnels of this ship were enormous, measuring approximately 400 feet in length! The *Kaga* recently was reconstructed and now has a practically clear landing deck, obstructed only by a very small navigating house on the starboard side. She now discharges her furnace gases through a short, flat-sided funnel, turned outboard and downward, on the same side. The *Akagi* has a similar funnel, but immediately behind it there is a second one, short, round and in a normal, vertical position.



Courtesy *Jane's Fighting Ships*

Japan's largest aircraft carrier, *Kaga*, has a novel deck arrangement. Upper one is for landing; two lower ones for taking off. Note funnel 400 feet long

The present tendency in the design of aircraft carriers, at least of those in our navy, is toward the "island" type, for experience has shown that, if the obstruction is not too large, there is little or no interference caused by air currents around the after part of the flight deck. In a small carrier, however, such as the new Japanese *Ryuzyo*, where the length is not great and the width of the landing deck is considerably less than in large ships, the relatively larger "island" superstructure can cause serious interference. Weight and space are usually saved by means of the "island"; it permits larger hangars and, therefore, better stowage for the planes. On the other hand, there is the inconvenience, even in the larger ships, that the "island" produces an unequal distribution of weight which often increases greatly the difficulties of navigation and keeps busy those whose duty it is to maintain the ship on an even keel.



Courtesy *Jane's Fighting Ships*

France's solitary aircraft carrier, the *Béarn*. Displacement is 22,146 tons. She is the only carrier mounting torpedo tubes, having four 21.7 inch tubes

THE displacements of the world's aircraft carriers range from the 7100 tons of the *Ryuzyo* to the 33,000 tons of our giant *Lexington* and *Saratoga*. The decisions regarding the tonnage of the newer carriers, especially those now under construction, have been in large part governed by the clauses of the Washington Naval Treaty of 1922. Our navy, to which were assigned 135,000 tons, had at its disposal after the completion of the *Lexington* and *Saratoga* some 69,000 tons. Our original intention was to build five carriers, each of 13,800 tons. Eventually, however, it was decided to construct but one ship of this size, the *Ranger*. In the next two vessels laid down, the *Yorktown* and *Enterprise*, the displacement was increased to 20,000 tons. Apparently our naval authorities feel that two ships of this size are of greater value than three of 13,000, the total tonnage in either case being about the same. The beloved late Rear Admiral Moffett at one time declared, however, that he believed the ideal size for an aircraft carrier to be that of the then projected *Ranger*.

America's lone carrier at present under construction, the *Wasp*, is to displace 14,700 tons. Although she will thus be only slightly larger than the *Ranger*, it is expected that she will more closely approximate in appearance the new *Yorktown* and *Enterprise*, being a small edition of these two splendid ships. The tonnage selected for the *Wasp* was the greatest possible without exceeding the treaty limit of 135,000 tons.

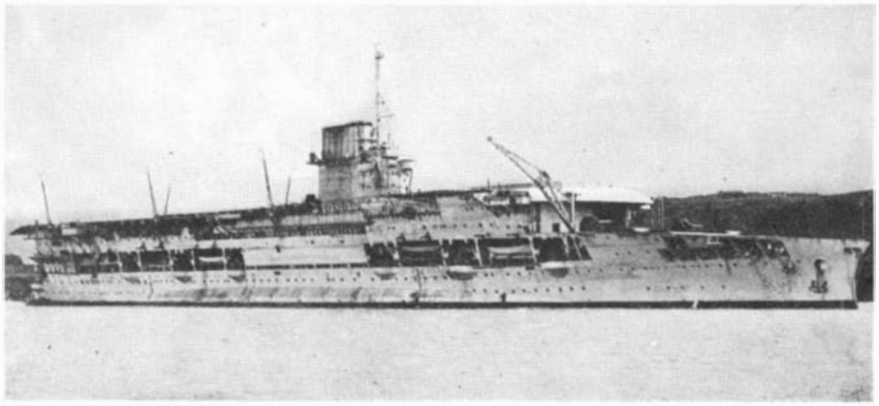
Omitting the oldest and more or less obsolete carriers, the speed of this type of warship varies from 23 to 34 knots. It is interesting to observe that, in every case, the transformed carriers retain the horsepower and speed provided in the original design as battleships, battle cruisers, and so on. Of those originally designed and completed as carriers, the *Hermes*, *Hosyo*, and *Ryuzyo* steam 25 knots, the *Ranger* 29.95, while the *Yorktown* and *Enterprise* are capable of about 34 knots, the highest speed of all.

The desirable speed for this type of ship is governed by tactical considerations. When planes are landing or taking off, the carrier's bow must be turned into the wind; to do this it naturally is necessary for her often to steam a course different from that of the fleet which she accompanies. Thus, in order not to fall behind and lose contact, the carrier should have a somewhat higher speed than that of the other large ships. In addition, her propelling machinery should be exceptionally robust and flexible so that frequent alterations in speed will not cause an engine-room breakdown at a critical moment.

THE number of planes which the various carriers are able to accommodate varies greatly and makes for some interesting comparisons. The *Furious*, with an unobstructed flight deck and horizontal smoke-ducts, carries 33 planes; her modified sisters of the "island" type, the *Courageous* and *Glorious*, transport 48 apiece. The Japanese *Akagi* and *Kaga* are each of 26,000 tons and have identical armament, but the former has about 50 percent more powerful engines and consequently a higher rate of speed, hers being 28.5 knots to the *Kaga's* 23 knots. This higher speed costs the *Akagi* some 20 planes in maximum carrying capacity, her complement being 60 planes, while that of the slower *Kaga* is 80. The influence of speed upon the plane stowage of a carrier was brought out clearly in 1929 when the Naval Affairs Committee of Congress was informed that an increase of three knots in the proposed speed for the projected *Ranger* would reduce by 40 percent the number of planes she could carry and operate.

Although it is easy for comparisons to be made between the number of planes borne by the various carriers of one navy, such is not the case when comparing the carriers of one navy with those of another, for governing factors other than speed must be taken into consideration if one is to understand the disproportionate number of planes carried by certain ships. In proportion to their size, our carriers are able to accommodate a larger number of planes than their foreign contemporaries. Taking as an example our new carriers *Yorktown* and

Enterprise, of approximately the same displacement, armament, and speed as Britain's recently launched *Ark Royal*, we find that our ships can carry 100 planes each, while the Britisher will accommodate no more than 70. In the older carriers of the two navies, this difference is even more marked. In searching for an adequate explanation of this disproportionate plane capacity, only two reasons can be found: (1) the fact that all of our carriers have a larger percentage of small planes (fighting, scouting, and so on, as opposed to huge bombers) than is the rule in their British contemporaries; and (2) the practice in American ships of stowing a greater portion of the planes in a partially disassembled state.



Courtesy U. S. Naval Institute

A British carrier: H.M.S. *Glorious*. Note funnel on starboard beam, crane to lift seaplanes, and the water-line bulge for defense against torpedo attack

The question of armament calls for but few comments. The powerful 8-inch gun batteries of the *Lexington*, *Saratoga*, *Akagi* and *Kaga* are abnormal and not likely ever to be repeated. The most recently completed carriers and those under construction mount only anti-aircraft guns, 4.7-inch in the British Navy and 5-inch in ours and the Japanese. These guns are "dual purpose"; that is, they can be employed against ships as well as aircraft.

As can easily be imagined, in the type of naval vessel under discussion there are a great many installations of various kinds which are not to be found on other warships. Most important of these are the hangars. These are huge open spaces which have no counterpart whatsoever in any other type of craft. They are generally from 15 to 18 feet high by some 50 to 60 feet wide and 350 to 450 feet in length. As they usually are filled with gasoline vapors they are spaces of considerable danger. Inasmuch as transverse bulkheads are out of the question, the subdivision of the hangars is obtained by means of steel screens moved by electric motors, and by thick asbestos curtains. There is, of course, a very complete fire-fighting apparatus installed inside the hangars. There is also ample provision for combating deck fires—as when planes have crashed and caught fire, for example. Powerful electric ventilators expel the dangerous gases from the interior of the hangars.

Another peculiarity of the aircraft carrier is the huge elevators which are employed for taking planes from the hangar to the flight deck or vice versa. Usually there are two such lifts, one at each end of the hangar, though the French *Béarn* is known to have three. These lifts generally measure about 50 feet square. They are worked by hydraulic power and operate very swiftly.

As the huge hangars must be free from hindrances of every kind, the necessary piping for the expulsion of smoke, ventilation of the engine and boiler rooms, and so on, has to be located on the sides of the ship, usually below the level of the hangar deck. The sides of the ship are therefore very crowded with all sorts of equipment. The rapid supply of shells to the guns is another difficulty encountered in this class of naval vessel.

Yet another problem peculiar to the aircraft carrier is that of the storage of fuel for a large number of planes. This fuel is stored in huge cylindrical tanks at each end of the ship. An extensive network of piping distributes the gasoline to various sections of the hangar, and to the flight deck. Compressed air is generally used to force the fuel through the pipes.

The task of checking the movement and bringing to a final stop the returning planes as they land on the flight deck is another interesting and troublesome problem. The mechanism employed has to be capable of stopping various types of planes—from those weighing 3500 pounds to those of 9000—and at landing speeds which may vary considerably. In all probability, the United States Navy leads all others in the development of the best method of bringing planes to an early stop after they have alighted on the flight deck. Needless to say, enormous advances have been made in this respect since 1911 when Ely landed on the crude and improvised installation set up experimentally on the old armored cruiser *Pennsylvania*.

The aircraft carrier proper is not the only type of naval vessel designed especially for the transport and operation of aircraft. There is also the aircraft tender, a vessel which can carry out all the functions of the carrier except to take its returning planes back on board right from the air. In other words, the aircraft tender differs from the carrier in that it has no flight deck. Her planes must land on the water nearby and then be hoisted on board by means of a crane. Of this type of ship our navy has but one of any importance: the *Wright*. France several years ago completed the *Commandant Teste*, which is capable of carrying some 30 seaplanes; Italy possesses the *Giuseppe Miraglia* (transformed from a liner) with accommodation for 15 seaplanes, while Japan, too, has a number of improvised aircraft tenders in service, with three of 10,000 tons building.

Sweden recently completed an interesting and novel type of warship: the flying deck cruiser *Götland*. On a displacement of only 4600 tons, she carries six planes and a catapult. For her size she has the good armament of six 6-inch guns, four 3-inch anti-aircraft guns, and six 21-inch torpedo tubes. The speed of 27 knots is on the low side, however.

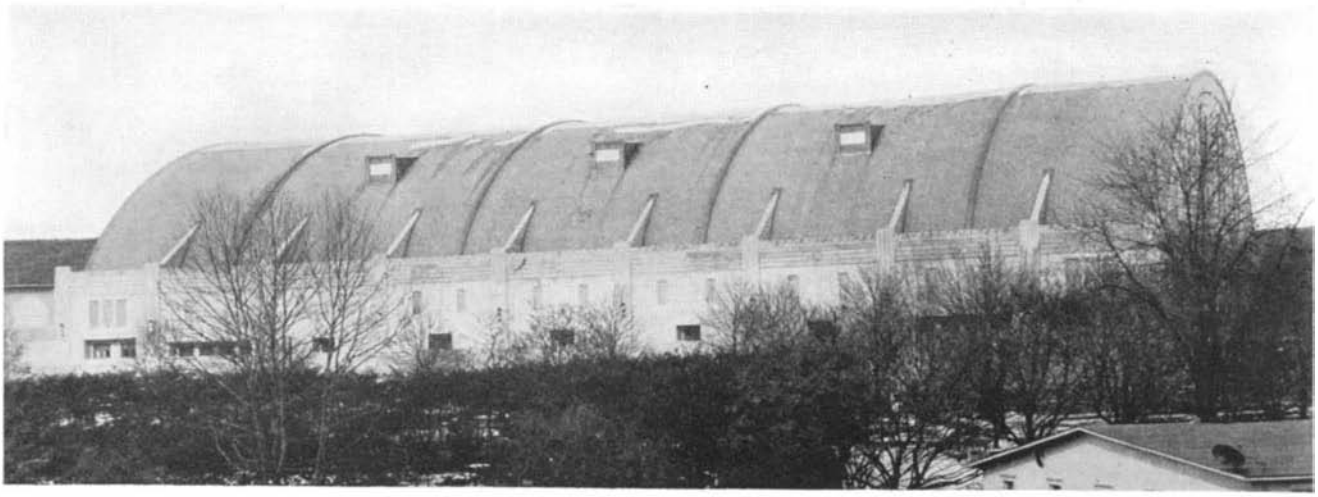
THE world's leading naval powers are at present building or will soon start work on no less than 13 aircraft carriers. We are building one: the *Wasp*. Britain is building three: the *Ark Royal*, *Illustrious*, and *Victorious*, and she will soon lay down two more. Japan has the *Soryu* and *Hiryu* well advanced and a third projected. France plans to begin work on two in the near future, while Germany is rushing a pair to completion.

The aircraft carrier promises to grow in importance with each succeeding year, and there is no doubt that it will take a prominent part in the next war in which large naval powers are involved. This will be especially true in a war in which the distances between the belligerent nations are great—too great to permit the effective employment of shore-based aircraft. The carrier is the sole solution to such a problem.

●

Publication of the foregoing article completes a series of four excellent studies of as many elements of sea power by the same author, Mr. Walton L. Robinson. These have appeared at intervals during 1937 and, if we are to judge by readers' comments and numerous press clippings, have excited considerable interest.

Because of the world's present huge naval building programs, we expect to present other similar articles regularly during the coming months. If you have any suggestions to make or would like to comment in any way, it would be our pleasure to hear from you.—The Editor.



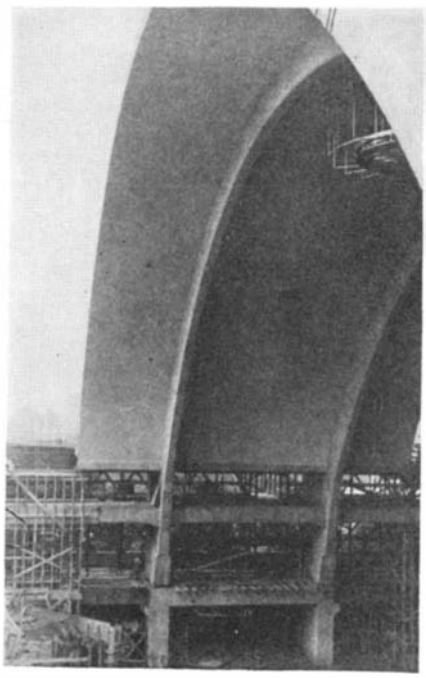
The Hershey Sports Arena is topped by the widest span, monolithic concrete roof in this country

Monolithic Shell Roof

CONCRETE shell roofs, so called because of their similarity to shells found in nature, are a comparatively new development. Such a shell dome is comparable to half a gigantic egg shell, the strength of which is well known.

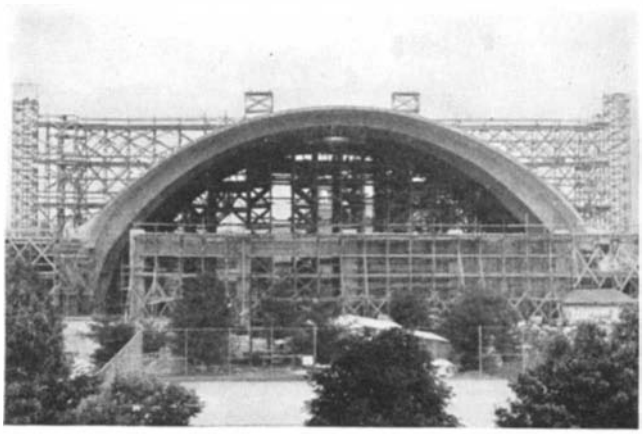
The principle of crowning or curving plates to produce rigidity has long been recognized and utilized in the industrial world; corrugated iron, automobile fenders, dish pans, paper dishes and spoons, and other articles in daily use are made into rigid units from thin sheets of metal or cardboard curved in one or two directions. All these thin curved plates have excellent structural properties.

Only last year the principle of having a thin, properly reinforced concrete plate curved and stiffened in a similar way was used in roofing the Sports Arena in Hershey, Pennsylvania. Here a concrete shell 3½ inches thick, stiffened by arch ribs on 40-foot centers, carries over a distance of 222 feet without intermediate columns, beams, purlins, or other intermediate supports. The shell is the outstanding feature of the structure. No ugly steel framing, bracing, or diagonals are used. The inside of the hall is clear of obstructions; a monumental appearance, fireproofness, and permanence were attained. Heretofore, a structure like this arena would have been of steel construction since a structural solution in concrete was beyond the conception of any architect or engineer.



Detail of a section of the roof of the Arena, showing carrying arches

The plan area covered by the roof is 232 by 340 feet; the over-all dimensions of the building are 245 by 356 feet. There are eight carrying arches, each with a span of 222 feet. The roof was designed by Roberts and Schaefer Company, Engineers, Chicago, and constructed by Hershey Lumber Products, the building organization of the owners—the Hershey chocolate interests. Though the design of this structure is quite intricate, the construction offers no unusual problems and could be done by local labor in a small town.



When the roof was under construction, an enormous amount of scaffolding was required to hold shell forms

The completed 3½-inch shell roof over a first-night audience at a hockey game. No columns obstruct the view

The Fallacy of Fighting

We Call Our Age the "Age of Science," but the Insects Know it is the Age of Insects . . . The Hope of Exterminating These Sportsmen's Pests is Futile

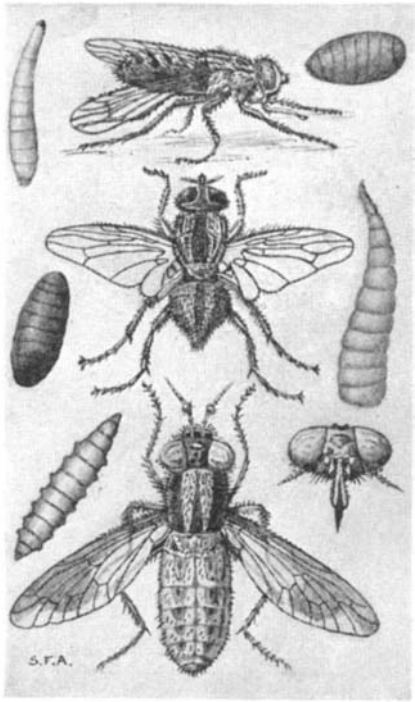
By S. F. AARON
Drawings by the author

THE quite natural wish which most of us entertain to diminish the existing numbers of flies is a pleasing thing to contemplate, but it sometimes leads us in the direction of expectations that can never be realized in actual fact. In the present discussion, only those species of flies that are nuisances, and that have been proved detriments to health, will concern us most. These are the house flies, the biting stable and horn-flies, the several kinds of blood-sucking horse, deer, and green-headed gad-flies, the bot and warble flies of horses, cattle, and sheep, the mosquitoes, and the black gnats or midges that the expressive Indians have called "no-see-ums." These species are all of the order Diptera—insects with but two wings. Not all their kindred are to be classed as pests, for many have no influence whatever upon the affairs of mankind, while others are positively salubrious; for example, the pollenizing bee-flies, the parasitizing syrphus and tachinid flies and the robber-flies that destroy many noxious insects, though some that are beneficial as well.

It is certain that it is quite beyond our power to limit appreciably the number of some species of noxious insects. Among these are the most pestiferous kinds, alike threatening man and domestic animals. These flies are carriers of fatal diseases, endemic and sporadic.

ALL the pestiferous species of flies find means of perpetuating their too numerous individuals in ways beyond our reach. Wherever farm stock exists, for example, there will always be flies, the larvae finding abundant sustenance in and about barns, stables, sties, poultry houses, outhouses, garbage, all over pasture fields, in the excrement of dogs, cats, and wild animals, in woodchuck and ground squirrel burrows, wherever flocking birds roost, and in almost all kinds of rotting vegetation. Moreover, it is altogether an error to suppose that the drying out of certain matter will prevent its further use as food for larvae, for the maggots carry or bring sufficient moisture to render anything palatable. A common error is to assert that the common house-fly does not frequently breed in cow manure.

Small wonder is it, then, that *Musca domestica* and its many relatives are exceedingly plentiful, at least at nearly all times when the temperature is above 56 degrees, Fahrenheit. Not remarkable is it also that the several species of biting flies, the tabanis group, appear seasonally in threatening numbers to interfere with the dairy output and sometimes to cause serious illness because of their septic inoculation—septic because the larvae occur anywhere in moist earth and the shallow waters of swamps and marshes.



At top: **Stable fly, larva, and pupa.** *Center:* **Horn fly, larva, and pupa.** *Bottom:* **Green-head biting gad fly, larva and its sucking proboscis**

If these conditions could be done away with over a vast extent of country, it might lead to the supposition that the pests could be extirpated. However, the supposition would be absurd, and even if it were not, the effort would be far too great.

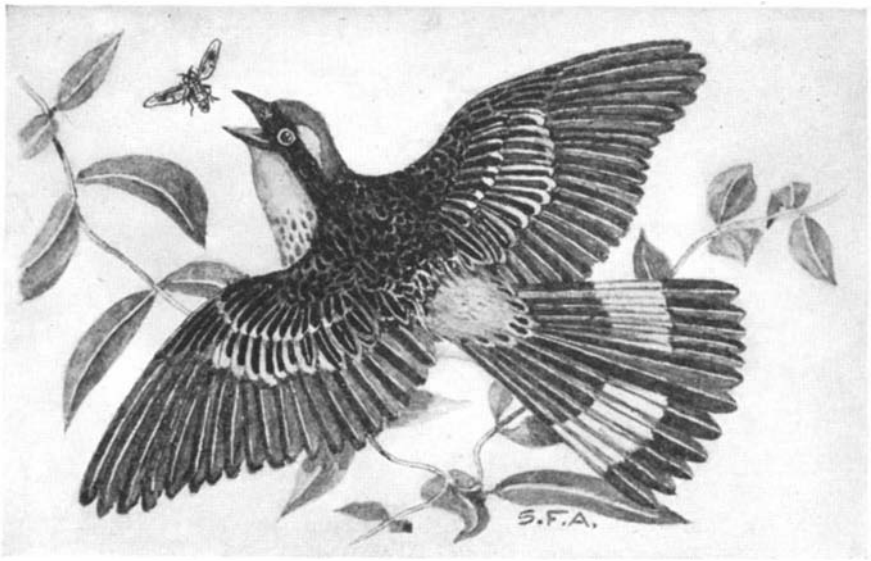
The puncturing stable-fly, a near cousin to the house-fly, breeds in situations similar to that of the domestic pest but is far less common, for reasons not difficult to understand; one or more kinds of active parasites affect it. The horn-fly occurs in vast numbers and breeds in manure of all kinds; it is an economic curse because it adversely influences cattle.

It has long been asserted that the complete destruction of flies would be a not too difficult matter. On the contrary, it would be so exceedingly difficult, expensive, and its desirable results so well-nigh impossible that, as an undertaking with the expectation of practical value, it may well be discarded. These creatures—the flies—are of the strong-winged class of insects; they travel far and fast, and they need only a few weeks of warmer weather to reproduce their kind. They would have to be combatted throughout very wide areas, involving the coordination of large communities of people who must not stop at expense and trouble. And then, after much effort has been made, and the optimists are preparing to congratulate each other upon the (imaginary) results, the flies, in a majority of cases —in all cases, in fact—will eventually prove to exist in about the same numbers as they did before. Where they come from would be as much of a question as why flies are, anyway. The idea of screening all manure and other breeding places, and of treating all with poison or deterrents of any kind with sufficient strength to destroy fly larvae, is nothing less than an absurdly impracticable notion; it would indeed be impossible.

IT is true that, in certain well-paved and perfectly sanitary areas of limited extent in cities where there are no stables, and where garbage is collected so often that the insects in their developmental stages do not have time to attain the winged state, and where the streets are kept remarkably clean, flies are comparatively rare; indeed, there are often so few of them, even in hot weather, as to make them appear astonishingly absent. Only now and then does one drift through the unscreened windows to grace the table, its presence the result of its clinging to some bakery truck or groceryman's delivery car until

more delectable odors attract it. Then, suddenly, there will come a swarm of flies, but from what original source there is not even a chance of guessing.

More flies of all kinds are destroyed through the normal processes of nature than by anything man has devised. In the struggle for existence they are at times exceedingly susceptible to the attacks of numerous enemies. Flies are protected in the adult stages only by their wings; they are the swiftest of wing of all creatures, irrespective of proportionate sizes. They have no stings or defensive jaws, and their sucking apparatus is never, or rarely, used defensively. Simply by their remarkable fertility they far more than offset any destructive agency acting against them.



The magnolia warbler captures a green-head gad fly while on the wing

THE enemies of flies are not an interesting consideration economically, but only as objects of nature study; for, though they lessen the numbers of these pests, they have not done so appreciably within our experiences. If there were no natural checks to flies, perhaps human existence would be altogether intolerable. However, we can somewhat profitably study the habits of the flies' enemies. Whatever limitations there may be on the numbers of flies are due to many causes.

In this limitation birds are a factor, though of secondary importance because they can rarely catch the swift-winged adults of the stout-bodied Diptera, while they do not often see the nocturnal species. They get many mosquitoes that fly in the daytime, such as the salt water and woodland kinds, as well as those flies that have just emerged from the pupal stage and are still weak of wing. These feeding habits of birds also apply to dragonflies, robberflies, shrews, mice, lizards, snakes, toads, and salamanders, but are reversed in the case of bats, as these catch many mosquitoes but do not get the day-flying insects including the stout-bodied, swift-winged species.

The birds that now and then pick up the muscid and tabanid flies are the true fly-catchers—the arboreal warblers, the vireos, and the very expert swallows and chimney swifts. Those birds that are gleaners, such as the nut-hatches, chickadees, terrestrial warblers, thrushes, bluebirds, orioles, finches and sparrows, woodpeckers, cuckoos and all the gallinaceous group, now and then obtain fly larvae and pupae, as do also the shrews, moles, and mice.

In this labor of destroying flies the omnivorous ants deserve much respect, but by far most important as enemies are those friends of mankind, the spiders. Because they destroy certain caterpillars which defoliate nearly all kinds of vegetation, several kinds of spiders are most essential to our welfare and actually necessary to our existence. Because of their destruction of flies they are scarcely less to be venerated. The common attitude toward spiders as creatures both horrid and harmful, is one of those frequent examples of ignorance based on no reasons whatever concerning most of the species and very little regarding any of them.

A longtailed shrew, one of the many enemies of the flies, feeding on delicious fly larvae in the disintegrated carcass of a bird. About two-thirds natural size

THE ground-hunting spiders get flies, much as do the shrews and birds; the web-makers, especially the orb weavers, get them coming and going, that is, both day and night. Even the strong-winged bee-flies, the largest and most powerful horse and cattle pests, and the pernicious green-heads cannot dodge the sticky snares, nor can the mosquitoes, which are quickly sacrificed on the blessed altar of spider engineering.

It has been suggested, because of the prevalence of the known enemies of flies, that an artificial increase of these forms might be advisable. This could be accomplished, but it appears never to be wise to interfere in any way with the balance of nature. We already have notable examples of this in the destruction of mouse and rat-killing hawks and owls; in the introduction of foreign species without their natural checks, and in the deplorable over-production of domestic cats.

Finally, the perennial hope of eradication of the mosquito has come to be regarded as something of a huge joke. The accepted definition of faith fits perfectly. After years of effort, following intensive propaganda; after such boastful results as have led to statements altogether untrue and even to the building of monuments to commemorate a supposed success, *Culex* and *Anopheles* still swarm, as may be fully proved, in their wide and chosen haunts.

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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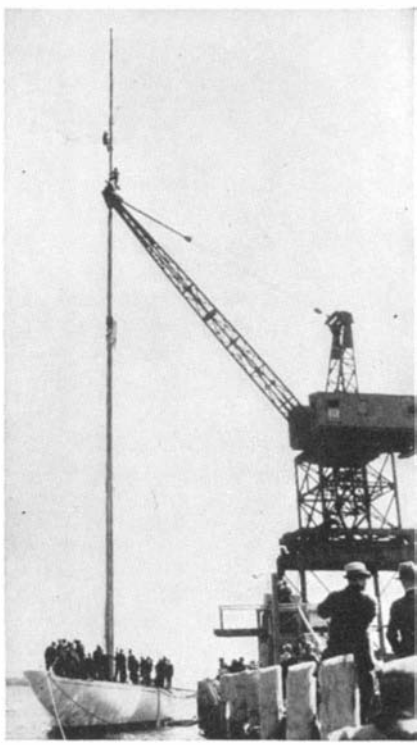
D. H. KILLEFFER
Chemical Engineer

AMERICA'S CUP DEFENDER "RANGER"

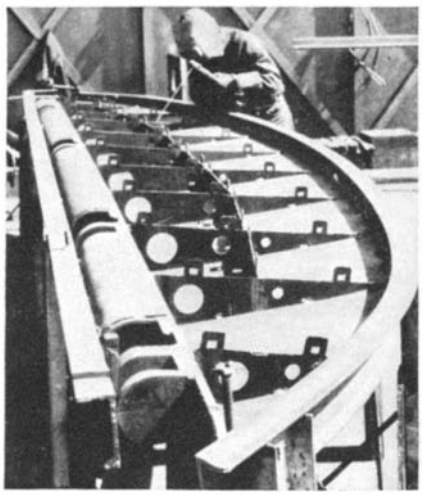
THE racing yacht *Ranger*, which will defend the America's Cup, embodies the latest principles of yacht design and construction. *Ranger* was designed by W. Starling Burgess, designer of the last America's Cup winner *Rainbow*, as well as the previous *Enterprise*. Mr. Burgess' father, before him, designed three America's Cup winners. Bath Iron Works, Bath, Maine, builder of many America's Cup boats, built *Ranger*. She is all-steel construction and utilizes arc welding extensively. The Lincoln Electric Company's shielded arc process of welding was used in construction.



"Stepping" the 165-foot duralumin mast on the racing yacht *Ranger*

Ranger is 135 feet 5¼ inches long overall and 87 feet at the waterline, 21 feet maximum beam, and 15 feet draft. Her mast—165 feet long, 22 inches by 14 inches at the base, and 11 inches by seven inches at the top—will carry between 6000 and 7000 square feet of mainsail. To obtain the strength required to withstand the terrific stresses of this tremendous sail area, and to keep weight at a minimum, the mast was made of duralumin and the fittings were electric arc welded. To counterbalance the draw of her mammoth sails, *Ranger* has a lead keel weighing 110 tons, the heaviest ever used on an America's Cup boat. This tremendous weight is held in place by a flat keel plate of arc-welded steel. The stresses to which the mast and keel plate are subjected when *Ranger* is under way with all sails drawing are terrific, since the bending moment between the pulling sails and the gravitational pull of the keel weight is enormous.

In addition to mast fittings and keel plate, *Ranger's* stem, her rudder and stern frame are arc welded for greatest strength per pound of weight. The stem was fabricated of three plates 48 feet long, 4½ inches wide and ⅝ inch thick. Use of electric welding in construction made it possible to fabricate the stem to conform exactly to the lines of the hull. In previous boats, the stem had been cast to an exact pattern. With electric welding it was not only possible to obtain perfect form but the structure was considerably lighter yet much greater in strength.

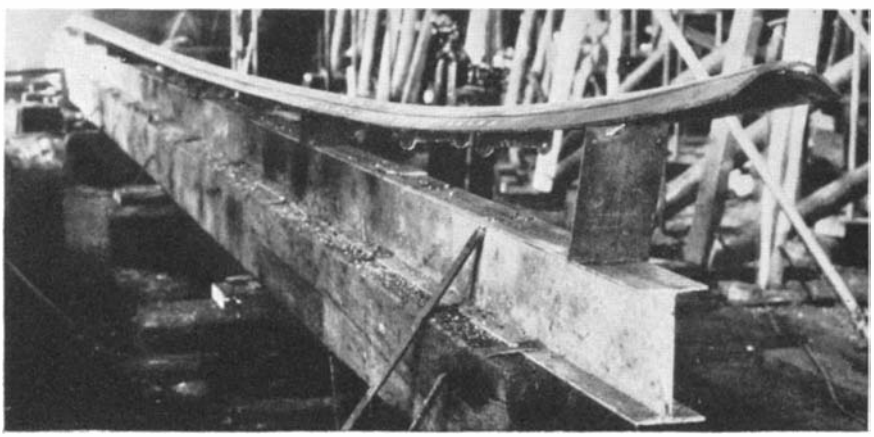


***Ranger's* rudder, four feet wide, was built up of arc-welded steel**

Ranger's rudder, another part of her structure which must resist extreme stresses, is entirely weld fabricated. It is 13 feet in length and four feet maximum width. It consists of various steel shapes and plate cut to conform to designed size and form and then fused into a single unit by the electric arc.

Ranger's stern frame was fabricated entirely from flat steel plates arc welded together.

The new queen of American racing



The stem of *Ranger* was fabricated of three plates 48 feet long

yachts will race against the British contender to determine whether the famous trophy stays home or crosses the Atlantic in possession of the British.

RUBBER

MORE than 50 million rubber trees are required to produce the 75,000 to 80,000 long tons of crude rubber used annually in its products by one large rubber company.

Oil Films—Living Cells

AN important approach to the problem of simulating conditions in living tissue, that the difficulties encountered by these microscopic particles in their struggle for existence may be better studied, was discussed by Dr. Irving Langmuir, associate director of the research laboratory of General Electric, at the recent Mark Hopkins centenary at Williams College. In his talk, entitled "Two-Dimensional Gases, Liquids, and Solids," Dr. Langmuir described experiments with liquid films which have properties like those of a cell wall, thus creating in the laboratory substances which throw light on the behavior of living tissue. The research involved, conducted by Dr. Katharine B. Blodgett and C. N. Moore, is an off-shoot of a general investigation of the properties of oil films on water.

"We have recently been investigating," said Dr. Langmuir, "the intermediate field between acid and alkaline water, using solutions that are either neutral or slightly acid or alkaline. We also have investigated the effects of small amounts of calcium, magnesium, sodium, and potassium salts in water. We find that, in solutions which closely approximate sea water in regard to acidity and alkalinity and have similar amounts of dissolved salts, particularly interesting phenomena are observed."

These phenomena, he explained, indicate that certain types of oil films on water, where they make contact with each other, are, in many respects, very similar to a cell wall. In these experiments, Dr. Langmuir pointed out, "we have the advantage, however, that we can make this artificial cell wall cover a square foot if desired; we can study in detail properties which it would be very difficult to measure in a living cell.

"By quantitative studies, we can derive fundamental laws that govern these changes in properties. We hope, by following up this work, we shall be able to establish some principles that will be of great use to the biologist in understanding the complicated dependence of living cells upon the composition of the surrounding medium."

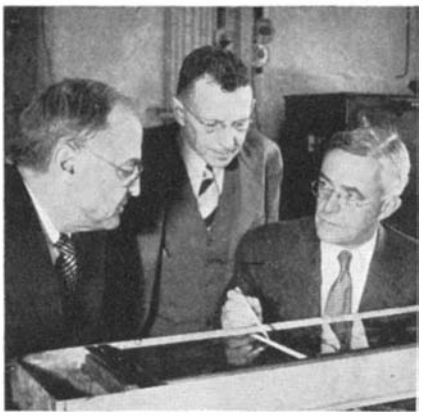
Polishing Pipe

UNAVOIDABLE imperfections in pipe formed of non-corrosive alloys widely used in industry must be removed if the pipe is to serve its purpose. A new machine polishes the interior of the tube, using a belt of coated abrasive similar to sandpaper. By this means the interior of the pipe is rendered as smooth and bright as the outside. —*D. H. K.*

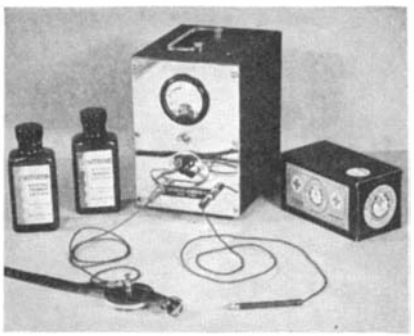
Home Electrolysis Depilatory Machine

SINCE the days of Cleopatra, women have been experimenting with depilatories and other methods of hair removal, but today as arms and legs take on a seasonal importance with beach days and modern swim suits, men and women alike are concerned with the permanent removal of excessive hair growth.

Beauty salons have been using for a number of years the method of electrolysis



Dr. Irving Langmuir (right) demonstrating oil films to Dr. W. R. Whitney and Dr. W. D. Coolidge



Equipment for home hair removal

to remove excess face or body hair. Such treatment is very costly. Home treatment, much less expensive, has been made possible by the introduction of the Beautiderm Midget, a new home model of the professional machine which promises to remove hair painlessly, scientifically, and permanently. It is manufactured by the Beautiderm Company.

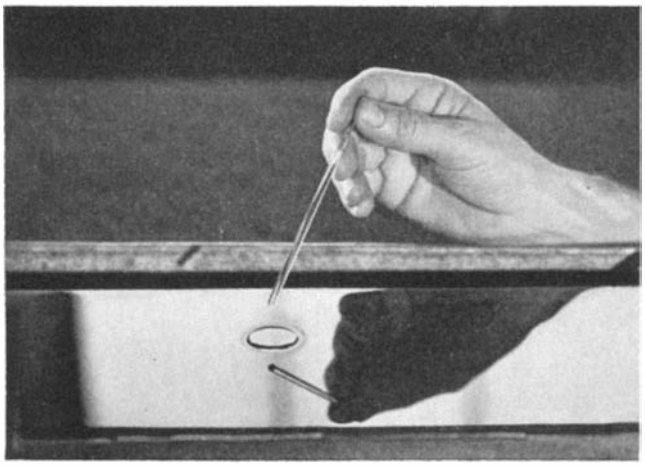
The Beautiderm Midget, which comes in three models, consists of a small cabinet equipped with a battery having a maximum of 4½ volts, an iridio-platinum needle of 1/7000 millimeter gage, a wrist electrode, small connecting wires for plugging into sockets in the cabinet, a bottle of antiseptic to be used before treatment, and a lotion for use afterwards.

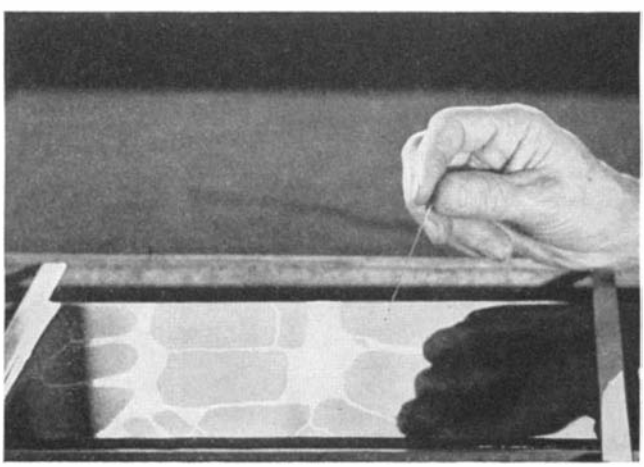
In using this machine, wire connections are plugged into the cabinet, and the wrist electrode, soaked in brine, is attached to the wrist. The rheostat dial of the cabinet is then adjusted for fine or coarse hair, and the needle is inserted into the individual hair follicle. The minute current which then flows destroys the hair at the hair root so that it does not return. The operation is then repeated with another hair about ¼ of an inch away. It will be seen, therefore, that only a relatively few hairs may be removed at one treatment.

These small electrolysis machines are low-priced, within the reach of the average person.

Chickens Will be Envious

AMERICAN chickens are due for a shock when the National Geographic Society-Smithsonian Institution wild animal collecting expedition returns from Sumatra





A "lens" of oil on water. An oil does not spread on water unless certain substances with an affinity for water are dissolved in the oil. *Right:* The dark areas are floating monomolecular films (two-dimensional solids) and the light areas are covered by oil (two-dimensional liquid). The two-dimensional solid film, which has great rigidity, was formed by spreading stearic acid on water containing tannic acid and calcium carbonate. The oil employed here was lubricating oil

this summer. Among the menagerie of strange creatures which it collected are several Maleos, birds half as large as chickens but which lay eggs with 10 times the volume of hens' eggs (about 2⅔ times the diameter). The huge eggs are covered by mounds of earth and vegetable debris and left to hatch. When the young Maleos emerge they are all ready to fly and take care of themselves.

Silk from Beanstalks

JAPAN'S growing production of rayon—she has lately become the world's largest producer—has forced her to seek domestic sources of the immense quantities of cellulose consumed by this industry. Attention has recently been directed toward the possibility of utilizing the stalks and husks of soy beans for the manufacture of their much needed raw material. Experiments have shown that a pulp containing more than 85 percent of alpha cellulose can be made from these by-products of the soy bean oil industry in Japanese-controlled Manchuria, and plants for its manufacture are planned with an initial production of 50,000 to 60,000 tons annually. Thus Japan seeks independence of foreign sources through bean stalks, just as Jack acquired fame thereby.—*D. H. K.*

Large Welded Lake Steamer

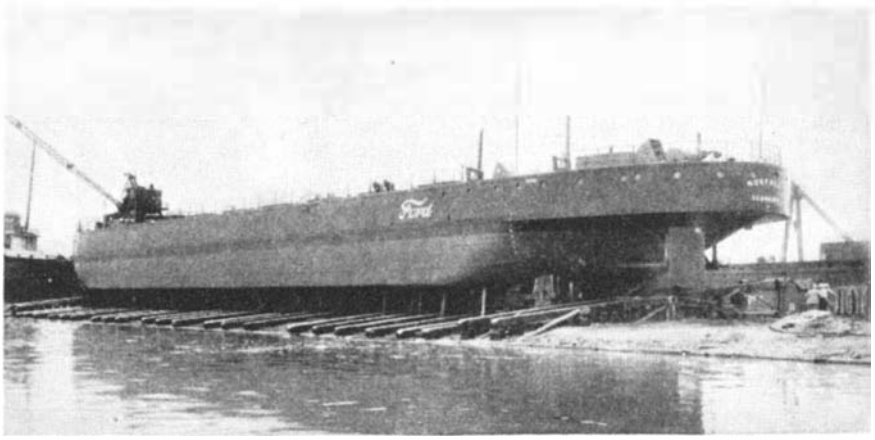
LAUNCHED June 5 at the River Rouge, Michigan, yard of the Great Lakes Engineering Works was the second of two unique arc welded 300-foot ships, largest ever built in a Great Lakes shipyard without rivets. The illustrations show the vessel ready for launching and being launched. For operation on the Great Lakes and through the New York State barge canal to Atlantic coast ports, this craft and her sister ship can carry 300 tons more cargo than the same size riveted vessel.

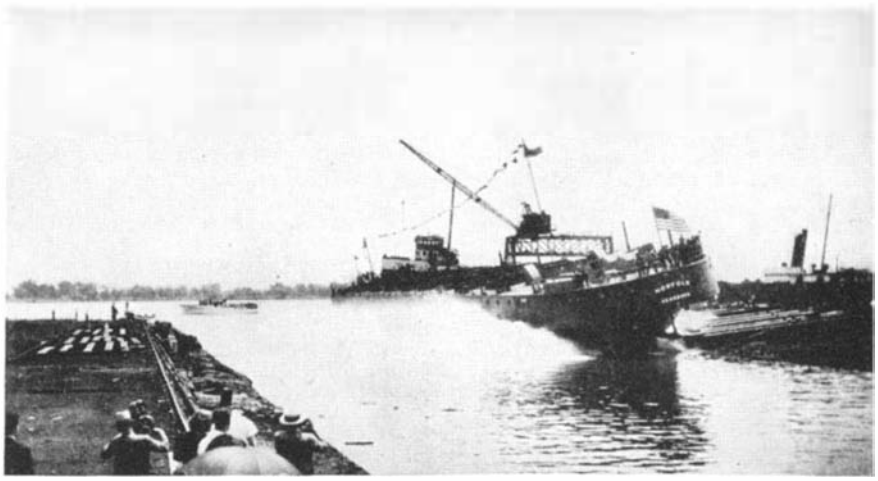
The vessel is 300 feet long, 43 feet beam, and 20 feet deep. The design for arc-welded construction was the work of Gielow, Inc., New York City, naval architects and marine engineers, in conjunction with the shipyard. The vessel is transversely framed to comply with the rules of American Bureau of Shipping. Power will be supplied by two eight-cylinder, four-cycle, 600-horsepower Cooper-Bessemer Corporation Diesel engines driving the twin-screw propellers.

The use of electric welding in construction permitted fabrication of the hull in complete sections in the shop. An advantage of electric welded ship construction, this method permits fast assembly and considerable economy.

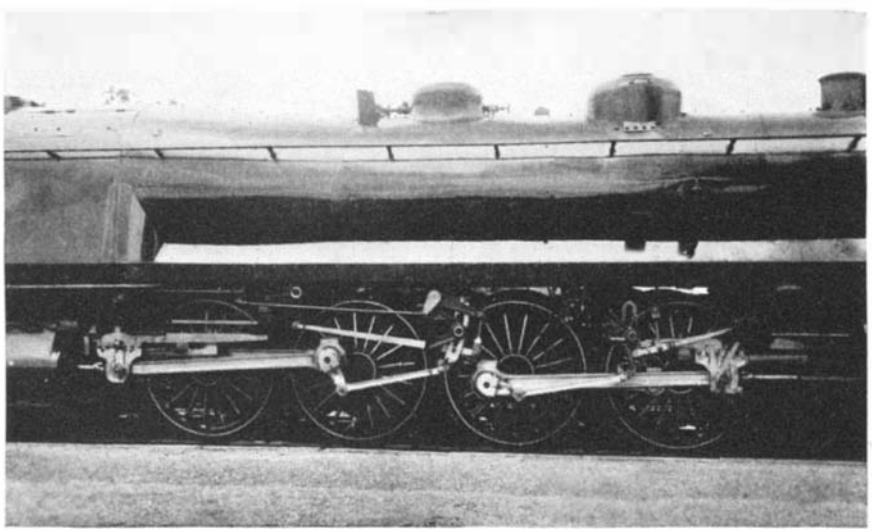
Commenting on the launching of this vessel, A. F. Davis, Secretary, The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, said: "With its increased cargo carrying capacity, this arc welded ship will save its owner thousands of dollars each year. A proportionate increase in the capacity of each new vessel built will permit tremendous savings to the shipping industry. It is to encourage, throughout industry, the sort of progress here illustrated, that the Lincoln Foundation is sponsoring a 200,000-dollar national award program."

TRANSPORTATION SECTION





Above: **The largest all-welded ship ever built in a Great Lakes shipyard, and** ***below,*** **the 300-foot vessel photographed when she first entered the water**



The driving wheels of the first 4-4-4-4 locomotive ever built

First 4-4-4-4 Steam Engine

FEATURING the latest in locomotive design and construction, the Baltimore and Ohio Railroad exhibited recently the first 4-4-4-4 type, 4-cylinder, single-unit, single-expansion steam locomotive ever built.

Named the *George H. Emerson,* in honor of the present chief of motive power and equipment of the B. & O., the new steam engine was completed on June 3 in the historic Mount Clare shops of the company in Baltimore from plans prepared by W. B. Whitsitt, assistant chief of motive power and equipment, and his staff.

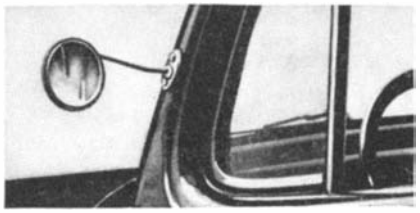
The locomotive was designed for passenger service but can also be operated in high-speed freight service over the main line from Jersey City to Chicago or St. Louis. Since its completion it has more than fulfilled operating expectations in road tests.

Outstanding of the improvements in the

new No. 5600 steam locomotive is the Emerson water-tube boiler which enables the fire-box to develop the steam capacity needed for the four cylinders at 350 pounds pressure. The superheater is of unique design and the valves are double-ported.

Attach Auto Mirror Without Drilling

SIDE-VIEW mirrors for automobiles are not new. One recently put on the market, however, is unique in several respects. First of all, it may be attached to the side door of a car in three minutes or less, without drilling and without special tools. Secondly,



Easy to install

it is permanently in place and theft-proof. The mirror is held by a molded rubber rim which prevents moisture from getting behind the mirror and peeling the reflecting surface. Perhaps best of all—it is very inexpensive.

Motor Car Lubricants —1937 Style

WHEN hypoid gears were first developed for automobile rear-ends, it was thought they could not be used because there was no grease then known that would lubricate them. The design of these rear-axle gears is such that forces between the bearing surfaces of the teeth are more violent than in prior differentials. However, research brought out a rather surprising fact. Those lubricants which contained sulfur—formerly carefully avoided in automobile oils and greases—were found to be better than oils in which this supposedly deleterious element was absent. Trials with compositions containing added sulfur revealed that unusual lubricating properties could be obtained. If the sulfur is used in the form of one of its more stable compounds, or is otherwise properly prepared, not only does it not destroy the gears and bearings but it acts as a positive deterrent to wear. Initially a tenacious layer of sulfur compound is laid down on the gear teeth by reason of the chemical activity of the sulfur. Then chemical activity stops. Whatever happens from there on, it has been proved beyond any shadow of doubt, by laboratory and road tests, that the hypoid gears so coated will not tear themselves to pieces as they will with ordinary oil.

Two explanations have been given. One holds that the sulfur film acts simply as a separating means, preventing metal-to-metal contact. This view is based on the fact that if the bearings can be kept apart, scoring and welding are prevented. The other theory maintains that metal-to-metal contact is unavoidable, but that if it is momentary, no damage will be done. On this basis it is suggested that the interposed lubricant film actually does break down at points on the faces of the intermeshing teeth but that the chemical activity of the sulfur, perhaps

speeded up by the developing heat at the point of greatest friction, is sufficient to cause the compound to replace the broken film instantly and effectively.

Whatever the true explanation may be, it has been established by extensive experiments on lubricant testing machines that sulfur is a desirable "extreme-pressure" agent. That is, it greatly increases the capacity of an oil film to hold surfaces apart. Ordinary mineral oil films on bearing surfaces break down at comparatively low pressures. With sulfur added, the load-bearing ability is greatly increased.

The efficacy of sulfur suggested the possibility that other substances might work. Compound after compound has been tried and found successful. Among the most promising groups are the compounds of phosphorus. Tricresyl phosphate, known as an ingredient of lacquers, has proved itself a high-powered lubricant.

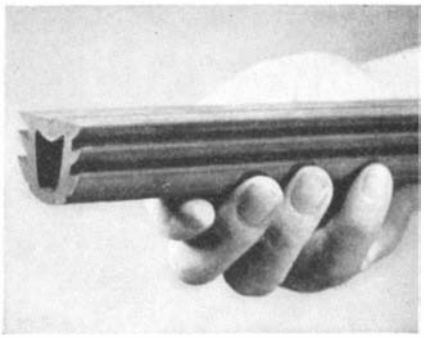
It is apparent that something of a revolution has been wrought in ideas of lubrication. From strictly neutral to definitely active oils is a decided change in practice. Already engineers have extended the chemical film idea toward chassis and even engine lubrication. If a guess could be hazarded it would be predicted that the era of pure mineral-oil lubrication is drawing to a close and that tomorrow will see lubrication controlled by a whole series of chemicals perhaps culminating in the virtual abandonment of mineral oil. Just as the latter displaced fatty oils, so is petroleum itself subject to replacement when new and better compounds are found. If superior lubricants are discovered they will be used, though what form they will take, who can say?—*J. Harold Byers.*

PRE-FORMED RUBBER EXPANSION JOINT FILLER

A NEW type of rubber expansion joint filler for all conventional joint openings used in concrete highways, structures, curbs, sidewalks, tanks, and other miscellaneous types of construction has recently been introduced by The B. F. Goodrich Company.

These pre-formed strips are made of rubber specially compounded for best aging and wear-resisting qualities. They are designed with flexible lips on the two sides, which project upward against the concrete surface of the joint opening, making their removal very difficult. In order that the strips

The rubber expansion joint filler for highways is pounded into place



Close-up of the expansion joint filler, showing fins and hollow center

may be easily compressed, they are made with a large tubular opening in the center. The top surface is slightly indented or grooved to provide for downward thrust of surface upon compression. Due to this latter feature, it is impossible for material to extrude above the wearing surface of the pavement.

The strips are designed to be placed under partial compression as they are made about 25 percent wider than the opening in which they are to be used. This permits the rubber to follow the concrete as it contracts and yet compress readily when the concrete expands.

Advantages claimed for this new preformed rubber expansion joint filler are that it eliminates expensive joint maintenance work; is low in cost; entails no waste through trimming; cannot be damaged by ordinary handling; is quickly installed by unskilled workmen without aid of special tools.

Lighter Freight Cars?

IF it were possible to eliminate one fourth of the weight from the 1,745,299 freight cars owned by American railroads, a saving of 154,000,000 dollars would be effected in their operating costs during the current year, Albert F. Stuebing, railroad mechanical engineer of the United States Steel Corporation told the New York Railroad Club recently.

Mr. Stuebing was quoting Mr. Ralph Budd, President of the Burlington Lines, who had recently compiled some figures based upon estimates of the Car Service Division of the Association of American Railroads.

Quoting Mr. Budd further, Mr. Stuebing continued: "The cost per ton mile of moving these cars, not counting their contents, is estimated to be 1.13 mills.

"If these cars weighed one fourth less, there would be a saving of 113,561,806,000 ton miles which, at 1.13 mills per ton mile, would amount to 128,324,840 dollars.

"Following the assumption that 1937 would see 20 percent more business moving, the saving could total 153,989,808 dollars were it possible overnight to reduce the weight of all freight cars by one fourth."

Although steel has always been synonymous with strength, stronger steels are the answer to the problem of reducing deadweight to cut railroad operating costs, Mr. Stuebing declared.

As far back as 1928 the United States Steel Corporation started pioneering in research for a high-tensile steel which would combine superior strength with a marked increase in endurance under service condi-

(*Please turn to page* 178)

THE AMATEUR TELESCOPE MAKER

Conducted by ALBERT G. INGALLS

CHATTANOOGA, TENNESSEE, has more amateur astronomers to the square inch than most American communities, perhaps because it has long been the home of the Barnard Astronomical Society (Barnard, the keen-eyed photographer's assistant who became a noted professional astronomer at Yerkes was a Chattanoogan) and is therefore telescope conscious. Clarence T.

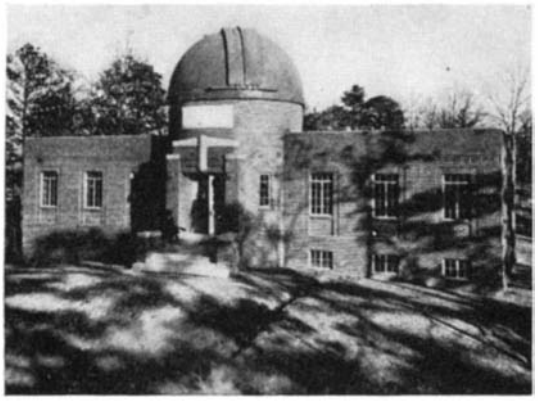


Figure 1: **Property of Chattanooga, Tennessee**

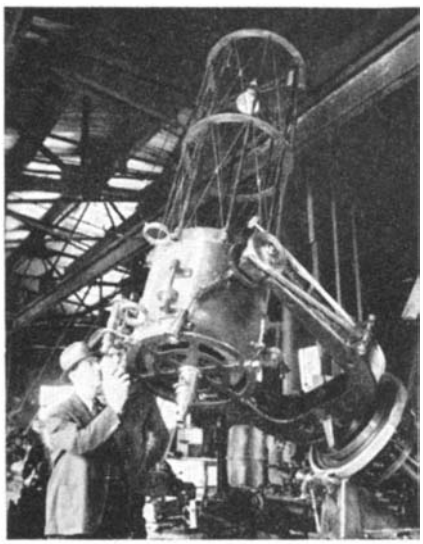


Figure 2: **Jones, Sr., and the 20¾″**

Jones, 210 Glenwood Drive, Chattanooga, an architect by vocation and an amateur astronomer and telescope maker by avocation, is the president of the society, and has been fathering and directing the construction of a city observatory (Figure 1), for which he was the architect. Within the dome is to be a 20¾″ Cassegrainian reflector (Figure 2) designed and built by Jones and his sons Clarence and Bruce, assisted by Paul Lewis. Before tackling the 20¾″ job Jones, senior, made over 25 smaller mirrors.

The mirror was made on the machine shown in Figure 4, where the disk, 2½″ thick, is shown while being perforated. Central spindle, 3 r.p.m., side cranks 40 r.p.m. and 1 r.p.m. Figure 3 shows the preparation of a plaster-backed polishing lap for an *f*/2.5 sphere for testing the secondary. The lap was made by the Ritchey method—pouring pitch between ¼″ strips of wood laid on newspaper. Cross marks were pushed into the strips before the pitch cooled, and the strips were broken into squares on hardening. The squares were later heated enough to detach the newspaper and applied to the disk, which was already covered with HCF, and others were similarly applied to the main mirror (Figure 5). An excellent method of supporting a mirror for test, devised by the late Henry H. Mason of Florida and once illustrated in these columns and used by Jones, is shown in Figure 6. A crank behind the board permits rotation of the spool and belt to bring any diameter of the mirror to a vertical.

Jones spent a year planning this telescope, making 15 detailed drawings. To make the main mirror took one month of day and night work. Iron tools were used for grinding. Polishing took 27 hours, figuring 30 hours, and at no time did the mirror misbehave. The secondary is a 5½″ convex.

FROM Cyril G. Wates, 7718 Jasper Ave., Edmonton, Alberta, Canada, we have received the following item pertaining to the telescope making art:

"With the Foucault test nearly eighty years old, it is hardly likely that anything connected with it is actually new, but speaking for myself, there was always something lacking in the precision of the test until I made the discovery that by sliding the knife-edge *along* the optical axis instead of *across* it, I could watch the shadows change from right to left, and thus determine the exact focal center of any zone.

"In order to slide the knife-edge along the axis with absolute precision an adjustable guide must be provided with means for moving the edge laterally without affecting the parallelism of the guide and the axis. I built a rather elaborate machine with micrometer adjustments, right-angled prism, and so on, but nothing of the sort is really necessary. A strip of wood screwed down to the table, a large block to slide along it, and a knife-edge mounted on this block in such a way that, by turning a screw, the knife can be moved in and out—that is all. The essential point is that the whole thing must be movable *exactly* along the optical axis.

"In actual testing, I start inside the focal center and work toward me; then start outside and work in. I find that there is rarely more than 0.01 of an inch difference, even on central zones. I have completely refigured my 9″ mirror, using this method, with the result that I can easily split double stars which were formerly quite hopeless. The whole point of the method is that you watch the shadow continuously and can easily determine the point at which it reverses, while the customary method requires the observer to judge a fixed appearance. It is the same difference as there is between a motion picture and a series of photographs."

FOLLOWS a second item by Wates:

"The contributions of J. H. Hindle and others in ATMA on the construction of diagonal mirrors for Newtonian telescopes leave little to be desired, but for the benefit of those who, like myself, hesitate to attempt the edging and figuring of a truly elliptical flat, the following considerations are submitted.

"Diagonal mirrors are generally made either elliptical or rectangular. In either case, the blank must be edged to size and then provided with a 'surround' of similar glass before attempting to figure the surface to a true plane. To these shapes may be added a third, viz., circular with straight edges. Let us see what is the loss of light due to the use of each of these shapes, taking a 12″ mirror with a focus of 96″ as an example.

"The correct size for an elliptical diagonal will be 2″ by 2.83″. The area of parallel rays intercepted will be that of a circle 2″ in diameter, or 3.14 sq. inches. Assuming glass ¾″ thick, a rectangular diagonal will intercept a rectangle of rays 2″ by 2.3″, allowing for the protruding lower edge, which could, of course, be ground off if desired.

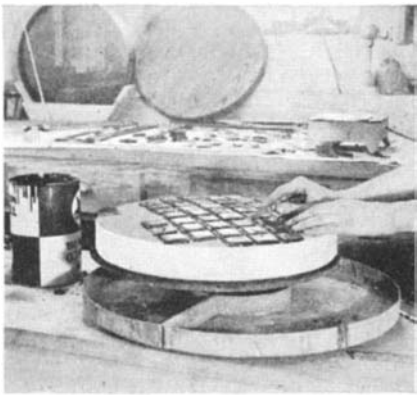


Figure 3: **The chocolate fudge lap**

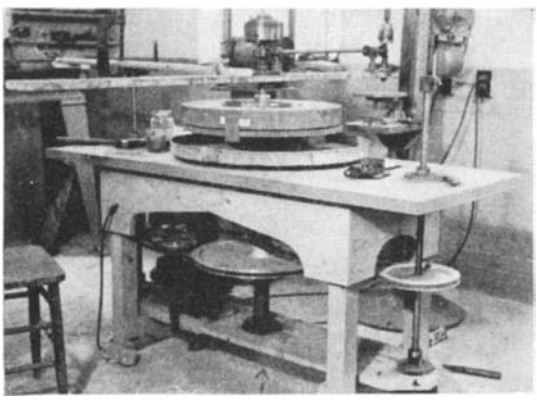


Figure 4: **The Chattanooga machine**

Figure 5: **Trimming the main lap**

This area will be 4.60 sq. inches, which is 1.46 sq. inches greater than that of the ellipse. The effective area of the O.G. being 110 sq. inches (approx.), there will be a loss of light of about 1.3 percent, which is equal to masking off a strip around the edge of the mirror .038″ wide—or about 1/32″.

"How about a circular diagonal? Again allowing for the square edges, the rays intercepted will take the form of an ellipse, 2.83″ by 2.30″, with an area of 5.11 sq. inches. As compared with the elliptical mirror, this represents a loss of light of 1.8 percent, equal to a strip .052″ wide around the edge of the O.G. As compared with the rectangular diagonal, the circular one causes a loss of light of only 0.5 of 1 percent, or an amount equal to grinding away 14 thousandths from the edge.

"These differences are so small that one is led to the conclusion that the labor involved in constructing a truly elliptical diagonal is sheer waste of energy, and that a circular mirror which can be polished and figured without elaborate complications is perfectly satisfactory in all but very short focus telescopes. Certainly the difference in performance between a 12″ mirror and one having a diameter of 11.948″ is hardly justification for the work involved."

FIVE men in Providence, Rhode Island—Prof. C. H. Smiley, mathematician-astronomer of Brown University, Donald S. Reed, Harry A. MacKnight, Paul Eberhart

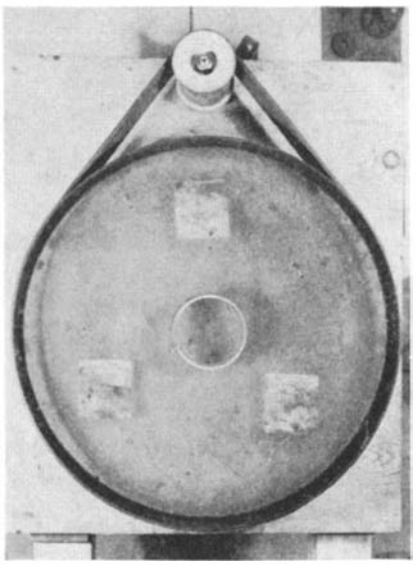


Figure 6: **Testing support dingbat**

Figure 7: **Hoffman, Schmidt, Eberhart**

Figure 8: **The schmidting machine**

and Frederick C. Hoffman—have made a 6″ Schmidt camera shown in Figure 7. The tube is shown inverted, Hoffman (right) has his thumbs on the mirror cell, his little finger on the film supporting ring, and Eberhart (left) his fingers on the ring for the correcting plate. Figure 8 shows the special machine by which these workers solved the problem of the difficult, irregular, knock-kneed, bow-legged, psychopathological curve on Schmidt correcting plates. Asked to describe this creation Reed wrote:

"Mr. MacKnight designed and built the grinding and polishing machine for the Schmidt correcting plate or lens. The plate was cemented in the Bakelite ring on the turntable and turned slowly by motor. A fine emery wheel rotating at right angles was used in grinding, and a similar wheel of wood with pitch on its edge was used with rouge for some of the polishing. The handle at the end of the long screw for radial movement moves the grinding wheel from center to edge of the lens. The depth of the cut is adjusted by a micrometer.

"The shape of the lens face was tested with a dial indicator measuring to .0001″. Ring laps with No. 600 Aloxite and rouge were used for final grinding and polishing. As you suggested, we used a Borium tool to rough out the deep curve of the spherical mirror and its tool on a lathe."

In Figure 8, MacKnight is nearest the reader, adjusting the abrasive wheel of the machine, Hoffman sits behind, while standing at the back, with the *f*/1 mirror in his hands, is Smiley who has led the project—not as a professor but as an amateur. (How to designate in this column men of different vocations who make telescopes is often a problem. As amateurs in a hobby they are all equals and so they are all simply "Smith", "Jones", "Brown" and so on, whether billionaires or paupers, old or young, doctors, professors or water boys—which we believe to be as they would best like it.)

RESIDENT in China is C. N. Joyner, address "P.W.D., B.M.C., Tientsen", an American civil engineer who built the telescope shown in Figure 9 and with it made photographs of the moon, and with these illustrated a book reviewed elsewhere in this number. Figure 10 is the homemade camera with which these lunar photographs were taken. It consists of a film-pack adapter connected to a Thorndyke shutter, the whole screwing into the eyepiece holder of the telescope. Joyner has two mirrors, a 10″ made by himself and a 12″ Hysil mirror made by H. E. Dall of England, each of 100″ f.l. His own four previous mirrors were roughed out using oil instead of water. The telescope tube is of plywood; the base has a run-off shelter. Beside Joyner in the photograph is his son Nicolas whom he describes as the "Gastronomer" or "Assistant Director of the Observatory in Charge of Gastronomy". (At about the same hungry age your scribe's initials were parodied within his family as "All Gone Inside".)

FIGURE 11 is an 8″ made by C. E. Raible, Seavey Road, Milvale, Pa. The mounting

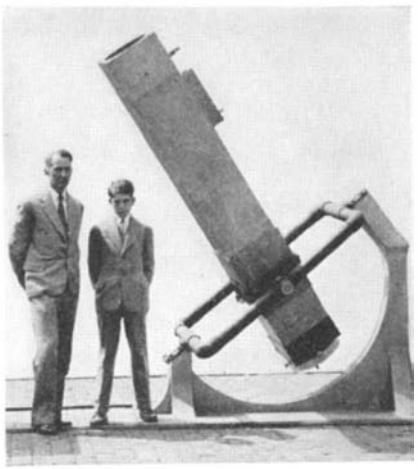


Figure 9: **Joyner, Joyner, Jr., and 10″**

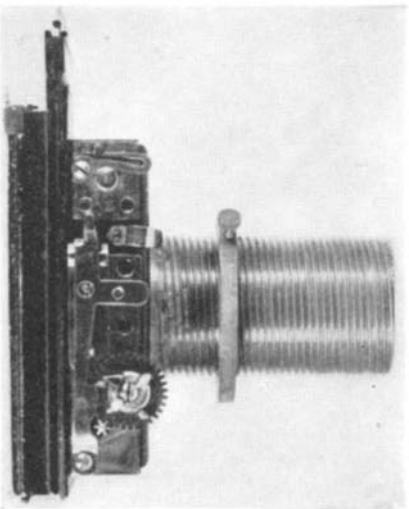


Figure 10: **The Joyner camera**

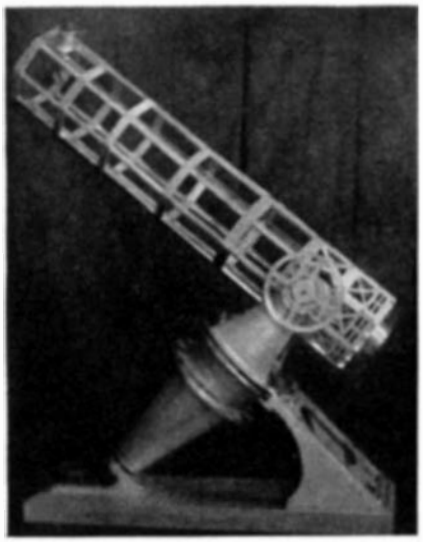


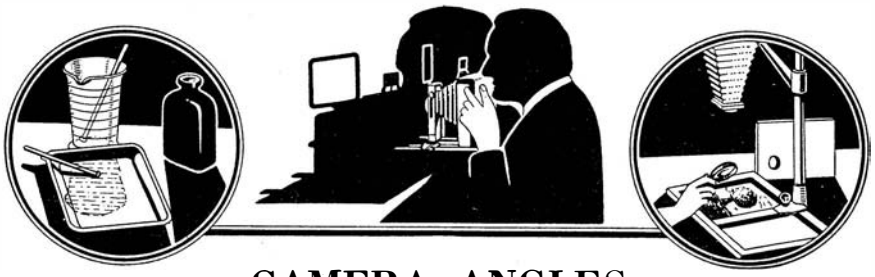
Figure 11: Raible's "Old Rigidity"

is based on an illustration of one of the designs that were proposed for the 200″ telescope. Raible made the drawings, patterns, castings, and did the machining.

FIGURE 12 is a mounting by C. E. Mielke, 235 Princeton Avenue, West View, Pa. It is made of pipe fittings but not ordinary pipe fittings. Mielke describes it thus: "The castings are standard 1¼″ flanged pipe fittings faced but not drilled. This size is suitable for a 6″ or 8″ telescope mirror. For a 10″ mirror 2″ fittings should be used. As they are rough cast on the inside, the two tees are bored 1½″ deep at each end and bronze bushings driven in. This gives the shaft a bearing at each end and also the large surfaces of the flanges are in contact, which makes for smooth operating and rigidity. The polar axis is a drive fit in the tee, so that the shaft turns with the tee."

YEARS ago W. H. Pickering and others described mysterious and periodic changes in size, shape, and color of certain lunar markings. Amateurs watched these but in later years observation largely lapsed. Now three excellent summaries of this subject, in the June-July number of *Popular Astronomy* (Northfield, Minnesota), bring it to the front again, and definitely describe observations that amateurs can make with plain equipment. Who knows—there may be marigolds on the moon, after all!

Figure 12: Never used before



CAMERA ANGLES

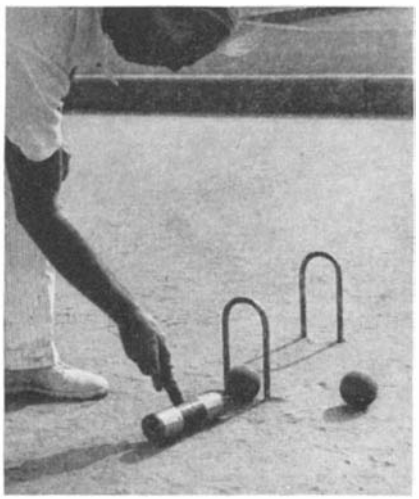
Conducted by JACOB DESCHIN

Close-Up Sports Photography

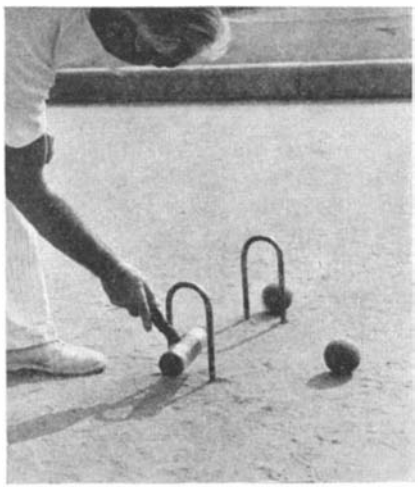
YOU can't beat the close-up for real story-telling quality. There's nothing like it for punch and clarity. Here in a completely segregated area, entirely removed from all that is going on about it, singled out, restricted, is the whole thing in a nutshell. You know what is happening and how it is happening because you're right on top of it and can therefore see it all clearly.

Close-ups are effective with many subjects in photography and particularly so with sports and games because what is happening is of prime importance. Action is going on all the time, movement is the theme. In order to follow the game intelligently we must see the details of the action. Where is the ball? How was it struck or thrown? How did the player get out of that fix? It is fascinating to watch the ball flying through the air or rolling over the ground because of the element of suspense involved. But why do we feel this suspense? If by some miracle the ball were to fly through the air or roll over the ground continuously, without halting anywhere, we would very soon tire of watching the game. What we are chiefly interested in is the impulse that actuates the ball's motion, on the one hand, and, on the other, whether it arrives at its destination and how.

At ball games, football, and other sporting contests in which the action is necessarily spread over a large area, it is difficult to follow these details camera-wise unless we use a telephoto lens. Sometimes even a telephoto lens is not enough, so we are content in the main to watch the game with field glasses and do the best we can photographically to record the game in the mass.



Roque (1)



Roque (2)

However, such games as golf and tennis and indoor games like billiards and badminton allow many opportunities for obtaining close-up shots that really mean something. Often, too, they have a pictorial feeling about them distinct from their value as records of the game's progress. On this point of pictorial effect, we would like to place special stress. After all, unless we are sports photographers assigned by a newspaper to "cover" a game and never mind the flowers, we should strive to make only those shots that look good as pictures as well as being important incidents in the game.

Not all important incidents, of course, make worth-while photographic shots from the pictorial viewpoint. So if you're out to make a record of the game, blaze away to your heart's content. You will probably be able to get enough pictures out of the harvest to make a fairly presentable series to show afterwards to your friends.

Wherever possible, however, better than a series of disconnected incidents will be groups of progressive steps in separate incidents. One such incident is described in the three photographs accompanying this discussion. The game played is known as roque, a form of croquet, and is ideally adapted to the close-up since it is played within an unusually small court. The three pictures constitute progressive steps in the ball's movements. The first shows the mallet poised for one of the most difficult shots in the game, that of driving the ball through a wicket which gives the ball a clearance of about ⅛th of an inch on each side. The second picture shows the ball moving through the second wicket with the mallet

(*Please turn to page* 174)

A New Photo Contest

OPEN TO ALL AMATEUR PHOTOGRAPHERS

$150 IN PRIZES

A cash prize and international recognition for your work awaits you if you submit one of the three best photographs entered in Scientific American's Second Photographic Contest. You do not need to be an expert photographer in order to enter. The rules are few and simple; they presuppose only the ability to recognize and compose a photograph with pictorial appeal, and sufficient technical knowledge to produce a print of good tonal quality.

Here are the Prize Awards

First Prize $75 · Second Prize $50 · Third Prize $25

Ten Honorable Mentions, Each to Receive a One-Year Subscription to Scientific American

There are no limitations as to subject matter. You do not have to do your own processing, although it is advantageous to do so because of the control which you yourself can exercise over the production of a finished print of something that has literally been yours since conception.

In order that the judges may deal impartially with all submitted prints, a lower limit of size has been fixed. Prints entered in this contest must be at least 3¼ by 4¼ inches, but they may be any size larger than this that the entrant may desire. Prints smaller than 3¼ by 4¼ inches are difficult to judge; they do not show details that become apparent in enlargements, which frequently improve a particular print greatly. Prints need not be mounted, but a well proportioned mount invariably adds considerably to the appearance. It is suggested that 8 by 10 inch prints, suitably mounted, will give the best display to a really fine photograph.

The rules are few and simple, but please read and abide by them to insure against disqualification.

RULES OF THE CONTEST

1. Entries will be judged on the basis of pictorial appeal and technical excellence. The decision of the judges will be final. In case of a tie for any prize, duplicate prizes will be awarded to the tying contestants.

2. Prints must be no smaller than 3¼ by 4¼, but may be any size larger than these dimensions. Prints need not be mounted, but may be at the contestant's option.

3. Photographs must be submitted by first class mail, with sufficient cardboard to protect the prints.

4. Each entry must have the following data written on the back of the print or mount: Name and address of contestant, type of camera, and film used.

5. Prize-winning photographs will become the property of Scientific American, to be used in any manner at the discretion of the publisher.

6. Scientific American reserves the right to purchase, at regular rates, any non-winning entry.

7. Non-winning entries can be returned *only* if sufficient postage is included when the prints are submitted.

8. No entries will be considered from professional photographers.

9. All entries in this contest must be in the hands of the judges by December 1, 1937. The results will be announced in our issue dated February, 1938.

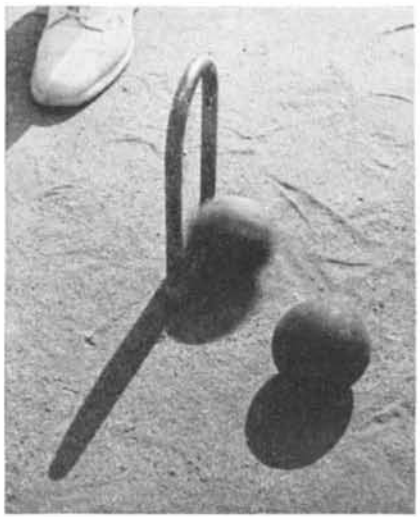
10. This contest is open to all amateur photographers who are not in the employ of Scientific American.

What could be simpler? Plan your entries now, and keep a sharp photographic eye peeled for the unusual shot that may be a prize winner. You may submit as many prints as you desire, sending them in all at one time or submitting them as they come along. Only one prize, however, will be awarded to any one contestant. The Board of Judges will be announced in a subsequent issue.

Address All Entries to

PHOTOGRAPH CONTEST EDITOR

SCIENTIFIC AMERICAN • 24 WEST 40TH STREET • NEW YORK CITY



Roque (3)

caught at the peak of its swing through the first wicket. The third picture shows the ball in actual motion as it comes through the second wicket. This last was, of course, taken in a repetition of the same incident, but does, nevertheless, constitute a definite part of the series. The last picture, incidentally, illustrates the pictorial type of picture discussed above. Notice how the motion of the ball contrasts with the rigidity of the non-moving ball in the foreground.

Pola-Screens for Amateur Cameras

BY means of a range of adapter rings, Pola-Screens may now be fitted to the lens mount of practically any camera. Separate lens hoods are also available. These screens are known as Type 1A and come in four sizes, designated as Series V, VI, VII, and VIII. While our readers are already familiar with the characteristic of these screens—that of cutting out glare and reflections—they will be interested to learn that, when using Kodachrome to make pictures in natural colors, subjects can be made to stand out strikingly against a dark blue sky. This method of darkening the sky, incidentally, is the only one possible in color photography.

Tilt Top for Your Tripod

AN interesting gadget for the amateur photographer, and one that will be of great assistance in certain phases of his

Tripod tilt top

work, is the Tilt-O-Rama tripod top that is being distributed in this country by Henry Herbert, New York City. This device has a swivel top and graduated panoramic scale, both of which may be seen in the illustration. The moving parts may be locked rigidly in position, after they are once set, and will support even large cameras securely and safely.

The adjustable tripod top is light in weight, being made of aluminum, and will fit any camera and tripod with standard socket and screw. The graduated scale is of great help to the photographer when making landscapes, and can be readily utilized in many forms of "trick" work.

Fascination of Silhouettes

THE beauty of the silhouette was appreciated long before photography came upon the scene, but a scissors cut-out of a profile is far inferior to the photographic silhouette in many ways. The slight suggestion of form that is often obtained by photographing objects or persons against a bright light gives a feeling of life not ob-

"Waiting for the Bus"

tainable in a straight cut-out or even the completely black, sharp-edged photographic silhouette. In "Waiting for the Bus" we have a real silhouette; that is, we see outlines but not faces. Nevertheless, the highlights on shoes and hats and dresses, on the upraised arm of the woman in the flowered dress and on one of the packages of the shopper give body and shape while retaining the silhouette effect completely. The shot was, of course, from an elevation and the picture was made in late afternoon.

The Rectifier Enlarger

WHEN a couple of camera enthusiasts get together and start ripping up existing notions about the construction of this or that type of apparatus in order to plan it closer to their collective heart's desire, you can expect almost anything. And one of the things they particularly love to

whale into is the usual enlarging camera.

Take the case of the Rectifier Enlarger, the joint enterprise of Joseph M. Bing, F.R.P.S., pictorialist and authority on photographic exposure, and Adolph Fassbender, F.R.P.S., pictorialist and instructor in photography. Feeling the need for an enlarger completely free of restrictions, and therefore constantly on the alert for every wish and whim of the pictorialist, the designers got to work, using for a base an original Austrian design. They had in mind a few friends of similar tastes to theirs—pictorialists, salon exhibitors, men and women in the advanced category of amateurs. They would make a few of the outfits and distribute them among their friends at a moderate price and without benefit of dealers. And so they did and so they are doing.

The Rectifier hangs against a wall, leaving the easel free to turn handsprings, if need be, in the cause of original pictorial treatments, for in the Rectifier it is the easel, not the housing, that is moved up and down for varying the size of the image, this raising and lowering of the easel being controlled by a counter-spring arrangement. The 18 by 18-inch easel revolves at the center from two supporting arms jutting out from the enlarger framework and may be used on either side, with a metal masking easel on one and with flexed spring clips on the other for "bleed" enlargements.

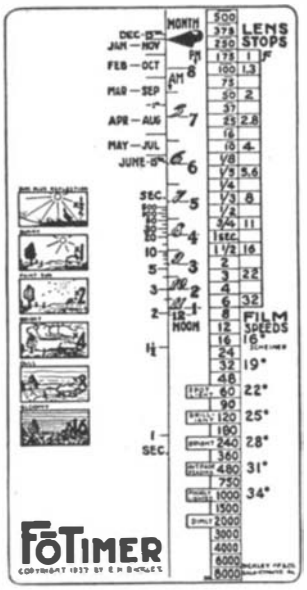
The Rectifier is equipped with a tilting negative holder in a turn-table device which makes possible a quick shift in the negative image, a change from a vertical to a horizontal position being effected without removing the holder. As the negative holder is tilted the housing is tilted with it, thus insuring correct and even illumination at any angle. The lens board takes lenses of various focal lengths interchangeably and, since the lens board is designed on the principle of the rising and falling front of the camera, the lens may be shifted about in various directions within the full 360°.

"Modern Angle"

EXERCISING once again our proclivity for showing off, we present again a photograph of ours that has graced the walls of an exhibition hall. The picture is called "Modern Angle" and was taken in a triple mirror situated at sidewalk level below a store window front. We hasten to explain this right away just to head off the super critics who will at once notice that the lettering visible in the picture is reversed. Incidentally, it took several exposures to get one that satisfied, because the scene kept changing all the time and it was necessary to get the right type of subject in the off-center position.

Slide-Rule Meter

BELIEVED by its sponsors to be a new thing under the sun, the Fotimer exposure meter is now on the market. The left-hand side of this so-called slide-rule



meter is devoted to the scales for determining variations in light conditions, while the right-hand side is devoted to applying this information to film speeds and lens stops. The makers of the Fotimer claim their meter is the synthesis "of thousands of tests, by numerous experimenters, covering long periods of years, not only on photographic film but also in connection with

"Modern Angle"

photo-electric cells of special sensitivity corresponding to that of photographic film." Directions for using the Fotimer are on the back of the slide, which is made of celluloid. Fotimer is made in various models to suit conditions in various latitudes.

Hint for Bromoilists

EXPERIENCED workers with the bromoil process suggest the use of the P. U. Opal Glass Palette for mixing and spreading bromoil pigments before applying the ink to the print itself. Its advantages are that the white base of the Palette affords the opportunity of judging color blends, prevents the carrying of clumps of pigment to the print and indicates when the ink is practically exhausted. Also, because the Palette is relatively heavy, it will not be accidentally picked up by the brush because of the tackiness of the ink.

Announcing the Mini-Photoscop

TAKING the camera-world completely by surprise is the recent announcement of the appearance on the market of a new photo-electric exposure meter distinguished principally by three features: 1. An electric cell of extraordinary sensitivity; 2. An instrument so small that it fits snugly in the palm of the hand, yet is accurate and rugged for all its compactness; 3. An unprecedentedly low price for a photo-electric exposure meter. The new meter is known as the Mini-Photoscop because of its small dimensions, its size being, in fact, about that of a package of cigarettes. It comes equipped with an ever-ready case, the cover of which also serves to protect the meter, when in use, against foreground reflections.

A feature of the Mini-Photoscop that should recommend it to many is the fact that it may be operated with one hand, both for aiming the meter and setting the knurled dial, irrespective of whether the meter is held in the left or the right hand.

By a slight shift of the knurled dial, on which the indelible scale markings are large and clear, readings are instantly made for still photography, motion picture work, or color photography. The meter is aimed and read in the same position as a book, the top-light influence being excluded and the reading angle restricted to less than the ordinary camera lens field, thus ensuring a correct reading for the subject.

Projector for Miniature Positives

THE popularity of Kodachrome and Dufaycolor natural color film among 35-mm camera users makes the ownership of a projector for viewing the resulting color transparencies as urgent as the need for a projector in motion picture photography. The announcement of a new projector by E. Leitz, Inc., makers of the Leica camera, is, therefore, welcome news. The new projector, known as the VIII-S, is claimed by its sponsors to give an image brilliant enough for moderately large gatherings, yet fully adapted for home use. The VIII-S uses a 250-watt bulb, will project single frame filmslides, double frame filmslides or 2-by-2-inch glass slides.

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 167)

tions. These efforts were successful and in 1934 an outstanding steel was introduced under the trade name Cor-Ten, now the leader of the corporation's high-tensile family. Two pounds of this steel will ordinarily do the work of three pounds of plain steel.

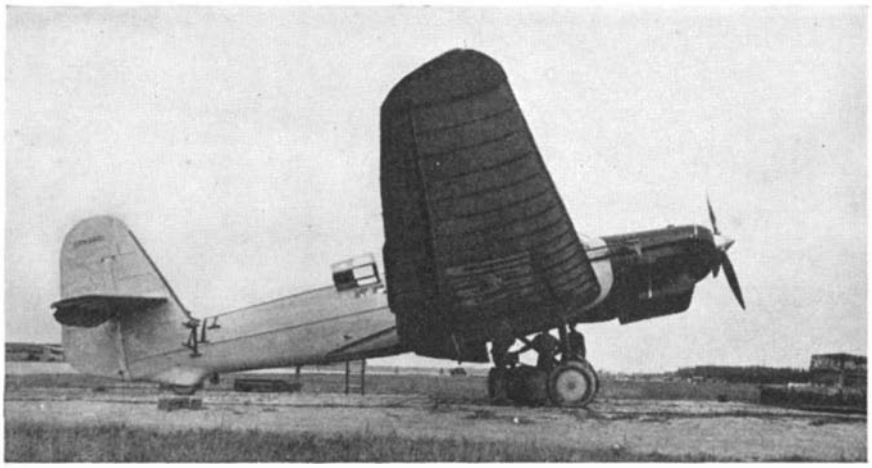
Herein lies one key to weight reductions and the means of effecting savings by the railroads. This high-tensile product is not only stronger than ordinary steel, but also more resistant to corrosion. Hence, thinner sections can be used in freight and passenger cars to give an average saving of 33 percent in the weight of structural parts. By thus eliminating costly deadweight from rolling stock, railroads can haul longer passenger trains and speed up their service. More pay load can be carried in freight equipment, with a substantial contribution to net earnings.

(End of Transportation Section)

Significance of the Moscow-U.S. Flights

WHILE the Soviet fliers from Moscow did not get to Oakland, California, on their first trans-Polar flight, but had to stop at Portland and continue their journey prosaically as passengers on another aircraft, and while they broke neither the long-distance flight record, nor the record of the longest non-stop journey, their achievement is nevertheless a remarkable one. Perhaps the readiest way of grasping the significance of the flight is to glance at the appended map and to compare the length of their journey with the distances of a possible journey from Moscow to California via Siberia and the Pacific Ocean. There is no doubt that if the West Coast of the United States is ever to be directly connected with the center of the Soviet Republic, it will be over the North Pole, taking "a short cut over the top of the Earth." The flight is all the more remarkable when the uncharted and unbeaconed territory is taken into account, as well as the tremendous difficulties of navigation in a region where magnetic indications are as uncertain as they are at the North Pole, where magnetic lines converge and cross in the most confusing manner.

The view of the ANT-25 indicates a robust and well proportioned airplane admirably adapted for its special task. Many wind-tunnel tests, careful vibration computations, and many trial and long-distance flights preceded the great exploit. The plane is 44 feet long, 18 feet high and has a wing spread of 122 feet. The wing area is 946.8 square feet. The weight empty is 9240 pounds, and fully loaded the wing loading is 26.24 pounds per square foot. The engine, Russian built, develops 950



Above: The ANT-25, first Russian plane to fly from Moscow to the United States. *Below:* The crew, right to left: G. Baudukov, V. Chkalov, and A. Belekov. At left is A. N. Tupolev, under whose supervision the plane was built

Courtesy of *The New York Times*

Route of the first Russian trans-Polar flight

horsepower and weighs 1430 pounds, which is relatively light for a water-cooled engine. It will be noted that the aspect ratio (wingspread to chord) of the wings is very large. This was necessary to secure efficiency in long-distance flying, but also introduced structural difficulties, since excessive wingspread means undue weight of wings. One reason why this difficulty was solved was because the fuel tanks were each 21 feet long and placed in the wings, so that the weight of fuel relieved somewhat the upward lift on the wings. Also, the fuel tanks were made an integral part of the wing structure—a procedure which American designers might well imitate on occasion. To safeguard against forced landings over water, air-tight compartments were provided in the wings, so that ample flotation was provided.

All our congratulations to the constructors of the plane and engine and to the pilots of the flight.—*A. K.*

At the time of going to press, a second Russian plane has just landed at San Jacinto, California after successfully flying over the Pole. This flight, in a plane similar to the one described above, set a new distance record of 6262 miles.—*Ed.*

Super-Terminal Airports

THE Bureau of Air Commerce is reclassifying airports of the United States. As airplanes become larger and the wing loadings heavier, the length of run for take-off also becomes longer and so does the landing run. Moreover, it is not sufficient to have just the right length of runway; adverse weather conditions may necessitate landing at far higher speeds than normal, with a correspondingly longer run. Also, the take-off is not safely completed when the wheels have merely left the ground; the subsequent climb to clear surrounding obstacles must be taken into consideration. As a matter of fact, no one is quite certain what the exact requirements of an airport should be. Investigations to be made shortly by motion picture studies of take-off and landing will be very helpful in this regard. But with the information already available, the Bureau of Air Commerce has promulgated the following classifications:

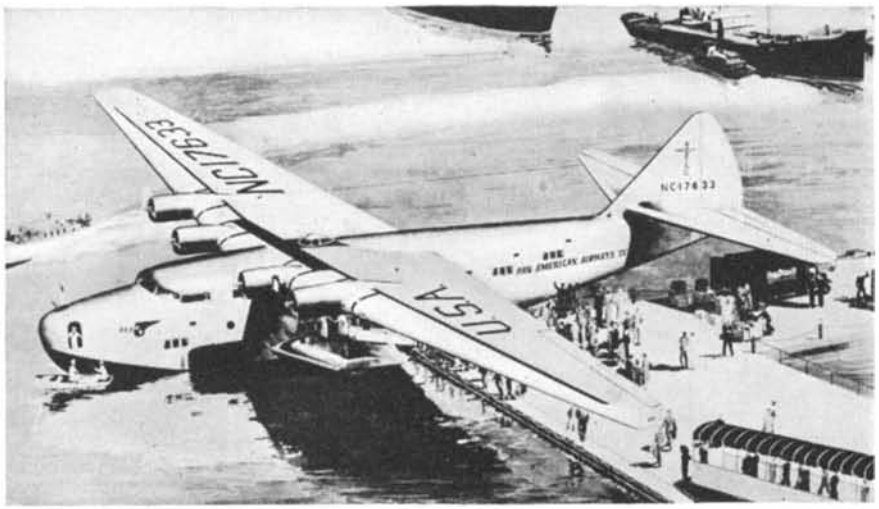
1. Super-terminals, with minimum runways of 4500 feet.
2. Terminals, with minimum runways of 3500 feet.
3. Limited terminals, with minimum runways of 2500 feet.
4. Airports with fuel, housing and servicing facilities.
5. Landing fields, which include emergency field, and so on.

Some of the best-known airports in the United States will not be able to meet the highest of these requirements and Newark, Chicago, Washington, Seattle, Detroit, Kansas City, and Portland, Oregon, will suffer tremendous loss of prestige thereby. Floyd Bennett in New York City will, on the other hand, meet all the requirements and its position relative to the Newark airport will be greatly strengthened.

Of course, there is a fine point in designing an airport; it must have runways long enough to be safe, but excessive length means a heavy financial burden. The difficulty is to strike the happy mean.—*A. K.*

Conquering the Atlantic by Air

IT is already a commonplace that a regular flying boat service is available between New York and the Bermudas, with Pan American and Imperial Airways happily cooperating and passengers commenting on the excellent meals served during flight. It is significant of the meticulous care exercised by these great operating companies that prior to extending the New York-Bermuda service farther across the Atlantic, they are going to make careful and numerous survey flights, with airlines charted and weather and radio services carefully checked and coördinated. Of course, the credit for the ultimate conquest of the Atlantic by air will be shared equally with the aircraft constructors and the engine builders, and the first information released on the giant Boeing *Clippers* for this work is of great promise. The Boeing Model 314 flying boat is to be equipped with four 1500 horsepower, double row, 14-cylinder Wright



An artist's drawing of the Boeing transatlantic *Clipper*

Cyclones, probably the most powerful air-cooled engines in the world. Six in all of these giants are on order for Pan American Airways. Each of the planes will weigh more than 82,000 pounds gross and will have a wing spread of 152 feet, an overall length of 109 feet, and an overall height of 28 feet.

As can be seen from the artist's conception of the Boeing *Clipper*, the latest ideas in aerodynamics have been embodied in the design. The cantilever wings are no longer a novelty, but the manner in which the engine nacelles blend into the wing with a minimum of disturbance is particularly neat, and the lines of the hull are beautiful to the aerodynamic eye. There has been a good deal of argument in the past whether wing-tip floats (as in the Sikorsky Clippers) or sponsons—short sea-wings—(as in the Glenn Martin designs) are superior for all-around service. Since the Boeing 314 is to have sponsons, it may be taken for granted that sea-wings have won the argument—probably because they provide better taxying properties, help a little on take-off, and give less over-all aerodynamic drag. Careful inspection of the drawing will indicate that each of the control surfaces—rudder, elevator, and ailerons—is provided with *two* auxiliary trimmers or tabs. This used to be Boeing practice on the rudder only, and this is the first time the use of two tabs has been extended to the other control surfaces. One tab is used to give trim—that is, to give the control surface a required, steady position for cruising flight; the other tab helps in balancing the controls and reducing pilot effort.

Aside from the basic design of these newest *Clippers*, there are many features of interest. The Boeing 314 will be able to carry 72 passengers on day-time flights, with a crew of eight. At night, they will provide upper and lower berths for 40 passengers. Capacity for airmail and freight will be 5000 pounds. Speed will be approximately 200 miles an hour, with cruising range of 5000 miles. About 15 tons (5000 gallons) of gasoline will be carried in wings and sponsons; it is another advantage of the sponsons that they provide additional space for fuel. There will be two full decks—an upper deck for flight crew and cargo and a main lower deck with luxurious passenger accommodations. Finally, there will be companionways (often predicted and only now realized) affording access through the wings to the engines during flight. At the forward end of the upper deck will be located the "flight-bridge" with posts for the master and five other flight-officers. Behind the control rooms within the wings will be the main cargo compartments, with sleeping and living quarters for the crew directly behind them. The nose of the hull will provide additional cargo space and a compartment for the mooring apparatus.

A circular stairway will connect the upper and lower decks. The main deck, besides passenger cabins, will contain a dining and lounge salon in the center section, a galley forward, lavatories and dressing rooms for men at the forward end and for women in the after section. We may take complete sound-proofing, heating, ventilation, lighting, and so on, for granted.—*A. K.*

YANKEE INGENUITY AND THE AIRSHIP

SINCE everyone else seems to have philosophized on the *Hindenburg* disaster and guessed at the cause of the accident, we have felt it wiser to refrain from similar efforts here. But the thoughts of a correspondent, E. Burke Wilford, of the Pennsylvania Aircraft Syndicate, should be placed on the record. "Why should American airship construction follow German practice so slavishly?" asks Mr. Wilford. "Yankee ingenuity should carry forward the German rigid airship in the same manner that Glenn Martin and Sikorsky have developed the flying boat far beyond the Dornier *DO.X*. Originality and experimental work by American engineers could increase propulsive and structural efficiency so much as to offset the decrease in lifting power due to changing from hydrogen to helium. Why adhere to fabric cover when our metal-clad *ZMC-2* has proved out so well in extended service? Bow elevators, already used in the submarine, would have prevented the crash of the *Akron*, and higher factors of safety the wreck of the *Macon*." Our correspondent is perfectly right. If and when we resume airship construction, it may be well to consider a parting with mere tradition.—*A. K.*

THOUGHTS ON PILOTS

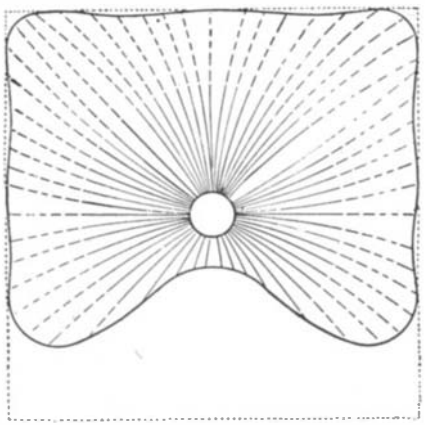
WHEN Major R. W. Schroeder speaks at an Air Line Safety Conference or on any similar occasion, we enjoy his racy speech, but still more his well-informed and

well-thought-out opinions on flying and fliers. Thus, on the question of co-pilots or second pilots: ". . . the pilot expects to be checked by another man. So we readily ask that we have the co-operation of the transport industry in providing a second pilot. We cannot expect him to have the judgment and experience of the first pilot, but he certainly should have a very good technical education and understanding of the construction and limitations of the power plant. Many of our old pilots are not of a mechanical turn of mind and generally they are not trained in engineering matters. They need the support of a second pilot who understands the general engineering condition of the aircraft and what a combination of temperature, pressures, and other items amounts to when summed up."

Apparently the new crop of young pilots is better in some respects than the old timers. "I am happy to report," says Major Schroeder, "that the operators have co-pilot material coming through that is very good first-class pilot material and I believe in many instances will surpass the present first-class pilot material. These new boys are not used to flying near the ground and do not know much about it and are happier when they are on instruments away from the ground, while the older boys hate to let loose of the ground. The new pilot recognizes that ships in deep air do not drag their bottoms any more than do ships in deep water at sea."

A Versatile Lawn Spray

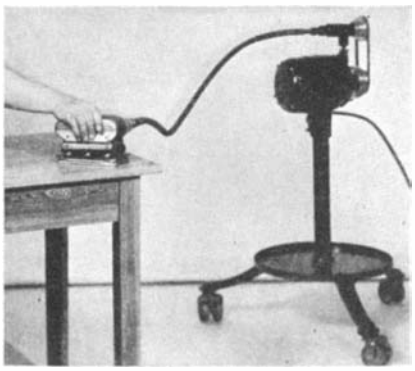
SPRAY patterns that are reminiscent of the broadcast patterns in the radio antenna story in another section of this issue are made by a new lawn sprinkler head. To outward appearance, this sprinkler is similar to many in general use, but it has adjustable nozzles which permit its use on sections of a lawn hitherto impossible to reach with a general spray because of the danger of wetting houses or pedestrians passing on the sidewalk. This spray can be adjusted to fit exactly a triangular section in the corner of a yard, a square section, an hour-glass section, and several other odd ones, to take care of varied limitations of different lawns.



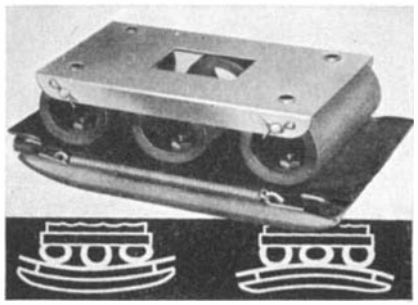
One of the many patterns possible with the new lawn spray described

Motorized Sander

OSCILLATION through a stroke of 5/8 inch is imparted to a new sanding pad by power supplied through a flexible shaft from a motor drive. Available motor speeds range from 1750 revolutions per minute to 2800 revolutions per minute to suit varying kinds of work. Three types of drive include motor mounting on a plate for bench work, motor suspension from overhead by means of bale-type handles and motor mounting on a pedestal as shown in the illustration. Operation is on 110 or 220 volts. The block to which the abrasive paper or cloth is attached is an assembly of flexible rollers of composition rubber and fabric with a flexible pad. The surface of the pad takes the shape of the surface being worked on—straight, convex or concave—as indicated in the lower of the two illustrations. From one to five sheets of abrasive can be attached at one loading, each being one third the size of a standard abrasive sheet.



The complete motorized sander. *Below:* Flexible pad and its action



The head is shaped to fit the hand and weighs 7½ pounds. The machine can be used in any position on surfaces of metal, wood, compositions, leather, or marble, for sanding, buffing, polishing. There is a water connection with a series of openings on each side of the block so the machine can be used for wet finishing. A special block is available for sanding with naptha or benzine.—*Industrial Equipment News.*

Salt Prevents Ill Effects of Heat

A SERIOUS problem to many of the important industries of the country is the effect of extreme heat on employees. In mills and factories where of necessity high temperatures exist, the problem of heat cramps and heat prostration is especially acute. Cramps and prostration, however, are frequently met with in the hot months of summer where workers are unprotected from the direct rays of the sun, and, for that matter, even in mills where the temperature is lower than that of the outside air.

The use of salt as a remedy and preventive measure in such cases is several decades old, but only recently has its effectiveness been scientifically proved by successive trials. One of the most recent and thorough

investigations of the value of salt as a heat prostration preventive was made by the Fatigue Laboratory of Harvard University, conducting experiments both at home and in the field. More than five years were spent in gathering data on the physiological and pathological effects of high temperature on workmen.

Dr. Arlie Bock, who is connected with the Harvard Fatigue Laboratory, suggests that a worker, working eight hours a day under extreme heat, should use plenty of table salt with his food and also should take five or six one-gram tablets of salt, enteric coated to prevent dissolution before the tablet leaves the stomach.

Salt tablets solve prostration problems. Since salt tablets have been made available several automobile plants have not had a single case of heat exhaustion. The tablets, each containing one teaspoonful of pure sodium chloride, are available at drinking fountains in many of the factories. They are swallowed whole, followed by one or more glasses of water. Holding that the principal cause of heat exhaustion is the loss of salt from the blood stream through profuse perspiration, Dr. E. R. Harris, physician at the Cadillac motor car plant, is urging shop workers to take from 10 to a dozen of the salt tablets daily.—Henry C. Marble, M.D., Surgical Director, American Mutual Liability Insurance Co.

Controlling Growth of Weeds

SULFURIC acid spray as a method of controlling the growth of weeds in fields of grain is gaining ground in the United States. Tests covering several years and several thousand acres of grain fields in California have demonstrated the effectiveness of this method. During the present season more than 6000 acres are being kept free from weeds by spraying with solutions of sulfuric acid which kill weeds but do not injure the growing grain.

This is a meager beginning when in California alone there are more than half a million acres that could be benefited and when the vast grain fields of the midwest and the Pacific Northwest have not yet been touched. In France the treatment is already applied to more than 500,000 acres and its use is growing in England and on the Continent. The California development includes testing new, more efficient types of sprayers to cover larger areas more effectively.—*D. H. K.*

Automatic Reception of Distress Signals

HITHERTO, the fate of the passengers and crew of a ship in distress has depended upon various uncertain circumstances. Oftentimes SOS signals did not bring the desired help, for the reason that when the call was sent out, the radio apparatus of some small steamer in the vicinity which carried only one operator did not get the message because the operator happened not to be on duty.

The German radio industry has recently developed an instrument for ships, which, when a certain pre-arranged alarm signal is received immediately preceding the SOS call, causes a bell to ring and a red light to glow. The alarm can immediately be disconnected by simply pressing a button when it has served its purpose. The instrument functions automatically, and requires little attention except occasional replacement of tubes. After having been thoroughly tested by the Reich Post-Office Department experts, this instrument has been installed on ships as a further means of safe-guarding life on the high seas.

LAKE MEAD

THE enormous man-made reservoir behind Boulder Dam known as Lake Mead stored 13,582,000 acre-feet of water on June 1 of this year as compared with 7,076,000 acre-feet at the end of May 1936. Next to this lake, the largest reservoir in the United States is the Minidoka project in Idaho with 2,484,820 acre-feet storage.

Signal Honor for Professor Russell

FROM *Nature*, published in London and regarded everywhere in the scientific world as the leading journal of science for the professional, we quote an appreciation of Professor Henry Norris Russell who, since 1900, has written a monthly astronomical article for Scientific American and for years has been its astronomical editor. *Nature's* comments on Professor Russell appear on the occasion of his election as a foreign member of the famous old Royal Society, an honor conferred only on a very few foreign scientists. The Royal Society is composed of the pick of Great Britain's scientists:

"Prof. H. N. Russell, professor of astronomy at Princeton University, U.S.A., is one of the best-known American astronomers. He first became prominent through his theory of stellar evolution, according to which a star, contracting continuously throughout its history, passed successively through a 'giant' stage of rising, and a 'dwarf' state of falling, surface temperature. This theory, regarded somewhat skeptically at first, gained general acceptance through the discovery, by means of Adams' and Kohlschutter's spectroscopic method for determining absolute magnitudes, of the reality of the distinction between giant and dwarf stars. The development of the theory of stellar constitution called for some amendment of the original postulates of Russell's theory, and it is characteristic of him that he made no attempt to preserve ideas based on insufficient data, but became a leader in the reformulation which was seen to be necessary. He was among the earliest to realize the importance of Saha's theory of ionization in stellar atmospheres, and took a leading part in working out its implications, always with a keen appreciation of the limitations placed on theoretical possibilities by difficulties inherent in methods of observation. The development of laboratory spectroscopy attracted him strongly, and with the collaboration of Prof. F. A. Saunders he obtained the first evidence of the co-operation of extra-nuclear electrons in producing line spectra: 'Russell-Saunders coupling' is now a well-established, and the most frequently recurring, type of such co-operation. More recently he has made important contributions to the analysis of

complex spectra corresponding to various stages of ionization—particularly those of metals prominent in celestial spectra.

"Prof. Russell's work is marked throughout by a breadth of interest and a clearness of apprehension of essentials which place him among the greatest men of science of the time. There is scarcely a branch of astronomy (with the possible exception of problems peculiar to the extra-galactic nebulæ) which has not attracted his attention and become elucidated thereby. He has recently advanced some very suggestive ideas relating to the origin of the solar system, and his text-book on astronomy, written in association with his colleagues, Profs. R. S. Dugan and J. Q. Stewart, is unique in its kind. He travels freely among the American observatories, and has for many years been regarded as a kind of unofficial ambassador-at-large, co-ordinating work of various types and often taking an active part in the solution of the problems encountered. His vivid personality is one of the most conspicuous and characteristic features of astronomical conferences, and the well-deserved honor now accorded him of foreign membership of the Royal Society will give universal satisfaction."

What *Nature* says in the next to the last sentence of the above quotation is often heard orally in American astronomical circles: Professor Russell's advice is sought by astronomers in many other observatories than his own at Princeton, and many speak of him as the dean of the profession in America where there are in all about 500 astronomers. (The above has been inserted without his knowledge.—*The Editor.*)

ICE CREAM

ICE cream was first produced commercially in 1851 in Baltimore. By 1900, according to *Food Industries,* annual consumption had reached 25 million gallons, and now it is 200 million.

Plastic Pistols

PHENOLIC resins are used to make the gun from which blank smoke cartridges are fired as an alarm when a bag of valuables is stolen from a messenger. This device, called "Tracelarm," described in this department in April, depends for its effectiveness on the fact that a light, strong gun for the delayed shooting of the alarm cartridges can be made of plastic materials which are not corroded or injured over a long period of time. This fact makes it unnecessary to grease or clean the shooting mechanism and keeps it always ready for action.—*D. H. K.*

Hay Fever Aided By Air Conditioning

VICTIMS of hay fever and other respiratory affections are assured of a "high degree of benefit" from air conditioning today, as a result of a series of pollen tests by Professor F. H. Hodgson, Department of Allergy botanist at Roosevelt Hospital.

Using an air-conditioning unit provided by Carrier Corporation, Professor Hodgson conducted his tests in a room where the air was heavily saturated with dust and pollen. The unit was a summer portable room cooler without special attachments.

Actual results in one of the main tests in a "room to be used by an allergic patient," Professor Hodgson said, showed the pollen count reduced, in 10½ hours, from 1050 to two per square centimeter.

Summarizing the results of his various tests, the Professor reported:

"From the many experiments described, it would seem that the efficiency of the air-conditioning device is sufficiently good to assure a high degree of benefit to a patient suffering from exposure to air containing irritants, especially house dust and natural pollens."

Another Household Menace

IT is conceded that bathtubs are dangerous, that thousands of people are badly injured by falling in them annually, and that nothing much can be done about it. Amazing to many people will come the news that there is another very dangerous household fixture, a tiny one which could easily and cheaply be replaced by one absolutely safe, and yet one to which little attention has been paid. This is the porcelain handle on many lavatory and kitchen sink faucets. It seems harmless, but isn't.

Recently we read a doctor's warning against this instrument. He stated that he had treated quite a number of cases of bad hand cuts due to breakage of such porcelain faucet stems in normal usage. Often, it appears, the porcelain shell breaks off the inside metal stem under pressure of the hand alone, and the hand is gashed on the jagged, razor-sharp edges. If this one doctor can report a number of cases, how many can thousands of other doctors report, and what would be the total, in thousands annually, of such injuries? And how many cases of blood poisoning result?

The importance of this came to us when, recently, a member of our editorial staff suffered a cut on the thumb from one of the rotating porcelain handles which broke apart in his hand. A small artery was cut and it was necessary for a surgeon to connect this, remove part of a severed tendon, and take five stitches in the cut. Not quite so harmless, eh?

Strange it is that, with plastics available that can be colored and molded to simulate porcelain or be given almost any hue, the fixture manufacturers haven't long since eliminated this dangerous, glass-surfaced weapon! Perhaps they just haven't gotten around to it or people don't know enough of the danger to demand a harmless fixture. We urge that steps be taken at once to correct this fault, and, in the meantime, warn everyone to use that handle delicately. Don't force it as though it were a spillway gate on a dam; it's only a little gate for a trickle of water.—*The Editor.*

Versatile Detergent

SODIUM metasilicate, modern crystalline edition of the familiar water glass, is finding important uses as a cleaning agent. It has the property of helping to disperse particles of dirt in water to a remarkable degree. In addition to its value in the ordinary washing operations which cleanse

clothing and utensils of the food industry, its unique properties are useful for a wide variety of different purposes. In concentrations of only 0.1 percent it makes the mud from drilling oil wells thin enough to pump. Dehairing hog carcasses is made easier if sodium metasilicate is added to the scalding water. Automobile radiators are cleaner by a solution of one ounce in a gallon, which not only removes dirt but reduces rusting. The processing of olives and the removal of skins from peaches are made easier if it is added to the water used. Even the homely tripe, which is considered a delicacy by many, is made whiter and cleaner by washing in a sodium metasilicate solution. These uses are aside from its very important application in laundries and in the washing of bottles.—*D. H. K.*

Astronomers Search Mars for Water—Find "No Evidence Whatever"

MARS continues to be a desert, defying astronomers' biggest telescopes and most delicate instruments to find any trace of water vapor on the rust-red surface of its middle part. So report Drs. Walter S. Adams and Theodore Dunham, Jr., of the Mount Wilson Observatory.

Last April, Mars was in an especially favorable position for observation. The astronomers turned the great 100-inch telescope on the planet, arming it with a nine-foot spectral grating to split the light reflected from its surface into the rainbow band of the spectrum.

Dark absorption lines appeared in the spectrum, part of them due to the "soaking up" of the planet's light by water vapor in the atmosphere of the earth. Particularly critical study was made to see if any of this light absorption took place in water vapor in the atmosphere of Mars itself, before the light left on its long trip earthward. But of this the astronomers reported they could find "no evidence whatever."

There remain still the polar caps of Mars—white patches on each end of the planet that grow and wane with changing seasons. But the position of Mars last April was such that, while good observations could be made on the middle of its disk, they could not be satisfactorily made on the polar regions. So that part of the puzzle will have to go unsolved for a while.—Copyright 1937 by *Science Service.*

SIDE-WINDER

ONE variety of rattlesnake known as the "side-winder" rolls over the sandy terrain in which it lives in such a way that its direction of travel is almost at right angles to the direction in which it faces.

Coin Wrapping Simplified

THAT necessity is the mother of invention has once again been proved by Albert Wagner of Chicago. He has worked in bank departments for many years and recently was assigned the tedious job of counting and wrapping coins. Mr. Wagner

Stacking and wrapping coins is made easy with this simple device

decided that his assignment would be much simplified if he could design an efficient coin wrapping device.

The result is Packoin, a contrivance which makes it easy to put coins into wrappers much faster than by other methods. Wrappers can be filled as fast as the coins can be pulled off the edge of a counter into the Packoin funnel, which is sturdily constructed of Bakelite molded. The bottom piece is also made of the same material and serves as a base on which to rest the end of the round coin wrapper.

Non-Corrosive Refrigerant

SULFUR dioxide, widely used in refrigerating machines, is a vigorous corrosive agent if even traces of moisture get into the system. A recent patent suggests adding an aldehyde (formaldehyde)—which boils at about the same pressure and temperature as sulfur dioxide—to this refrigerant in charging a refrigerating machine. This addition is stated to inhibit corrosion of metal parts even if moisture should enter the system.—*D. H. K.*

Molded Contact Lenses

THE perfection of molded glass contact lenses, a great forward stride in the development of these invisible substitutes for spectacles, long awaited by the optical profession, was given public announcement recently by Carl Zeiss, Inc., after two years of co-operative work between their research laboratories in Jena and leading oculists in America.

This newest development in contact lenses follows widespread public and professional interest in these invisible aids to vision which are already worn by over 4000 people in this country. [See Scientific American, November, 1936.—*Ed.*]

Molded glass contact lenses are prescribed by oculists for patients whose irregularities of eyeball need for perfect fit a contact lens of equally irregular shape.

For this small minority of difficult cases, the general opinion of the optical profession is that this newest improvement in

contact lenses, now made with the same accuracy and precision as the ground type in common use, gives reasonable assurance that any eye may be fitted so as to ensure perfect comfort.

The new molded glass contact lenses in appearance are the same tiny, thin, transparent shells now in general use, covering just the iris and pupil and a tiny portion of the white of the eye.

In addition to bringing contact lens making to a hitherto unattainable degree of refinement, Zeiss has worked closely with those oculists in the United States who have been experimenting with the other portion of the work; that is, the making of the mold of the patient's eye.

Oculists in America use various materials for making molds. One method is to make a mold of the patient's eye with a mixture of Negocoll and water. When the mold is set, two plaster casts are made from it, one to go to Zeiss for making the glass contact lens, and one to be kept by the oculist for checking and record. Zeiss forms the lens against the cast, thereafter grinding in the corrections for vision in the center part which rests in front of the pupil.

Vitamins and Gout

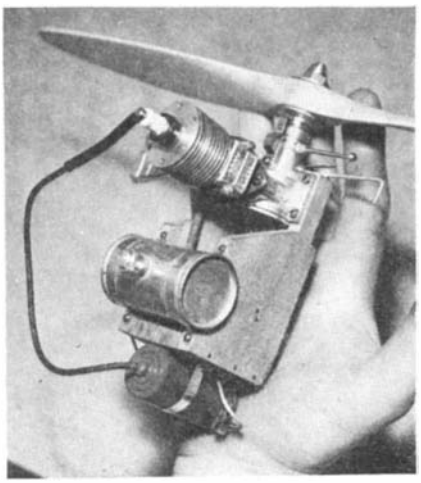
A VITAMIN discovery that sheds new light on gout and may prove a remedy for the ailment was reported by Dr. Martin G. Vorhaus of New York before a recent meeting of the American Medical Association.

Cases of this disease were improved by doses of vitamin B_1, Dr. Vorhaus has found. Pain and swelling disappear; what is even more striking, X-ray pictures of the affected joints show that new bone tissue is apparently formed.

This is the first time that anyone has ever discovered any effect of vitamin B_1 on bones, Dr. Vorhaus pointed out. Hitherto this vitamin was known only to affect nerves and the utilization of sugar. The discovery of its effect on bones is so new that Dr. Vorhaus and his associates have not yet decided exactly what is the relation between the vitamin and bones.—*Science Service.*

Tiny Gasoline Motors in Mass Production

THE possibility of using small, highly efficient model airplanes as anti-aircraft targets is being given serious consideration by United States Army tacticians. Little ships, powered with tiny, one-fifth horsepower engines like that shown in one of our illustrations, may be adapted to such a use. They could be flown, according to plans under consideration, at 4000 feet, effectively simulating the flight of and presenting the same target as a bomber at 20,000 feet. These tiny engines burn a mixture of gasoline and oil, are two-cycle—as are outboard motors—and have the same rotary valve action as outboards. Triumphs in mechanical perfection, they are built in mass production at Glendale, California.



This small but efficient engine uses a mixture of gasoline and oil

Electric Fret-Saws

IN compliance with the oft-expressed wish of many amateur wood workers for a small handy fret-saw worked by electricity, A. E. G. Company of Berlin has developed and put out an interesting little saw that has no electric motor, yet is electrically operated. It consists of an alternating current magnet and a suspended steel membrane, called the "anchor." The saw-blade is attached to the lower end of this anchor, while its upper end is held in an elastic steel hoop. When the current passes through the magnet, the steel membrane vibrates, carrying with it the saw-blade, which then moves back and forth 6000 times per minute. With this high speed, the sawing process is accelerated, while the strain on the saw is so slight that it shows no signs of wear for a considerable time.

Stalking Odd Fish New Austral Sport

VISITORS to Cairns, in Queensland, Australia, have evolved a new sport—stalking the shy mud-skipper, which holds the distinction of being the world's most amazing fish in that it not only swims, but walks and leaps as well, and breathes through its tail.

Scientists know this unique creature as Periopthalmus. Queensland is the only place in Australia where it is found. With a stroke of its tail, the mud-skipper may skip over a yard of ooze. Shorter skips are made with the aid of its pectoral fins which are modified to be used as feet and even as hands in climbing up the oyster-encrusted mangrove roots, on which it likes to bask in the tropical sunshine of Queensland.

The mud-skipper's "golliwog" eyes earned the creature its scientific name. They are periscopic organs, each at the end of a protuberance and can be revolved in any direction, which is one reason the mud-skipper is so elusive. The creature's nest is a round pool, about twice the size of a dinner plate and with walls only a few inches high. In addition to its regular gills, its tail functions as a secondary organ of respiration, and scientists claim the mud-skipper might "drown" if kept in water too long.

Get Elderly Patients Out of Bed

ELDERLY persons who become sick must be gotten out of bed and back on their feet as rapidly as possible, in order to stall off death, is the opinion of Dr. Louis B. Laplace and J. T. Nicholson of Philadelphia.

Confinement to bed hastens death in per-

sons over 60 years, they found. The reason is that remaining inactive and prone for long periods allows the blood to accumulate in the small veins and arteries. The total volume of blood is thus reduced and its circulation is further impeded by the hardening of the blood vessels that occurs in old age.

The blood therefore remains in the capillaries until it is forced out by contractions of the muscles, but a person confined to bed moves his muscles so little that the blood does not circulate enough. As a result, tissues degenerate, ulcers form, and the body is slowly poisoned by absorption of the products from the degenerated tissues. The patient sinks into stupor and the final invasion of the bacteria into the lungs causes the fatal pneumonia.

The way to prevent this is to order elderly patients out of bed as soon as possible and, while they must remain in bed, to give them massage, exercise in bed, deep breathing, and frequent shifts of position.—*Science Service.*

WIRE

IF joined together to make one long piece, the 79,373,000 miles of wire in the Bell Telephone System would reach from the earth to the moon and back more than 160 times.

Reducing Wood Swelling and Shrinkage

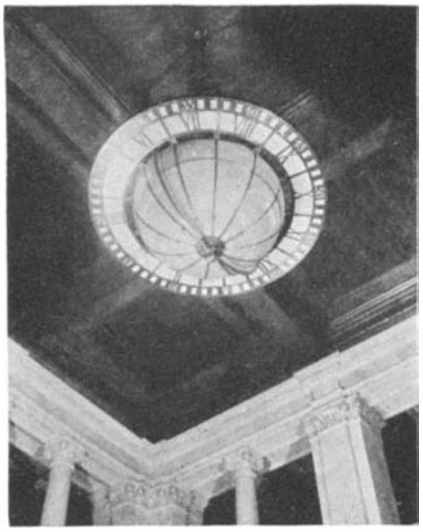
CHANGES in dimensions of wood pieces, particularly those used in parquet floors and mosaics, frequently destroy their usefulness and often account for the ghastly squeaks in floors and wooden structures of various kinds. These changes of size are caused principally by the tendency of wood to absorb or lose moisture with changes in the relative humidity of its environment. The processes of swelling and shrinking follow the grain of wood so that shape as well as size changes. Shape changes depend on the way the piece existed in the original log and result in serious distortion of most cuts.

Researches carried out at the Forest Products Laboratory have shown that the introduction of sugar solutions, particularly solutions of invert sugar obtained by treating cane sugar with acids, materially reduces the tendency of the wood to change dimensions. The treatment consists in soaking the wood in sugar solution under alternate pressure and vacuum and subsequent drying in air. Although not entirely satisfactory on account of a slight tendency of the surface to become sticky in very damp weather, this treatment has advantages over others where wood is used for framing and other concealed members in a structure.—*D. H. K.*

Hanging Globe Electric Clock

REMARKABLE beauty and individuality in timepieces are illustrated by a unique terrestrial globe clock hanging in the foyer of the Christian Science Monitor Building in Boston.

Lights in the dial around the globe indicate the hours by large Roman numerals and minutes by the smaller Arabic numerals around the edge. The operation of this clock is controlled by a Telechron motor, as is also a twin celestial globe at the other end of the foyer which gives the day of the month.


The suspended globe is a clock

Lubricating Peas

TO avoid breaking dry peas in some of the new seed planting machines, it has been found that 1½ ounces of powdered graphite added to each bushel of seed so lubricates their flow through the machine that damage is prevented.—*D. H. K.*

Gas Through Metal

THE diffusion of gas through a piece of solid metal, so slowly that only one cubic inch of the gas passes through in a hundred thousand years, can be measured, Dr. Francis J. Norton of the General Electric Research Laboratory announced at the Chapel Hill, North Carolina, meeting of the American Chemical Society. The method of measurement introduces a new application for the all-metal vacuum tube, born in the same laboratory within the past few years and seen so commonly today in radio receiving sets.

Ordinarily it is considered that a metal container is gas-tight, provided its seams are tight. Hydrogen, the lightest gas, however, slowly escapes through metal, even of appreciable thickness. In his paper, Dr. Norton pointed out that, in high-pressure steam boilers, at a temperature of about 575 degrees, Fahrenheit, water and iron react to produce iron oxide and hydrogen. The iron oxide forms black scale on the tubes of the boiler; some of the hydrogen escapes as gas within the tubes, some combines with oxygen dissolved in the water, and the rest diffuses through the steel. The reaction occurs even at room temperature, but is greatly speeded up as the pressure and temperature are increased.

A detector-amplifier-triode metal vacuum tube was used by Dr. Norton for observing the hydrogen flow. The metal vacuum tube ordinarily has a coating of protective paint, and this was sand-blasted off for most of the experiments. The tube shell was then dipped into water at different temperatures and for different lengths of time, and the

Coal miners, moving from 15 to 25 tons of coal in a day, perform a lot of work on their shovels alone. If these implements can be made lighter, yet able to stand the gaff, the miners can conserve energy. Thus the aluminum shovels, shown in the illustration above, which weigh two pounds less than ordinary coal shovels made of sheet iron

grid current measured. The measurements showed that, at 78 degrees, Fahrenheit, hydrogen entered through the 30-mil steel shell at a rate of one tenth of a micron per hour, which is about one cubic inch of gas per thousand years. The gas which passed through the steel was analyzed and found to be pure hydrogen.

Addition of 0.1 percent of sodium chromate to the water, known to inhibit corrosion, was found to stop the penetration of hydrogen through the steel.

A New Use for Dyes

THE French scientist, Georges Claude, whose many scientific achievements are well known, has discovered a method whereby trans-oceanic air travelers may have a better chance of being rescued than heretofore, if the airplane is forced down at sea. From a recent *Associated Press* dispatch from Paris, *The DuPont Magazine* quotes these details:

By releasing a quantity of fluorescein, a coal-tar dye of high tinctorial strength, at the place where the plane descends, the water in that vicinity is changed to a distinctive color that is easily visible to rescue parties at a long distance.

In experimental tests made in the rolling Mediterranean Sea, 22 pounds of fluorescein placed in the water colored an area nearly 300 yards square, and the marking remained from 12 to 15 hours and was visible at a distance of 10 miles, according to a report made to the Academy of Sciences.

Here is another practical use for a coal-tar dye to write down in the book of chemical contributions to the aviation industry—an interesting one, and if it proves some day to be the means of rescuing even a single life at sea, it will be important.

Treat Ulcers by Continuous Drip of Milk Into Stomach

A CONTINUOUS feeding of milk, drop by drop, into the patient's stomach is the new method of treating stomach ulcers reported by Dr. Asher Winkelstein of New York.

Frequent feeding of small amounts of milk and cream has for years been part of the standard medical treatment of stomach ulcer. The milk, together with alternating doses of alkaline powders such as bicarbonate of soda, is given to neutralize the acid normally secreted by the stomach but which irritates the ulcer and prevents its healing.

Dr. Winkelstein's modification of this method into a constant feeding of milk, a drop at a time through a tube, is based on studies of stomach secretion, especially at night.

The importance in connection with stomach ulcers of nervous over-secretion of acid by the stomach was emphasized by Dr. Winkelstein.—*Science Service.*

CURRENT BULLETIN BRIEFS

(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)

Neoprene, a Remarkable Engineering Material, is the title of a well-written booklet that describes in rather complete detail the uses and possibilities of a synthetic rubber-like material that has grown in a few years to be an important factor in many industrial applications. This booklet shows the advantages which Neoprene holds over ordinary rubber in certain uses. Write for *Bulletin 937A, Scientific American, 24 West 40th Street, New York City.—3 cents.*

Engine Bearing Service Manual tells how to diagnose and correct automotive engine troubles caused by worn or cracked bearings. The pamphlet contains 32 pages, has numerous illustrations, and covers the entire subject in non-technical language. It discusses the various engine troubles caused wholly or in part by defective bearings, and describes related operations necessary to check the cause of the defects. Each type of automotive engine is covered, and the many types of bearings used are discussed. *Federal-Mogul Corporation, Detroit, Michigan.—Gratis.*

Accident Facts, 1937 Edition, is a 96-page booklet, including a comprehensive index, which gives accurate data on accidents during 1936, and comparisons with accidents in the same fields during earlier years. It covers all kinds of accidents including occupational, motor vehicle, railroad, aviation, and home. *National Safety Council, 20 N. Wacker Drive, Chicago, Ill.—50 cents.*

Greater Lighting Efficiency is an illustrated booklet which gives facts and figures about the newly improved 33-inch and 50-inch horizontal Cooper Hewitt lamps, as redesigned for better industrial lighting. These lamps now feature instantaneous starting, greater operating stability, and increased light output per watt. Information is

given for computing the proper spacing of these lamps to obtain any given illumination level. Write for *Bulletin No. 520, General Electric Vapor Lamp Company, Hoboken, New Jersey.—Gratis.*

CORROSION RESISTANT STEELS IN SULPHITE PULPING, by F. L. LaQue, is a reprint from *The Paper Mill and Wood Pulp News*, dealing with the toll of sulphite corrosion in paper mill equipment. This type of corrosion has been requiring repeated replacement of machinery in the industry ever since the inception of the sulphite process. Only within comparatively recent years have steps been taken to minimize this loss which is reflected in the increased cost of paper production. Corrosion of materials formerly used in cooking equipment and now being replaced by stainless steel was estimated in 1930 to cost all the sulphite mills in the United States and Canada an average of 10,000 dollars per year per mill. *The International Nickel Company, Inc., 67 Wall Street, New York City.—Gratis.*

ESSENTIAL EXPERIMENTS IN GENERAL SCIENCE, by Herschel N. Scott, published in two parts, affords an efficient outline of actual demonstrations of the broad principles of science as a background for the high school course in General Science. Part One is divided into nine units, usually taught during the first semester, and Part Two into seven units for the second semester. The units are divided into individual experiments which are adequately described. *Beckley-Cardy Company, Chicago, Illinois.—50 cents per part.*

HAYNES STELLITE J-METAL CUTTING TOOLS is a new 52-page illustrated booklet of interest to every user of machine tools. It contains complete detailed information on how to achieve maximum results in machining cast iron, malleable iron, and most steels. Included are such important topics as methods of obtaining longer tool life, proper tool grinding, and recommended speeds for machining a variety of materials. An extensive table of grinding wheels enables the user to select quickly the proper wheel for any specific tool grinding operation. *Write for Bulletin 937B, Scientific American, 24 West 40th Street, New York City.—3 cents.*

HOW TO RUN A LATHE, a well-known machinists' manual, has recently appeared in its 33rd edition. In 160 pages, profusely illustrated, is presented the latest and most authoritative information on the fundamentals of modern lathe practice. The book is widely used as a handy reference by all engaged in metal working operations, as it gives instructions on every phase of lathe work in easily understandable language. It also includes a vast amount of useful shop information, such as reference tables and formulas, tables of cutting speeds of metals, gear cutting, shop hints and short cuts, and so on. *South Bend Lathe Works, South Bend, Indiana.—25 cents.*

RADIO SERVICING SHORT-CUTS, by M. N. Beitman, is a really practical handbook for the radio service man. The information given includes many money-making ideas as well as service hints applicable to all sets. It states that four out of ten radio jobs can be repaired with a screw driver, pliers, a soldering iron, and *no* radio test equipment. By actual test nine out of ten jobs need only the addition of the simplest meters. The faults of many radio sets can be found by a visual inspection and this booklet tells how. Write for *Bulletin 937C to Scientific American, 24 West 40th Street, New York City.—50 cents.*

MORE GOODS FOR MORE PEOPLE is an accurate analysis of the reductions in cost of materials and goods made possible by modern production methods. It gives startling figures which show what dozens of products would cost if made by methods in use 20 years ago. *National Machine Tool Builders' Association, 10525 Carnegie Avenue, Cleveland, Ohio.—Gratis.*

PICTORIAL OF WELDING PROGRESS is a photographic review of industrial uses for arc welding. It is presented in the form of an eight-page rotogravure section, and gives succinct information in its well-written captions. *The Lincoln Electric Company, Cleveland, Ohio.—Gratis.*

INDUSTRY AT WORK gives a complete picture of modern packaging as it applies to modern industries. Lavishly illustrated with photographs that practically tell their own stories and show particularly those packaging operations which are controlled by weight. *Write for Bulletin 937D, Scientific American, 24 West 40th Street, New York City.—3 cents.*

CAPITAL GOODS AND AMERICAN PROGRESS is a simple discussion of the causes of sharp fluctuations in capital goods production, and the relation of the capital goods industries to employment and the American standard of living. A series of carefully worked out charts illustrate the text. *Machinery and Allied Products Institute, 221 North La Salle Street, Chicago, Illinois.—Gratis.*

PHOTO DATA AND EXPOSURE RECORD contains ten pages of data and tables presented in compact form, together with helpful suggestions for the amateur photographer, and a record section containing a new type of table which allows room for over 800 records of exposures. This pocket-size booklet may be obtained from your photographic dealer or directly from *Galleon Press, 381 Fourth Avenue, New York City.—25 cents.*

WELDING IN CONSTRUCTION WORK illustrates a great variety of applications of arc welding in the structural field, both in the erection of miscellaneous structures and in maintenance work on construction machinery. The bulletin contains 12 pages well illustrated. *Write for Bulletin 937E, Scientific American, 24 West 40th Street, New York City.—3 cents.*

WORLD CHEMICAL DEVELOPMENTS IN 1936 is a new review of the chemical industry of the world, covering developments in 40 countries. It discusses new processes, plant expansion, cartels, export bounties and other government assistance, and other significant phases of the industry. It deals with such products as plastics, solvents, paints, naval stores, industrial chemicals and chemical specialties, insecticides, dyes, and a host of others. *Superintendent of Documents, Washington, D. C.—30 cents (coin). (In lots of 100 or more, 25 percent discount.)*

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., LL.B., Sc.D.
New York Bar
Editor, Scientific American

Inventive Adaptation

THE adaptation of a device or method which has been used in one art to a new use in a non-analogous art may amount to invention.

In a note entitled "Futile Utility" appearing on this page in the June, 1937, issue of Scientific American, it was pointed out that ordinarily a new use for an old device does not amount to invention. This principle of law is usually applicable where a device is applied to a use which is inherent in, and naturally flows from, the nature and construction of the device even though the use was not appreciated at the time that the device was created. Where, however, a device is modified and adapted to a use in an entirely non-analogous field, the adaptation may amount to invention.

An example of the type of adaptation which may amount to invention is to be found in a recent case decided by the United States District Court for the District of Delaware involving several patents for a machine and method used in forming points for shirt collars. The Court found that prior to the invention of the patents in suit considerable difficulty was had in the formation of collar points due to the accumulation of surplus material at the points. Many unsuccessful attempts had been made to overcome this difficulty. The Court found that the patents in suit overcame the prior difficulties by means of a method and a machine which confined the edges of the collar at the points to the desired shape and then applied heat and pressure to the collar within the confined area.

At the trial it was contended that the confining of an area of material by means of a die and then applying heat and pressure to it in order to obtain an object of the desired shape was a common method of forming objects from plastic materials, and that the application of this treatment to textile materials was merely a new use for an old method and apparatus, and did not amount to invention. The Court disagreed with this contention, and found that the patentees had done more than merely find a new use for an old method and apparatus; they had adapted a method and apparatus known in one art to a new and non-analogous art. The Court pointed out that textile material such as used in forming collars did not flow when heated as in the case of plastic materials, and that it was necessary to change or modify the apparatus used in treating plastic materials in adapting it to the manufacture of shirt collars. It was finally concluded by the Court that the method and apparatus for forming points on shirt collars was a patentable invention, and in this connection the Court quoted the United States Supreme Court as follows:

"Indeed it often requires as acute a perception of the relation between cause and effect, and as much of peculiar intuitive genius which is a characteristic of great inventors to grasp the idea that a device used in one art may be made available in another as would be necessary to create the device *de novo*."

Protected Plans

PLANS or diagrams for the construction of toy models have been held in a recent decision to be proper subject matter for copyright.

In its decision, the Court found that both parties to the suit were selling sets of parts which when assembled constituted crude models of the ship *Queen Mary*. The purchasers of the sets were furnished with instruction sheets containing plans or diagrams for teaching the assembling of the various parts. The plaintiff's plans or diagrams were copyrighted, and plaintiff contended that the defendant had copied them. The Court found that the plans or diagrams were proper subject matter for copyright, and awarded a temporary injunction restraining the defendant from selling plans infringing on the copyright, pending the trial of the case.

Still Expanding

IN a note entitled "Expanding Symbols," appearing on this page in the March, 1937, issue of Scientific American, we pointed out that trade marks are of growing importance in modern commerce.

The importance of a widely known and distinctive trade mark is further emphasized by a case recently decided by the New York State Supreme Court indicating that the courts attempt to protect such marks even against encroachments of a non-competing character. In that case the plaintiff was the owner of the well-known trade mark Philco for radio sets, storage batteries, and similar products, and the defendant was using the same trade mark in connection with the sale of razor blades. The plaintiff and defendant did not sell in competition with each other, as it can hardly be contended that razor blades compete with radio sets and storage batteries. In spite of that fact, the Court awarded a temporary injunction to the plaintiff restraining the defendant from using the trade mark Philco in connection with the sale of razor blades.

In disposing of the contention that the parties were not engaged in actual competition with each other, the Court stated: "Courts generally have come to recognize that actual competition in a product is not essential to relief under the doctrine of unfair competition. Whatever may have been the ancient rule, it is now clearly established that the two products need not be competitive."

Fraudulent Copying

ORDINARILY the copying of a machine or article of manufacture cannot be restrained unless the copying constitutes patent infringement. However, there are certain instances where copying of a machine or article of manufacture may amount to unfair competition, and as such will be restrained. Thus where fraud or subterfuge is resorted to in making the copies, the copying will be restrained.

In a recent case in New York, a court restrained copying which it found to be fraudulent. In that case the plaintiff designed and built a monophone for use on ships, and a salesman using one of the machines made by the plaintiff, obtained an order for 46 monophones from a steamship company. Instead of returning the machine to the plaintiff and giving them the order, the salesman delivered the machine to a competing manufacturer and employed that company to copy the monophone and fill the order obtained from the steamship company. The court found that the circumstances as outlined above constituted fraud, and awarded damages to the plaintiff, and an injunction prohibiting further manufacture of the monophone by the competing manufacturer.

Drumhead

THE drum is one of the oldest musical instruments known. Even the most primitive of peoples employed the rhythmic beatings of the drum in connection with their savage rites. Because of its antiquity it would naturally be assumed that the drum had long ago been developed to a state of perfection. Accordingly, when a patentable improvement is made in a drum it is news.

A United States Circuit Court of Appeals has affirmed the decision of a District Court sustaining the validity of a patent on a drumhead. The patent is for a drumhead made of silk or similar fabric treated with a cellulose ester and a plasticizer.

In reaching its decision the Court found that prior to the teachings of the patent in suit, drumheads had been made of animal skins, particularly calf skin, and that they were affected by variations in temperature and humidity. Thus on a humid day the drumhead was loose while on a dry day it became taut. This of course was a disadvantage which required frequent adjustment of the drumhead. The Court then pointed out that the fabric drumhead invented by the patentee had overcome the difficulties and that it was unaffected by changes in temperature or humidity.

The Circuit Court of Appeals, in affirming the decision of the District Court, stated: "We agree with it (the District Court) that for the first time in the art the patentee's invention did away with the centuries-old use of animal skin drumheads and gave the musical art a drumhead of treated silk impervious to weather conditions and of sustained tonal quality."

Books SELECTED BY THE EDITORS

FAMOUS AMERICAN MEN OF SCIENCE

By J. G. Crowther

ALMOST any good writer could compile the biographies of four outstanding American men of science, but these are no ordinary biographies. In addition to giving an account of the careers of Franklin, Henry, Gibbs, and Edison—probably the ablest four scientific men in our history—the author, a widely known expositor of science, has given interpretations of their lives in terms of historical background and social philosophy, and penetrative ones at that. Of the four men of science chosen, everybody has heard of two; well-read persons know of the third; but how many outside the realms of pure science have more than heard of Willard Gibbs? Yet a vote among pure scientists both here and in Europe would surely include Gibbs as one of our four greatest scientists, if not the greatest. The chapter on the rise of American inventiveness shows clear insight into American life, as does the whole book, whether in accuracy of description or in the interpretation of American history—social, industrial, and political. In this respect alone this work is a remarkable feat of writing.—$3.70 postpaid.—*A. G. I.*

THE NEW INTERNATIONAL YEAR BOOK (1936)

By Frank H. Vizetelly, Litt.D., LL.D.

FOR those who are familiar with past editions of this work no recommendation is necessary. It is perhaps the most complete survey of happenings in all fields of human endeavor that is available in this country. Listed alphabetically, the news of the whole past year is included in meaty, condensed form. Several bindings are available, of which that in cloth is $6.50 postpaid.—*F. D. M.*

NATURAL COLOR FILM

By Clifford A. Nelson

"WHAT it is and How to Use it," the subhead of this volume, ably covers the scope of the text. It is specifically confined to the use of "Kodachrome" and tells what to photograph, how to compose for best arrangement of colors, light conditions, and exposure, and the general technique of handling the film and camera. While the author deals more specifically with motion picture work, the information given will be of great value to the still photographer who desires to use Kodachrome. The text is non-technical to a degree, authoritative, and highly informative. Several charts assist in explaining certain phases of the work.—$1.65 postpaid.—*A. P. P.*

THE MOON WITH THE NAKED EYE AND FIELD GLASSES

By C. N. Joyner, B. E.

A 135-PAGE book containing eleven 5 by 7 inch half-tone photographs of the moon, each faced by a key chart of names of features and an informative chapter of description; also chapters of general interest, an index to lunar features, and in a pocket a 24-inch folding map of the moon's main naked-eye features. This book is for naked eye and field glass work.—$3.00 postpaid.—*A. G. I.*

THE NEW BETTER SPEECH

By Andrew Thomas Weaver, Ph.D., Gladys Louise Borchers, Ph.D., and Charles Henry Woolbert, Ph.D.

NERTS! Swell chance these profs have to put over a serious study of our lingo! The bozos who read the magazines made up of pix and newspapers ditto will just hand 'em a razzing for their efforts. But, seriously, if we are to believe the apologists for our slipshod speech—who claim that it is usage that makes our language—then there is no new, better speech. However, those who are seriously interested in improving their diction and their personalities—seriously interested—will find this volume a gold mine of information and inspiration. We actually found it stimulating reading. If you are a speaker, debater, writer, or just an everyday talker you, too, will read the more than 500 pages of this book with great interest.—$1.75 postpaid—*F. D. M.*

SAFELY THROUGH CHILDBIRTH

By A. J. Rongy, M.D.

AN illustrated guide for the expectant mother, by a well-known gynecologist, clearly explaining procreation, pre-natal care, labor, and post-natal care; also undesired abortion. Our grandmothers got along without such storehouses of scientific information, in addition to bearing much larger families than women do today—and often lost half of their babies if not themselves, due to thus leaving everything to the beneficent processes of nature.—$2.15 postpaid.—*A. G. I.*

THE MODEL

By William Mortensen

WHEN the amateur photographer attempts to take photographs in which models play an important part, he is likely to encounter difficulties in that his models assume strained, unnatural positions. Without some knowledge, either gleaned or inspired, it is virtually impossible to produce satisfactory photographs of models except by the mere chance exception which proves the rule. For those photographers who would like to know the difference between good and bad photographs of models, who perhaps may wish to use models in their own work, Mr. Mortensen has produced the present book. Dealing with the subject of posing in a realistic manner, with emphasis on the right and wrong methods, he has managed to put over his subject with a minimum of superfluous words and a maximum of excellent illustrations.—$2.15 postpaid.—*A. P. P.*

FREEHAND AND PERSPECTIVE DRAWING

By Herbert E. Everett and William H. Lawrence

ACCOMPLISHED artists often fail miserably when drawing perspective. For them, as well as for the student draftsman or artist, this volume is a complete technical treatise on the subject, starting with explanations of the perspective of the simplest forms and continuing through more complicated forms such as, for example, a many-gabled house, elaborate column capitals, and floral designs.—$1.65 postpaid.—*F. D. M.*

MODEL AERONAUTICS

THE third year-book of the above name is somewhat of a revelation to the reviewer. A flying model is frequently thought of as just something with which to amuse a boy. In reality, a flying model of the best type is a piece of skilled engineering, involving lightness of construction, skill in building the rubber motor, and a thorough knowl-

edge of the aerodynamics involved, so that the model not only makes the longest possible flight but also does not stall and dive too steeply to earth when the motor has finished its effort. The construction of a gas-driven model is a work of even greater complexity. The year book covers Theory, Aerodynamics, Propeller Design, such topics as whether a propeller should be free-wheeling or not, scale models, gas-models, and so on. We heartily recommend it to anyone who wishes to acquaint himself thoroughly with this delightful hobby. Even the well informed aeronautical engineer can learn something from its pages in regard to low-speed aerodynamics, and the behaviour of an aircraft when the motor suddenly stalls. —$1.15 postpaid.—*A. K.*

ZERO TO EIGHTY

By Akkad Pseudoman

"BEING my lifetime doings, reflections, and inventions; also my journey around the moon"—the subtitle—means but little to the reader until he has learned that the author is Dr. E. F. Northrup, writing under the queer sounding pseudonym. At first glance, the book itself would seem to be just another Jules Verne attempt to incorporate certain basic scientific facts into a work of amazing fiction. Dr. Northrup's work, however, is much sounder than others of its general type from the standpoint of physics and dynamics and is well enough written to be entertaining fiction. To check his theories in regard to the flight to the moon, Dr. Northrup made a number of costly experiments in his laboratory and the result is that there is strong flavor of reality to his theoretical flight. As a result of his research he has developed—in theory—an electric gun the barrel of which is 170 miles long and would lie on the gentle slope of Mt. Popocatepetl in Mexico. This will prove intensely interesting to all followers of Jules Verne—those who delve into scientific fiction, both young and old—who are looking for new worlds to conquer.—$3.20 postpaid; Foreign $3.50.—*F. D. M.*

BEYOND NORMAL COGNITION

By John F. Thomas, Ph.D., with a foreword by Prof. William McDougall

A DETAILED study of mediumistic utterances, with central emphasis on the question: "Are there instances of supernormal information?" Most of the 24 mediumistic records analyzed in it were "absent sittings"—that is, taken when the person who alone knew the facts was some thousands of miles distant. The book is concerned with so-called "mental" mediumship alone, thus excluding physical levitations and so on, and the entire procedure took place in the light. (This research represents an effort on the part of psychologists rather than parlor amateurs, and there was no trifling with mediums, no laying down of obstructing conditions to hamper science; there is also a welcome absence of certain other kinds of hocus-pocus, as the work was done at Duke University under university supervision.) Telepathy and clairvoyance hypotheses seem by these studies to be validated. This book is not meant to be easy running reading; it is a study.—$3.70 postpaid.—*A. G. I.*

MAN IN A CHEMICAL WORLD

By A. Cressy Morrison

CALLED by the publishers the "Autobiography of an Industry," this book is just that. It is a straightforward presentation of the story of chemical advance in all fields of human endeavor and shows how this great branch of science has lifted man to his present high state of technical achievement. Reading it gives one an entirely new conception of present-day civilization for, without a doubt, we lean more today on chemistry than on perhaps any other single science. The long chapter entitled "All the Comforts of Home" is alone, to the layman, worth the price of the volume. A complete index makes this book valuable as a reference.—$3.15 postpaid.—*F. D. M.*

DR. BETTERMAN'S DIARY

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MODERN WAR

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WHETHER you agree with Colonel Dening's premise that armies, not air forces, decide wars, you will find his discussion extremely stimulating. This controversy relative to the menace of aircraft in modern warfare will continue to rage, proponents of aircraft gaining the ascendancy at times while those who believe that aircraft do not present an unconquerable menace win a point now and then. Colonel Dening makes out a strong case for the latter, discussing the fallacy of the air menace, the military power of a nation, objectives in war, the tactical changes in instruments of war, and army organization. In his conclusion, he mentions that his aim has been to call attention to certain mistaken ideas and to indicate the factors that are likely to decide the next struggle—this next struggle seeming indeed to be the key-note of the volume.—Stiff paper binding, $3.00 postpaid.—*F. D. M.*

COLLEGE PHYSICS

By John A. Eldridge, Professor Physics, University of Iowa

AS an offset to many or most of the physics textbooks that have appeared during the past decade or two, this one is not three fourths atomic physics, with the older physics badly neglected, but the reverse: most of its 616 pages are devoted to classical physics, and with emphasis on everyday things rather than detached theory. It is compact rather than wordy, and is not a "physics-made-easy" text (there being no such animal in this branch of science). It is recommended mainly as a review for those who have once studied physics and later let the joints become creaky.—$3.90 postpaid.—*A. G. I.*

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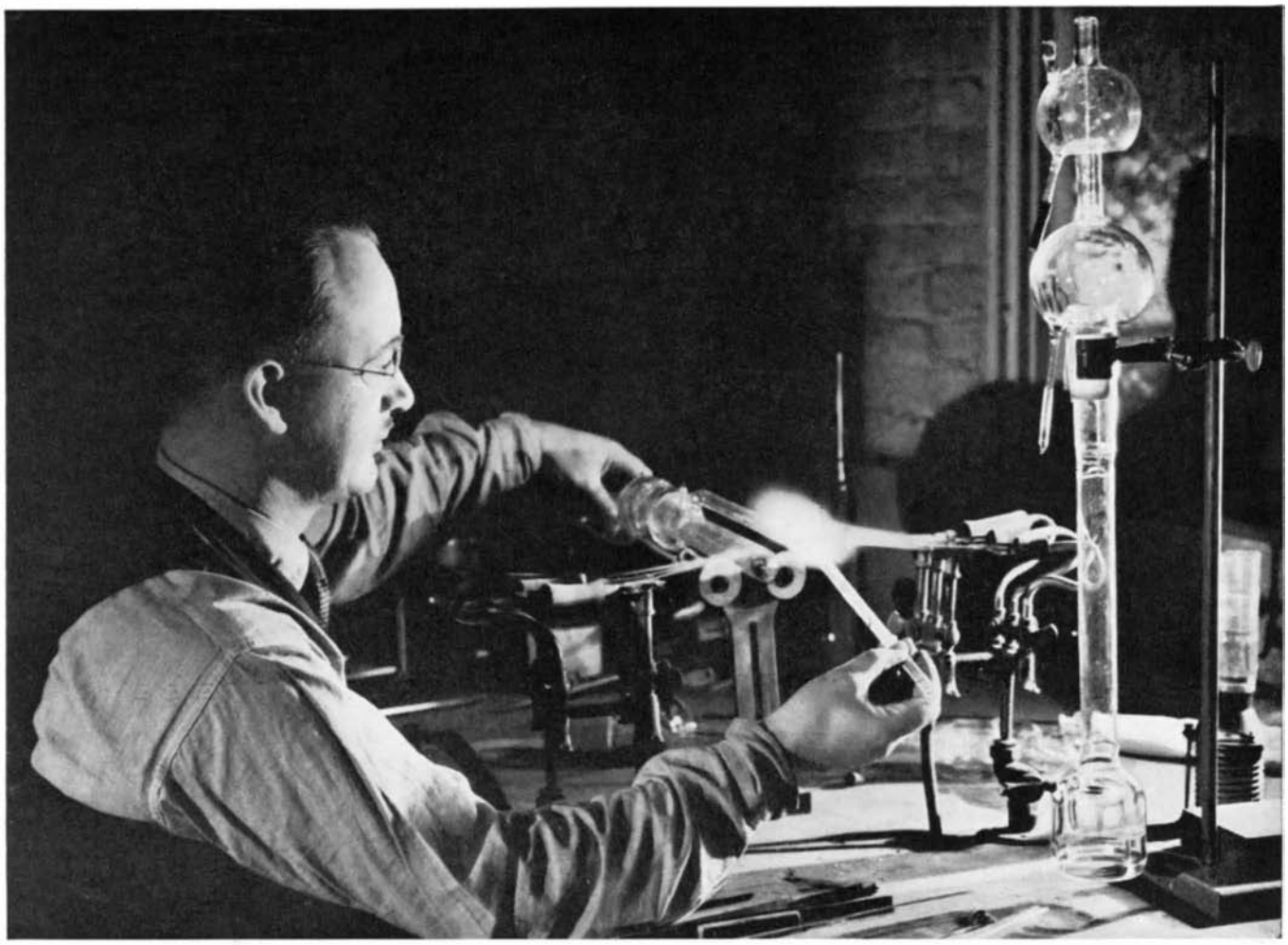

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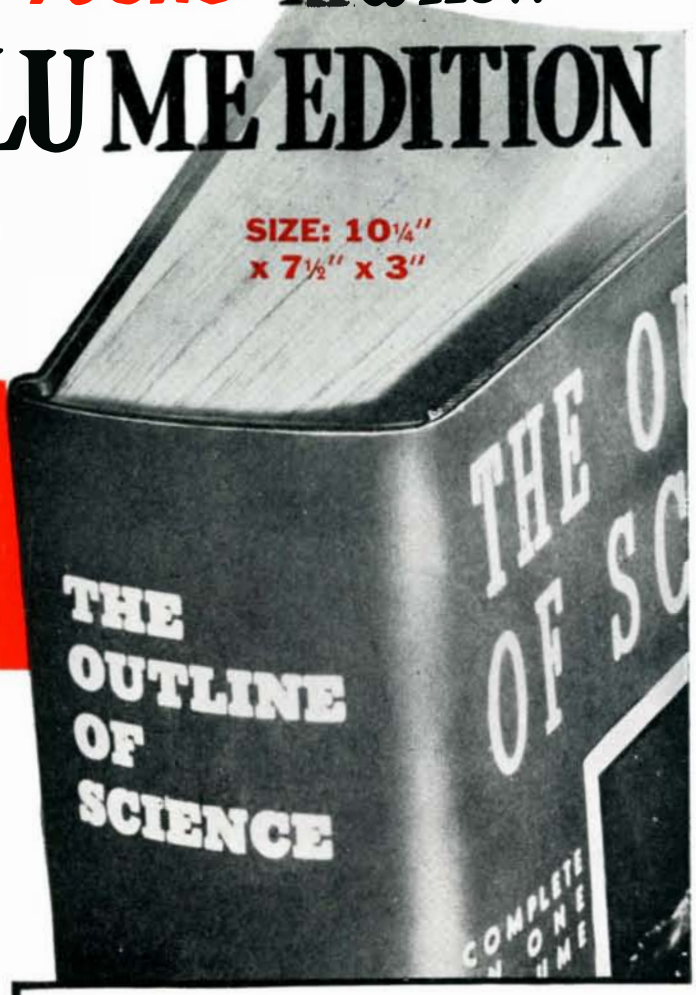

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By Professor J. Arthur Thomson

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