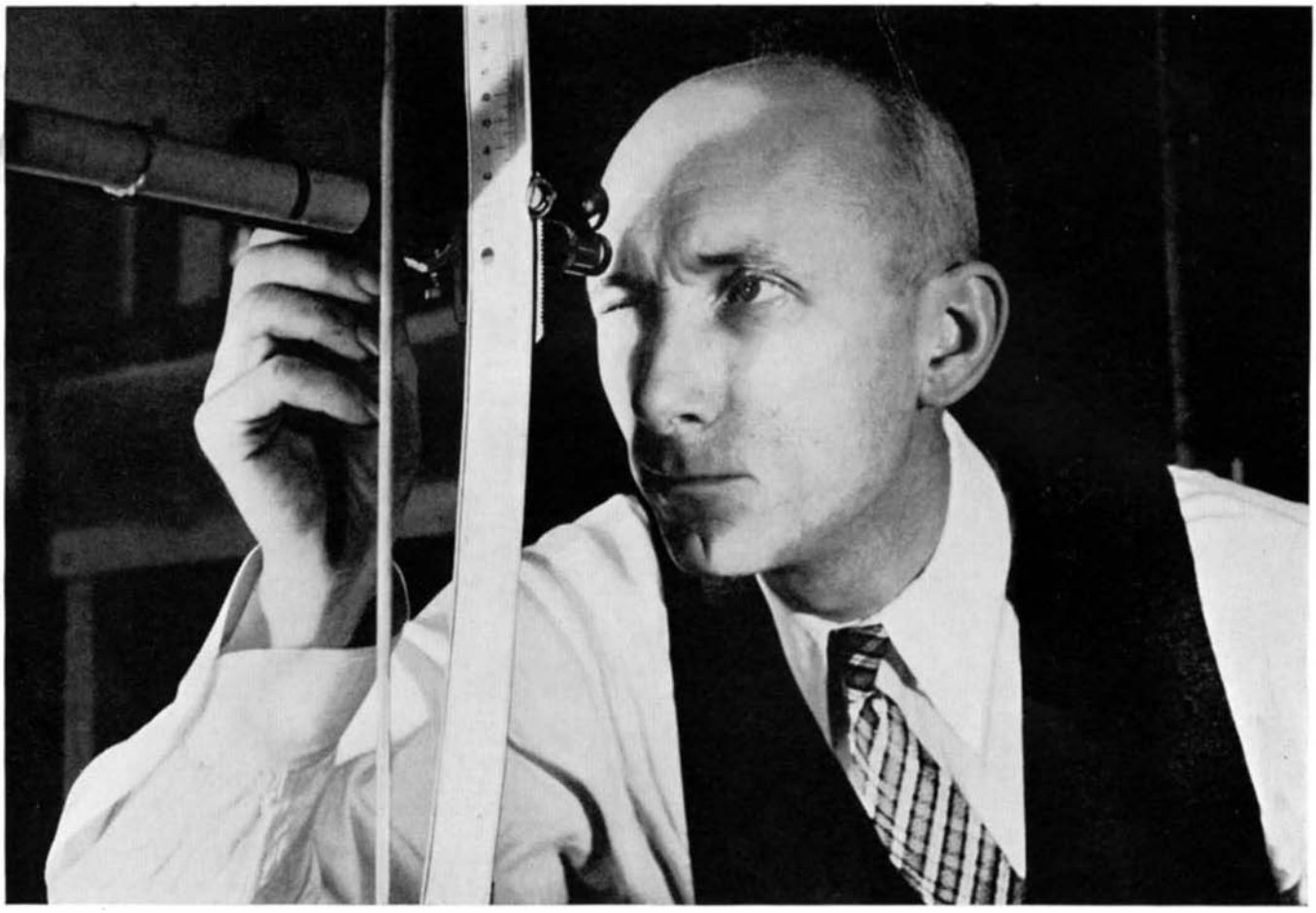
CANCER AND FISH: Cancer Research Aided by Fish

SCIENTIFIC AMERICAN

January • 1937 ★ 35c a Copy

ROBERT YARNALL RICHIE



By As Little As 3/100,000 Inch

A MEASUREMENT that is finer than the one-hundredth part of a human hair. This man measures the expansion, by heating, of a piece of metal. If this expansion deviates by as little as 3/100,000 inch from the expansion of the material it is to match, only failure can result. Such precise measurements made possible the new all-metal radio tube.

Measurements of equal precision, in General Electric laboratories, are fundamental to the further development of quality in design and manufacture of General Electric products. Careful measurements made possible the hermetically sealed G-E refrigerator, with its lifetime dependability and its low-cost operation. Precise measurements, by G-E scientists, of electric currents in vacuum tubes have led the way to present high standards of radio reception.

These are but a few examples of the contributions of scientific research and engineering in General Electric laboratories in Schenectady—contributions which have stimulated new industries, increased employment, and provided greater comforts of living.

G-E research has saved the public from ten to one hundred dollars for every dollar it has earned for General Electric

GENERAL ELECTRIC

The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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

CONTENTS • JANUARY • 1937

DRAMATICALLY symbolizing industry in America, which may be said to be founded largely on the development of machine tools, is the intriguing photograph reproduced on our front cover. Showing a workman in the shop of the Mission Manufacturing Company, Houston, Texas, engaged in grinding a reamer, its prosaic features have been given an unusual interpretation by the art of the photographer, coupled with an appreciation of the subject.

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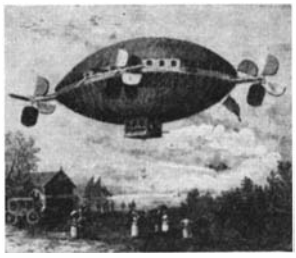
50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of January, 1887)

AIRSHIP—"The accompanying engraving illustrates an aerial vessel and propelling wheel, the invention of Mr. Moses S. Cole, of Greytown, Nicaragua, Central America. . . . It is claimed that this vessel can be raised, lowered, steered, and propelled in any direction at the will of the pilot. The vessel is provided with a central compartment having suitable rooms for the accommodation of passengers and crew. On the top of the ceiling is secured an inflated balloon of semi-spheroidal form. . . . The main driving shaft is placed transversely across the floor, and is formed with a crank at its center, to which the motor is coupled. On each end of the shaft . . . is secured a wheel having several wings, which open and close automatically, according to circumstances; these wheels serve to raise or lower the vessel. Wheels similar in construction are placed at the ends of the vessel. . . . The wheels are each mounted on a shaft having crank arms, which receive a rotary motion from the main shaft by suitable connections. The end wheels steer the vessel in any direction, and propel it in a horizontal plane."



RAILROAD ANCHOR—"The *Railroad Gazette* proposes the following: To have an anchor to drop from the rear end of train and engage with the ties. . . . By having a good long spring to ease the shock when the anchor came to a bearing, in addition to the relief which would come from the draw springs of the entire train without any expense at all, a train might easily be brought to a stop within 15 or 20 feet from an ordinary passenger speed, if something did not give way." (!)

BRICKS—"It may not be known to some what causes the different colors in bricks. The red color of bricks is due to the iron contained in the clay. In the process of burning, the iron compounds are changed from the ferrous to the ferric condition and rendered anhydrous, thus developing the color. Certain clays—like those in the vicinity of Milwaukee, for instance—contain little or no iron, and the bricks made from them are light or cream colored."

PILE DRIVING—"In Pesth, Hungary, dynamite has been successfully used for driving piles. An iron plate 15 inches in diameter and 3¾ inches thick is placed in a perfectly horizontal position on the pile to be driven. A dynamite cartridge, in the form of a disk, containing 17½ ounces of dynamite, is placed on the iron plate and exploded by electricity."

MINICAM—"A remarkable photographic apparatus, to be used for detective purposes or ordinary portrait photography . . . is enclosed in a watch case which opens in the ordinary manner by means of a spring. As the case opens, a miniature camera shoots out for a moment, shuts up again, and the thing is done."

MULTICHARGE CANNON—"Colonel Haskell asks Congress for an appropriation for the further test of the multicharge gun . . . (which has attached) . . . to the barrel, at intervals along its length, a series of exterior powder pockets, that communicate with the interior of the barrel. The ball is started from the breech by a moderate charge of powder in the usual manner; when the ball passes beyond the first pocket, the burning powder fires the charge contained in the pocket, and its pressure is added to that of the initial charge, and so on; each pocket of powder contributes successively to add a new pressure behind the projectile."

BUFFALO—"A gentleman is now successfully domesticating the American buffalo at Stony Mountain, Manitoba. Starting his herd in 1878 with four heifer calves and one bull, it now numbers 61 head; the greater number pure buffalo, the rest half breeds."

FARM SCIENTISTS—"The farmer or his laborers to-day do not one hundredth of the actual work. Steam or horse driven machinery are the agents. The farm is converted into a factory. Grain is sowed and fertilizers are distributed by machines. Improved cultivators are used in treating growing crops. After harvesting by power, thrashing machines are substituted for the old time flails. The farming of 50 years ago is becoming a lost art. To a great extent, the farmer is deposed from his position as the principal producer of a region's wealth. This honor must be shared by others. The chemist has had his part in the change, but the inventor stands above all in this. To him the new condition is principally due."

FLOATING CRANE—"This crane . . . has a jib of sufficient rake and height to command the hatches of the largest ocean steamers, and is also adapted for lifting dock gates in and out of place for repair. For this latter purpose it was necessary to provide lifting power for 100 tons, with a projection of about 6 ft. over the side. The extreme rake of the jib is 49 ft., which gives a projection of 22 ft. 6 in. over the outside of the fender timbers when the jib is athwartship, and the weight which can be lifted at this rake is 30 tons. Any load between 30 and 100 tons can, of course, be lifted at an intermediate rake."

GREEN RAY—"The green ray is a flash of emerald colored light, said to be observed sometimes for a second or half a second at the moment the sun's disk disappears below the horizon, and just when one sees only a very small segment of its surface."

LICK OBSERVATORY—"The San Francisco *Chronicle* says the crown and flint glasses of the great objective of the Lick Observatory have arrived safely at the summit of Mount Hamilton. The boxes containing the glasses were taken to the south room of the observatory, where a fire had been started hours before to produce the proper temperature."

PATENT SYSTEM—"All who are interested in patents should keep a watchful eye on Congress. At every session efforts are made to secure the virtual abrogation of the patent system, which, if not perfect in every respect, has aided in an important measure in placing the United States ahead of the rest of the world."

Personalities in Research

L. WARRINGTON CHUBB

A VERSATILE and prolific inventor, Dr. Chubb, who is the Director of Research Laboratories of Westinghouse Electric and Manufacturing Company, has 120 patents in his own name, in addition to numerous others developed in his position as Research Director. Electric welding, electric measurements, rectifiers, developments in metallurgy, circuit interruption, radio, electric heating, machine design, development of materials, surge generators, household refrigeration, inverse refrigeration, communication and signalling, electronics, electrolytic treatment of wires, chemical systems for maintaining temperatures, elimination of automobile headlight glare, have been his chief fields of activity. His most important work, Dr. Chubb believes, has been in the development and application of magnetic materials, particularly silicon steel.

Dr. Chubb, who is widely known for his research activities, has contributed greatly to the advance of modern progress. He has been associated with the Westinghouse company since 1905 and has been its Director of Research Laboratories since 1930.

While still a very young man, before most people were thinking of what since has become such an outstanding factor in the growth of American culture and civilization, Dr. Chubb was deeply interested in radio and its tremendous potentialities. When he was still a high school student, he performed his first experiments in this connection; and, later, as a graduation thesis, gave an exhibition of experiments in wireless control, including such picturesque demonstrations as firing a mine, ringing bells, and the like.

Born at Fort Yates, North Dakota, in 1882, he spent his early days at that place, where his father, an army officer, was stationed. After having received his preliminary education, he attended Ohio State University, from which he was graduated in the class of 1905 with the degrees of Mechanical Engineer and Electrical Engineer. In the same year he entered the apprenticeship course of the Westinghouse Electric and Manufacturing Company. When his training in that special course was completed, he was given a position in the company's engineering department, and was assigned to the laboratory of standards.

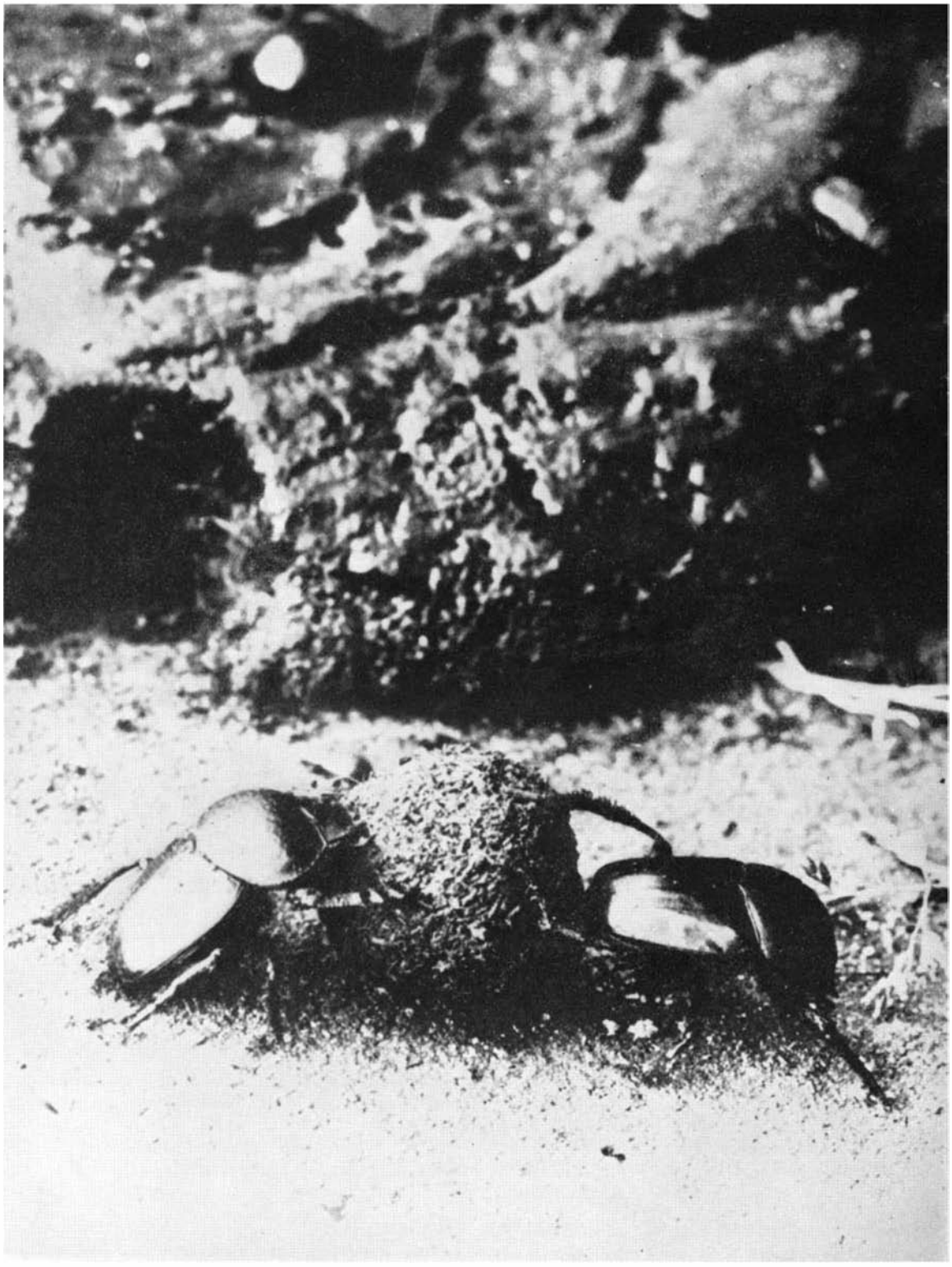
In 1907, he joined the research division, and carried on in that connection a large number of scientific investigations. Of special importance was the comprehensive study he gave to the preparation and properties of magnetic steel. In 1910 he was placed in charge of the electro-technical section of the research division. In the course of the World War his assignments were largely of a military character, including the invention of methods to detect submarines, the development of new types of underwater mines and bombs, submarine storage batteries, manufacturing problems on small rifles, gas masks, treatment of shells, and shrinking of large ordnance. He was also engaged in the study of various types of apparatus and phenomena as an assistant to Mr. Lamme, of the Naval Consulting Board.

In October, 1919, he represented America as a delegate to the International Electro-Technical Commission in London, England, and again in March, 1920, was sent as a delegate to the meeting of that committee in Brussels, Belgium. In 1920, after the Westinghouse company had definitely entered the commercial wireless field, he was made manager of the Radio Engineering Department. Early in 1930, Dr. Chubb went to Camden, New Jersey, to occupy the position of assistant vice president of engineering of RCA-Victor Company. In June, 1930, he returned to the Westinghouse organization as Director of Research Laboratories.

He is a director of Polarized Lights, Inc., and was a director of Audio Vision Appliances and the American Institute of Electrical Engineers.

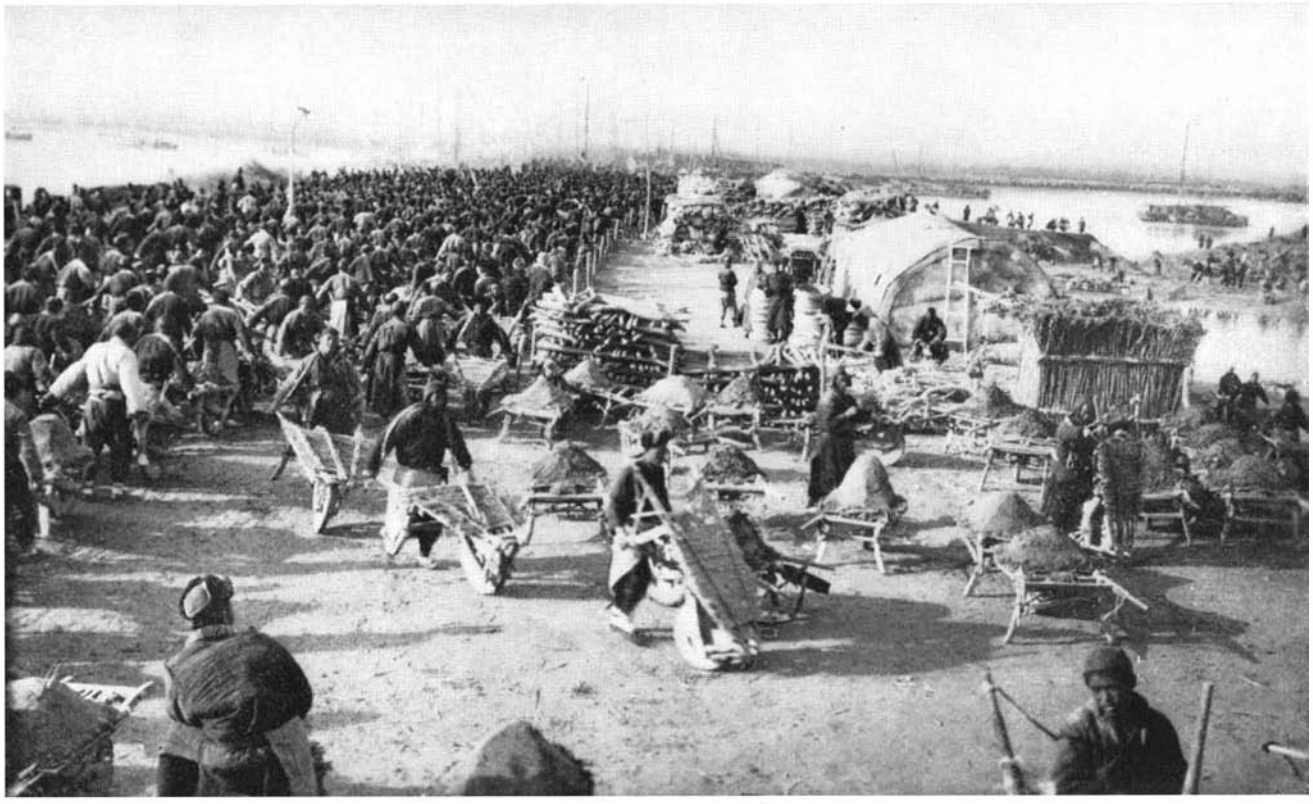
In the spring of 1933 he was awarded the Honorary Degree of Doctor of Science at Allegheny College in recognition of his outstanding achievements in the field of electrical associated sciences.

It is our happy privilege to announce that, beginning with this issue, our readers will have the benefit of the counsel of Dr. Chubb, for he has accepted the position of Contributing Editor for Scientific American. This appointment has been made in furtherance of our "Research Leaders Help Us Edit" program.



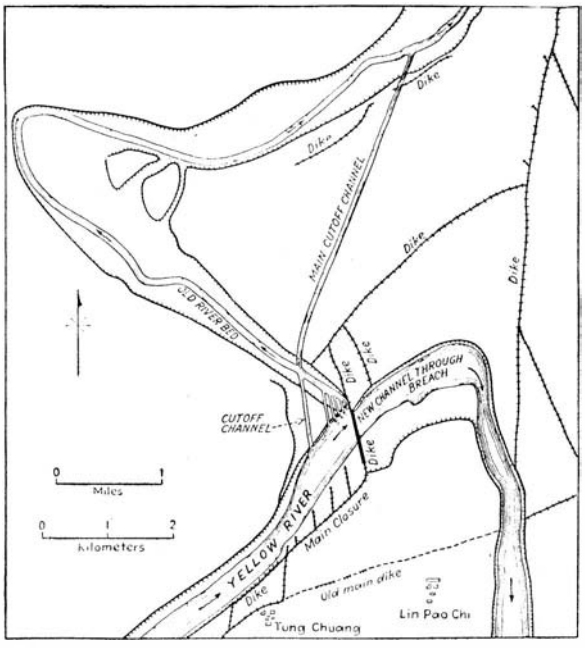
SACRED SCAVENGERS NOW RESOURCEFUL ENGINEERS

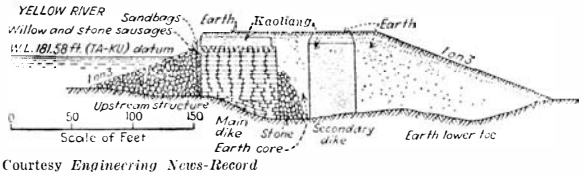
SO seemingly intelligent are the antics of those energetic and enterprising insect skatologists, the tumble-bugs, that most persons having the instincts of the engineer or rigger will often spend hours watching a pair of them, male and female, rolling a ball of dung over hill and dale (so it must seem to them) toward some suitable place where the eggs may be laid in it and a safe burial made until the grub of the young hatches. In overcoming obstacles they show remarkable resourcefulness. These familiar beetles are the very same as those depicted in the Sacred Scarabs of ancient Egypt



Tramping on one another's heels, perhaps, but *not* WPA workers; these Chinese are working hard for 10 to 15 cents per day. For half a mile back from the working face of the dike under construction, loaded wheelbarrows occupy all available space

China's Ol' Man River





Courtesy *Engineering News-Record*

New and old channels and the dike system where the break occurred; also, section of closure dike

Yellow River Breaks Dikes . . . Chinese Rebuild . . . Huge Engineering Job Done With Hand Labor . . . Ancient Chinese Methods

By O. J. TODD

Consulting Engineer to the Shantung Government and the Yellow River Commission, China

THE Yellow River, rising in snowclad peaks of Tibet and flowing for 2700 miles through nine of China's provinces to the Gulf of Chihli, offers a challenge to the ingenuity of man. In the late autumn, winter, and spring it is docile enough. In the summer its dragons writhe, as the Chinese put it, and the battle is on between man and this great mud-carrying stream.

This river has been building up the Great Plain of China for ages by depositing enormous loads of mud on the adjacent lands when, in high flood stages, the earth dikes give way and the silt-laden waters flow over the bordering farming region.

A serious dike break along the lower 400 miles of this river means great disaster to the countryside. The country is so flat that the river does not readily return to its original bed as a faithful horse returns to his stall after a run and roll. After a major break, a prolonged fight ensues before the river is back in its former course. These battles are not easily won, for the scenes of the most dangerous breaks are usually out on the plains that are composed of very fine soil which is easily eroded. There are no hills or rocky ledges to which the repair work may be tied.

The maximum flood of modern times on this river occurred in

Photographs by the author

August, 1933, when the peak of the flow passing the railway bridge in Honan was approximately 800,000 cubic feet per second or 50 percent greater than engineers had formerly estimated would be the size of a major flood. This caused dike breaks on both banks near the eastern border of Honan, and the following year further breaks occurred on the north bank nearby so that the only remaining barrier to the north was a badly protected earthen dike. If this should break in time of another major flood, then the city of Tientsin with over a million population would be doomed. The history of the migrations of the Yellow River's course shows that from 2278 B.C. to 11 A.D. this river emptied into the sea across the flats where Tientsin now stands. Thus it now threatens the safety of both rural and urban dweller. In the rainy season it can quickly become a fury whose control is never certain.

WHEN a major flood came out of the loess hills of western Honan down the channel of the Yellow River in July, 1935, lack of vigilance in patrol and an unsuspected weakness in the earthwork caused the south dike to be breached in several places without even being overtopped. The village of Linpaochi near the western border of Shantung Province (a town of 5000 inhabitants) lay across the new path of the river. Now its ruins are being excavated from a soil cover six to eight feet in depth. Deposits of fine silt to a depth of three feet were found 50 miles away from the breaks when the waters receded.

This flood continued through western Shantung and northern Kiangsu provinces until it reached the Yellow Sea, nearly 300 miles from the break, close to the old mouth of the Yellow River from 1324 to 1852. It takes months for the river to dig a new channel even across the Great Plain of China since the water is not confined to a narrow channel but spreads out over the nearly level farming country. By January, 1936, the entire river's flow was pouring through a wide breach that then included the several small ones. A great lake of varying width soon developed with a total area of 6000 square miles; and a population of 4,000,000 was directly affected. Here the average farming and village population totals about 700 per square mile. The losses in crops, buildings, and other property totalled 75,000,000 dollars.

When serious breaks of this sort occur along the Yellow River dikes, the majority opinion favors a program of reverting the flow back to the old channel. But many times in China's history such attempts have been unsuccessful, as in 1852 when the lower river swung far to the northeast and has remained there ever since. There were many who advocated letting the river follow its new trend after the last great catastrophe but the authorities decided to use all available means to force the river back into the bed it had left in July, 1935. This work was undertaken in November, 1935, and completed by early April, 1936. It entailed four months of intensive effort by many thousands of men employing methods not familiar to Americans of today yet most practical and interesting.

Twisting hemp into ropes by the ancient Chinese method; and, below, the ropeway near the dike job

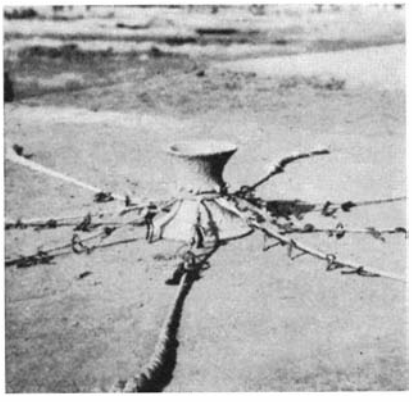
ON our own Colorado River we had struggled with a similar problem 30 years ago and put that stream under control by using a wooden trestle from which many train loads of rock were dumped to form the core of a rock-fill dam which was later waterproofed. In 1923, I had successfully used a similar method on the Yellow River in eastern Shantung where the problem of throwing the entire river back into its old bed was very much the same as confronted the Chinese here near Linpaochi and Tungchuang in western Shantung. But this time advocates of the old Chinese method, with certain modern improvements, prevailed, and the so-called "contraction" method was adopted. It had the advantage of being applicable in the winter months before it was safe to drive piles for a trestle because of running ice and ice jams. Its greatest disadvantage lay in the possibility that the soil at the closure might be loose and therefore rapid scouring would take place as contraction proceeded. But a good site was found where a sufficiently thick layer of clay prevented rapid cutting of the bed while the closure work proceeded.

Here came the tug of war. During the last month on the job, work went forward night and day to rush the closure of this gap—that at first was a mile and a half across—before the water with its increased speed cut a channel too deep to control. A cold winter that caused the river to be frozen for an entire month so that men could cross freely on the ice, delayed the operations, but with it came low stages of water. Usually spring freshets bring the river up in late March, but this time the season was late and a race was run and won against this spring flood coming down from the melting snows of Tibet. The main closure was effected on March 27th and a secondary dike was completed eight days later. The spring freshet arrived April 12th.

THE methods used were briefly as follows: The old earth dikes were raised and widened, starting well back along the old dike line. This main dike was continued toward the break, working out from both ends with well pounded soil—all placed by hand labor, men carrying the earth in willow baskets or bringing it in by wheelbarrow if the distance was great. In the basket method, each man carries two rather flat baskets, one suspended from each end of a flexible carry pole that he balances on his shoulder. The total weight of a load is about 125 pounds. This is the customary way of handling short-haul earth work in China. The pounding of the earth in place is done in layers one foot thick by use of a stone "flapper" weighing about 80 pounds and tossed eight to ten feet into the air by eight men with ropes so tied to this stone as to move it uniformly up and down.

In all this work, the handling of earth is the largest item whether it be in building up a dike or excavating a channel. Most of it is done on a piece basis by the "fang" (100 cubic feet) or by the cubic meter. As the work advances toward the closure and wheelbarrows

Like tossing a man in a blanket, the flapper is tossed by Chinese to compact soil. Below is the heavy flapper with eight handling ropes



are used for the long hauls, many thousands of men are thus engaged and lines of these barrows are often held up temporarily while other parts of the work are being put in readiness. This is especially true in the wet sections of the dike work where the core of the dike is made of kaoliang (sorghum or tall millet) stalks. At such points the individual often suffers if he is held in line for hours on a cold night yet cannot leave his place and may be allowed to move forward but a few feet at a time.

At the same time the main earth dike is being advanced toward the closure section, a number of spur dikes, or groins, are built out at an angle of 45 degrees pointing downstream to help deflect the current from the main dike. These are faced toward the outer end with stone work.

Meanwhile, 600 junks are bringing in stone from a point 70 miles up the river where it has been brought by ox-carts and light railway push cars six miles from a station to which it has been shipped 100 miles by standard railway from the quarries.

Hundreds of carts bring in kaoliang stalks and willow branches from the countryside, and the material yards grow to great proportions. Hemp comes in on wheelbarrows from other farming districts just as it is taken from the stalks by the farmers and dried. A large yard is fenced off for the rope makers and here the hemp is made up into two-inch rope for use in binding together the kaoliang stalks for the core of the dike in the closure section. In this same yard, galvanized iron wire from America is twisted into light wire cables by these same simple twisting devices that the Chinese have used for centuries in making rope.

Making willow fascines in a work yard near the dike

FOR making the closure where earthwork alone would not be safe against possible rises of the river, and where a core must be held in place, two types of construction were chosen, for which a total length of 2735 feet was reserved. Of this stretch of special construction, the last 130 feet of swift-water channel was reserved for the stone "sausage" method which is rather new in China. The rest was done by the kaoliang core method long used in China for dike breach closure.

A kaoliang dike-core is made by placing alternate layers of these dry stalks with layers of earth so that the roots of the kaoliang, which remain on the stalks, always face the upstream and downstream sides of the dikes as the stalks are laid parallel to the running water.

A "sausage" of stones and willow withes, ready to be dumped from a boat

This main core is about 50 feet wide with vertical sides and is carefully tied together in sections 30 to 50 feet in length by hemp rope of one and one half to two inches diameter. On the kaoliang layers, compressed to about three feet in depth, earth is placed to a depth of 12 to 18 inches according to the weight required to sink the mass when pushing it out into the river.

In this work, the coolies must work rapidly, and woe betide a youngster who is slow in dumping his armful of kaoliang stalks. A "river police" foreman will be after him to chastise him for getting in the way, using a kaoliang stalk if he cannot reach him and box his ears. Here the boys do not fare as well as an American mule which has the power to land a telling kick on the boss' ribs. It is all done in good spirit, though the river police are in dead earnest. There is real discipline here and no time for laggards. The river police are the trained river hands with years of experience on maintenance work along this river and attached to the provincial river bureaus of Shantung and Honan. They are better trained than many army men, hard working and reliable.

THE main kaoliang core carries an earth cover about three feet thick when completed to full height. Its upstream toe is protected by heavy stone rip-rap placed on woven willow mattresses that are tied to the main dike by the locally twisted wire cables. On the down-stream face of the dike is a wide earth fill, carefully "flapped" down to make it water-tight. The kaoliang core prevents swift currents from striking this earth water-proofing.

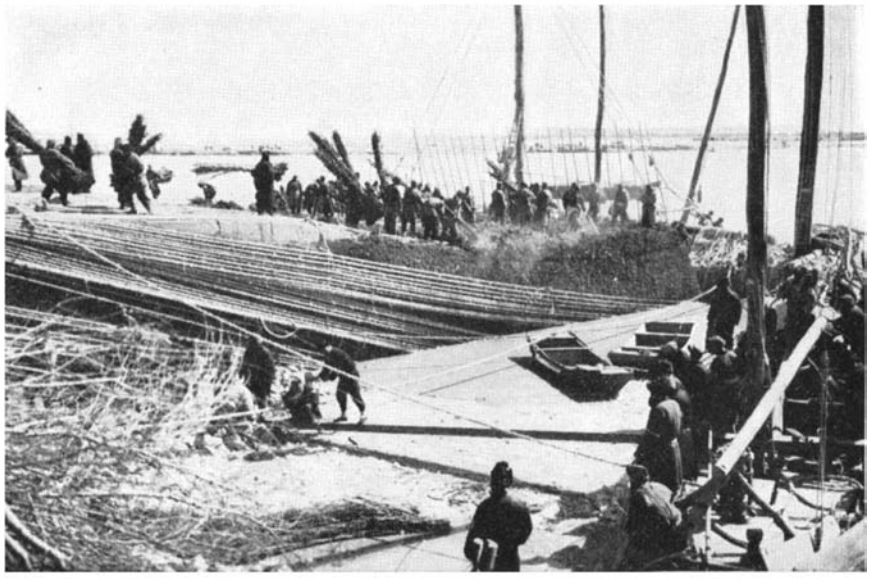
In extending the kaoliang core into the flowing stream, anchor ropes are used, attached to boats held in place upstream. Also a large boat is kept directly in front of the working face of the dike and on it is a long spar supported three feet above deck. Around this spar are wound the 40 to 50 long ropes that form the cradle into which the 10 foot kaoliang stalks are placed as the work of building up this core proceeds. At frequent intervals hundreds of men are put on the new kaoliang work to jump up and down and settle it into the water as men gradually let out the cradle ropes wound around the horizontal spar on the working boat. In this manner the core of stalks may be settled through 30 to 40 feet of water down into the mud to cut off the flow pretty thoroughly. As the core grows toward completion and the various sets of cradle ropes are tied back into the main dike to willow stakes that act as anchors, other heavy ropes are used to build a sort of breast strap. These are tied well back on the sides of the dike and pass around the face, thus binding the core together as a solid body.

To the American, this type of work seems risky, yet it is done with such precision, and the ropes are tied back with such care, that it is effective. The use of large quantities of loose stone dumped immediately upstream of this semi-permeable core as it advances into swift water is a new precaution that makes this practice more conservative than formerly. It prevents undercutting to any large degree.

But the closure of the last 130 feet was the most thrilling of all. Here the willow fascines, 50 feet in length, were brought in from the work yard and used as casings for the "stone sausages." These were rolled in from the two ends of the kaoliang core to plug completely this last gap where water was flowing swiftly and the final heading up came to six feet, the difference between head and tail water.

SMALL willow branches were tied together by wires every three feet to make these long fascines that were six inches in diameter. These encased the sausages which were built up at the ends of the dike and on the boats anchored in between. Here men worked feverishly as several fascines were laid as a base, stones were placed on top of them, other fascines were brought in to make the sides and top, and finally ropes were tied around the great "sausage" every three feet of its length. A long heavy rope was woven through the middle to act as an anchor to hold it in place as it was being rolled into the swiftly flowing stream. One must be at the site and see the operation to know how enthusiastically the Chinese river police enter into the spirit of this work.

When 1000 of these sausages had been made and rolled in and the water had become so swift that it took as many as four one-quarter-inch wire cables to hold one sausage in place, the final closure was effected on March 27. As soon as the main flow was cut off (though there was still much leakage) willow branches and



Pushing north end of the closure work into deep water. Note numerous ropes

bags of earth were brought on and the closing was completed. Another week of hard work completed a secondary dike and did the necessary waterproofing. Then earth was added to give further weight to tighten up the voids. Another week of hard work was necessary to complete the secondary dike which was closed by an old fashioned kaoliang plug lowered by ropes released simultaneously from the two sides. This method is used when moderate quantities of water are being blocked off and depths are not excessive. Finally, practically all leakage had ceased.

In the meantime, the water in front of the closure section had risen five to six feet above the winter stage that it had maintained. It was forced through the old channel where heavy silt deposits lay and through a new cut-off channel that had been excavated by 20,000 workers with picks and shovels in frozen ground in February and March. Gradually the water cut away the silt in the old bed and the river resumed its old course with little to obstruct its flow.

EVERYWHERE hand labor prevailed, if we except two small pumps for removing water when excavating the channel damp and a hundred dump cars with track used to bring bags of earth along the main dike to help in the closure. Common labor is plentiful and cheap in the Great Plain of China, generally being 10 to 15 cents per day in our American currency.

Under the eyes of the Shantung and Hopei river police who are experts in the handling of both men and the local materials used, these low-wage laborers do a thorough job in the fashion followed by their ancestors for hundreds, perhaps thousands of years. Under them, work goes forward with a system no less remarkable than it is strange to the occidental. Since the materials used—stone, earth, kaoliang stalks, hemp, and willow withes—are local products and are not factory processed, the wise oriental—in a sense—sets nature to combat nature.

A torrent pours through the narrow gap on the final day

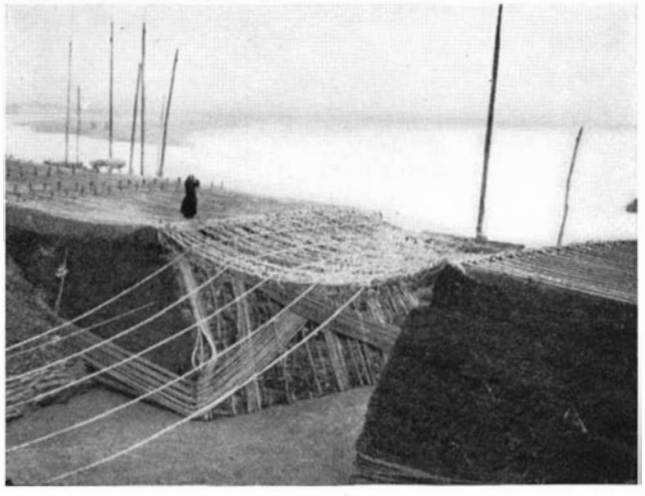
More than 1,400,000 cubic feet of stone were used on this work; 300,000 burlap bags were filled with clay and used at the end to complete the closure; 15,000 tons of dry kaoliang stalks went into the core of this dike in the wet section less than 3000 feet in length. The willow used for fascine and mattress work weighed 4500 tons. A total of 1000 tons of hemp rope was made on the job and used to tie the kaoliang stalks in place, while 2000 tons of American wire went into the small cables and the willow mattresses. Ninety thousand willow stakes were used to anchor the ropes and wires. The earthwork in the dikes totalled nearly 25,000,000 cubic feet while nearly 20,000,000 cubic feet of clay and silt was the total excavated by hand and carried out in baskets in digging the long cut-off channel. Native picks, shovels, and wheelbarrows were the tools most used in performing this feat of putting the Yellow River back in its channel.

The descendant of Confucius who successfully accomplished this work of closure and led the army of workmen that totalled 25,000 at one time, was Chief Engineer H. Y. Kung of the Yellow River Commission.

It was a great privilege to be a foreign adviser on this work and note how excellently the Chinese have learned to meet these emergencies with methods and materials at hand and how they have learned to use that great and powerful asset of China—man power—for it is with this that they do these difficult tasks and at low costs. The entire cost of this work was around 800,000 dollars U. S. currency.

●

I. B. Babcock, Walter P. Chrysler, Reginald M. Cleveland, J. J. Pelley, Kermit Roosevelt, Philip H. Smith, and Alfred H. Swayne—an imposing group—are the authors of the seven feature articles, on as many transportation subjects, coming in our February "TRANSPORTATION NUMBER." They will bring you up to date on Buses, Automobiles, Air Transport, Railroads, Ships and Shipping, Trailers, and Highways. In addition, the issue will carry the usual significant science.—The Editor.



The "dragon's net" is ready for closing the secondary dike; and, at right, the kaoliang plug is being constructed thereon

Showing "unmistakable characteristics of the style of Praxiteles"

ARCHEOLOGIST'S PUZZLE

IN several recent instances the scientific prestige of old classical writings often thought of as possibly inaccurate has been enhanced when things described in them thousands of years ago have actually been dug up by modern archeologists. Lucian, an ancient Greek writer, described a certain statue of Apollo at Athens as (1) leaning against a column, (2) holding a bow in the left hand, and (3) having the right hand on the head. Recently the American School of Classical Studies at Athens, led by Prof. Leslie T. Shear of Princeton University, was excavating in Athens and found many wells and cisterns. In one well 50 feet deep a head, an arm, a leg (see the lower photograph) of what appeared to be an ivory statuette were found in the mud that filled it. Therefore every ounce of earth removed from the well was eagerly sifted and over 200 fragments were found. The account is given in *The Illustrated London News,* from which the illustrations are taken by kind permission. No picture puzzle could furnish the intense interest afforded the archeologists as they set to work piecing together the three-dimensional puzzle shown below. With the help of a few fill-ins—a part of the stomach, bits of the right leg, two fingers—the Apollo statue was fitted together and proved to be just under one foot in height. That it agrees with the ancient description given by Lucian seems evident from (1) a spot on the back of the left shoulder where it was "leaning against a column," also the round base of the column, shown near the bottom of the page; (2) the position of the fingers, loosely holding a bow while the Apollo rested after shooting, with (3) his right hand on his head. These "tie-ups" may prove that this is the statue Lucian saw. Experts in the study of Greek sculpture abundantly confirm the attribution of this work in ivory to the great Greek sculptor, Praxiteles, maker of many masterpieces.

The group of more than 200 fragments which confronted the eager archeologists at the end of the sifting search

OUR POINT OF VIEW

Fewer Patents?

APROPOS of current agitation directed toward raising the standard of inventions for which patents are issued by the Patent Office, and the suggestion that patents be issued only for important inventions, it should be noted that under the law as it now stands the Commissioner of Patents may grant patents only for something for which "the claimant is justly entitled to a patent under the law" and which "is sufficiently useful and important."

Every patent that is issued, no matter how insignificant and frivolous its subject matter may appear to some persons, carries the legal presumption of validity, since it may be assumed that the Commissioner of Patents has found that the inventor "is justly entitled to a patent under the law" and that he has also determined that the invention is "sufficiently useful and important" to justify issuing the patent.

It is not surprising that patents are frequently issued for things which prove to be unimportant and lacking invention; but who is competent to judge accurately the value of an invention at the time a patent is sought?

Instead of making it more difficult for the inventors of simple devices to obtain patents, the Patent Office should be more liberal. With no background by which to determine the effect of a new patent on industry, it would seem to be almost impossible to determine correctly its degree of usefulness and importance. Many patents, differing from prior patents only in slight degree, have been issued and later found to be highly valuable. For example, locating the eye in the pointed end of a needle instead of the blunt end, at the time it was done did not seem to be a very important invention, but it was the invention which enabled industry to produce a successful sewing machine.

It should be remembered by those who are insisting that patents be issued only for important inventions, that when an invention is first conceived and reduced to practice many are skeptical as to its value and importance. It is only by receiving a patent for his invention that the inventor will have the opportunity of proving the practical value of his invention to industry; it is the evidence of such value that leads the courts to decide for or against the validity of the patent.

An invalid patent hurts no one, for the courts will not sustain it, but the fear of granting an invalid patent should not justify the proposed change. It would be much better if the Patent Office adopted a general rule that every new thing—something that a diligent search of the prior art shows to be new—should be given the benefit of the doubt, and the applicant should receive his patent. This plan would save a great deal of argument on the part of the Patent Office on one side, and the applicant on the other, on the question as to whether or not what the applicant has done really amounts to invention. Novelty creates a presumption of validity.

What Can Science Do?

WHEREVER men of science gather for discussion today, whether formally in conventions or informally in limited groups, or even casually in twos and threes, one significant subject usually comes in for debate—the glaring misuse and prostitution of the great gifts that scientists have made to the world. As never before in the world's history, war today is a direct application of science—or rather, a direct perversion of it, for in all the world no group of men can be more peaceful by nature than its scientists. Their gifts were intended to enable man to create and enjoy, but the world quickly converts them into agents of destruction; intended to enable man to live more happily, they are perverted into agents of death. The knowledge of chemistry and physics turns into a technique of destruction with poison gas and projectile. The invention of the airplane results almost at once in the provision of a speedy factor in warfare which leaves almost no man on earth the privilege of going to sleep for even a night without the fear and knowledge that death on wings may overtake him in his bed before morning.

The most recent by-product of the growth of science, some think, is the totalitarian state with its pugnacious, bristling aspects. Not that science is the direct cause of the totalitarian state; it merely favors its growth. Instantaneous means of communication—the telegraph, the telephone, the radio, gifts of science—assist strong men to dominate, as never before, large groups of human beings (none of the great empires of the past was comparable in population with the nations of our times). Strong men are but the expression of the urges of whole peoples, and the forces made available by science have merely implemented these forceful characters.

At root, the cause of war has nothing to do with science; it is as old as mankind. Speaking before an assemblage of chemists, Dr. Gilbert J. Fowler recently described the roots of war in terms of three lusts—the lust for *power*, the lust for *prestige* and the lust for *possession.* Of these, the last named is probably the least. All three lusts will doubtless pertain to man as long as man pertains to the earth. Thus, to face reality, it seems quite possible that a long procession of dominants, armed and greatly enhanced in power by the resources of force afforded them by science, will be likely to infest the future. What could Alexander, Julius Caesar, or Napoleon not have "accomplished" with these resources!

Since it seems unlikely that so fundamental a change in the "nature of human nature" as the destruction of the three lusts can be effected, and since there is no way for science to recall to its laboratories the various tools it has given the world only to have them seized by the lustful, what then is left? Some are saying that science "should do something about it." New discoveries should be released only under certain safeguards. A little thought shows how impractical are such hopes; there is no way to give out a discovery yet restrict its use rigidly to peaceful purposes. Others are saying that men of science themselves should assume direct responsibility in connection with the control of their discoveries after they have left the laboratory, and not merely turn out new things and then forget them while working on more new things. But scientific men as a whole are the last type on earth either to desire to direct or to know how to direct the rest of the human race; they are a type apart, their minds functioning in so different a manner as seldom to understand the world or be understood by it (briefly, rational rather than emotional).

Where, then, is the solution?

Pessimistic as it may seem, to end on a minor note, there may really be no solution at all; not all problems have solutions. This is realism, of course, and it offers unpleasant thinking. Must our children and their descendants then pass through as endless ordeals of future fear and furore as our ancestors? It is possible that just this will be the sad truth. Man is the only animal which seeks to end war at all, for all the other animals have war at all times. But man believes he is "higher" than the animals, and in one way he is. In another he is not.

Probably in a case such as this there is nothing that science can do, as long as man is chained to his own nature.

Broiler Factories

Eggs and Broilers in Mass Production . . . Thousands of Hens Indoors in Cities . . . Scientific Management . . . Controlled Food, Climate

By PHILIP H. SMITH

This might be almost any kind of plant, but the egg sign identifies it as an egg factory

FACTORY-MADE eggs and broilers are here. Chicago boasts three factories, one in the congested loop district housing 23,000 hens on six floors. A prominent hotel on the Atlantic seaboard has a roof-top plant from which broilers go down a chute to the kitchen. By the time you read this a race will have been decided as to whether a 50,000 or a 123,000 hen factory will be the next to open. Both are being engineered, and both will be metropolitan enterprises, not suburban.

These many projects are not merely novelties to flower in news photographs and then wither; 10,000 of them, large and small, are operating. They represent the practical fulfillment of an idea that one branch of farm activity could be industrialized and moved bodily into the heart of big cities to achieve great economies. That the move runs wholly counter to the much touted, little practiced idea of industrial decentralization only adds to its significance.

Large-scale factories are feasible today because the problem of establishing a complete control over the onery hen has been approached scientifically and the obstacles eliminated one by one. The only thing left unplotted is the managerial problem, which contributes to make this business comparable with all industry.

Battery brooding, as the system is called, involves confinement of the birds in wire cages from the first day of life until they cease producing eggs or have reached the proper weight for marketing. During their life span the birds are routed through three departments—starting, growing, and developing. When the males are sold as broilers, the females are carried on to a fourth department—laying. At each stage, the number of birds per cage is reduced until the laying bird has a cage of her own. Once isolated, she becomes a producing unit. As the egg is laid it rolls out of her reach into a tray to be recorded and collected. The minute her egg production drops below a predetermined standard, she is marketed for meat and her place is taken by a better worker.

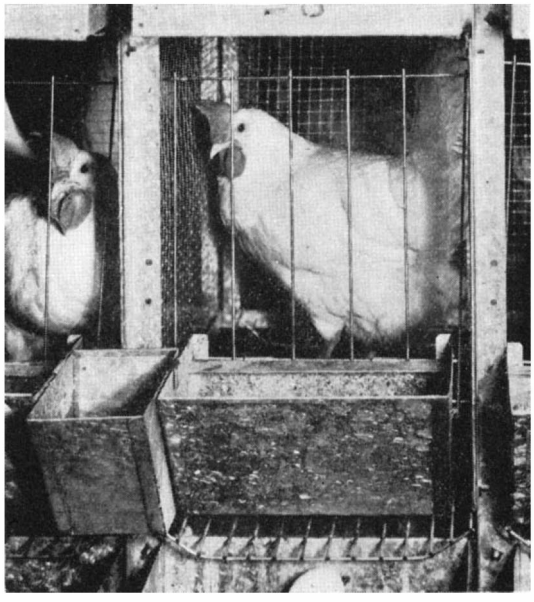
The cages are so designed that the birds stand upon wire mesh and reach outside for their food and water. There is no litter to be scattered, nor can the food and water be wasted. Every ounce of mash goes to make meat or eggs. The droppings fall through the wire onto endless belts and are disposed of by winding up the belt against a scraper superimposed on a pan. The cages are built in units, four tiers high, to economize on space and permit easy handling.

The first question which is asked about this factory system is: "Don't the birds suffer from lack of exercise and sunshine in their confinement?" Agricultural experiment stations have pondered this same question and so did the people who developed the system. When confinement in cages was first tried, the birds suffered from rickets, but experimentation proved that it was the lack of sunlight which caused the trouble and this difficulty was ironed out by feeding cod-liver oil in the diet to provide vitamin D. Since then no physical ailments have been detected, though many generations of confined birds have been studied.

Another problem confronting experimenters was to curb cannibalism. Birds are especially prone to it when confined by the hundred as day-old chicks. The solution amounts to a trick. Ruby-colored glass at the windows and similarly colored light bulbs ended all the trouble. It was suspected that cannibalism was induced by the sight of blood where the pin feathers came through the skin and confirmation was had when neutralization of the blood color ended the practice.

THE caging of birds provides an excellent control over many diseases. Standing the birds on wire, for example, gets them away from soil and litter which are disease carriers. Sectional or unit water supply is another aid to prevent the spread of trouble. On the other hand the confinement system requires watchfulness in other directions. Experimenters found that great care must be taken to insure an adequate supply of oxygen for each bird. A certain number of cubic feet of air must be given each bird if it is to thrive and produce efficiently, and this calls for a controlled ventilating system.

The advantages of the factory system



Healthy and contented, good layers spend their entire lives indoors in well-kept cages

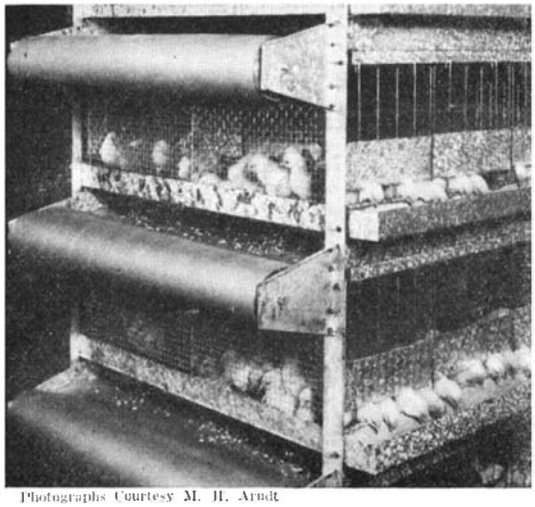
over the range-kept method have been definitely established by prolonged test. Under controlled conditions of temperature, light, and humidity, production can be stimulated and maintained as a constant throughout the year. Artificial light provides a 13-hour working day; temperature and humidity controls eliminate the winter influence and there is no longer a seasonal fluctuation in output. This permits close control of costs, allowing for long term sale contracts at established prices. Feeding costs can be lowered because there is no scattering of the rations. The mash is always available to the bird, and intake and output ratios can be determined. Litter is eliminated, thereby simplifying the maintenance of sanitary conditions.

THERE are two more economies inherent in this factory system which cannot be enjoyed with the old, open-range system. The first is economy of land. Under natural conditions there is a limit to bird density per acre, roughly figured at 100. That is to say, 100 is nature's figure and to exceed it is to encourage the rise of diseases. With the factory system, the only limit of density is the economic one of land and building costs, taxes, and so forth. At the M. H. Arndt experimental plant, where this battery brooding system was pioneered, 16,000 birds are housed on less than one acre and all labor is performed by two men.

A second economy arises from the conservation and utilization of droppings. Droppings have a definite value and complete salvage not only conserves resources but increases factory revenue. At the above mentioned experimental plant the sale of droppings to nurserymen pays the total labor cost.

The egg and broiler factory has far-reaching significance not alone because it threatens a revolution in the chicken business, but because of its effect upon other industries, notably railroad and cold storage. The system makes possible production close to the centers of consumption, thus reducing transportation needs with accompanying gains in freshness of product and lower breakage losses. Growth of the factory idea would bring about definite shifts of producing centers. At present, production and consumption are widely separated. For example, along the northeastern seaboard, which embraces coast cities from Boston to Washington, 30 percent of the nation's eggs are consumed, yet within that territory no more than 14 percent are produced. The Pacific coast states shipped 38,000,000 eggs solely for New Yorkers in 1934. Common sense says: ship the feed from the low-cost producing centers and not the perishables. The cold storage industry would be affected likewise. Controlled conditions of production which eliminate the seasonal influence in output, void the very reason for storage.

The growth of the factory idea can be gaged from the fact that there are already more than 10,000 installations, for the most part of moderate size. But as yet only 4,000,000 of the 400,000,000 birds in the United States have been caged. The most striking thing is the marked tendency for the size of producing units to be expanded and to utilize multi-story buildings in the heart of cities rather than on the periphery. The profit per hen per annum, which can now be figured closely, does not permit the erection of new structures in congested areas. The establishment of city factories depends upon being able to rent or purchase obsolete structures which no longer have economic value for other enterprises.



Photographs Courtesy M. H. Arndt

Youngsters that will never scratch gravel. The belts to catch valuable droppings are shown

Row upon row of cages house thousands of hens in factories that are keyed to mass-production. Careful scientific supervision assures pre-determined results

COMMERCIAL practicability is an established fact, but there remain many researches to contribute to the further success of battery brooding. Experimenters are trying to breed birds that thrive better in confinement. "Confinement minded" is the phrase being used to express this objective. There is much in the physical structure of a hen which does not contribute to egg production or to the prompt development of flesh, hence breeders aim to eliminate the non-essentials and fit the bird to the cage and its life work. Finding incentives to lay is another object of study. Music has been tried and, strange to relate, increases production.

Better utilization of waste and by-products, being an aim of all industry, applies as well to the egg factory. Here an attempt is being made to make better use of droppings as a fertilizer. The material is strong in ammonia and a great deal of its content is highly volatile. One experimenter is now trying to capture and retain these volatiles by placing chemicals on the belts under the cages so that a chemical union will be formed while the droppings are fresh.

Of course, institution of the factory idea intensifies the commercial elements of merchandising, financing, cost accounting, and so forth, but this is also indication that industrialization of the hen has successfully modernized the poultry business. Trial and error has accomplished this transition.

Rotating Rocks

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.

THE simplest questions which the astronomer is asked sometimes turn out to be the hardest to answer; for example, does this planet rotate? How long does it take to turn around? And in what direction is its axis?

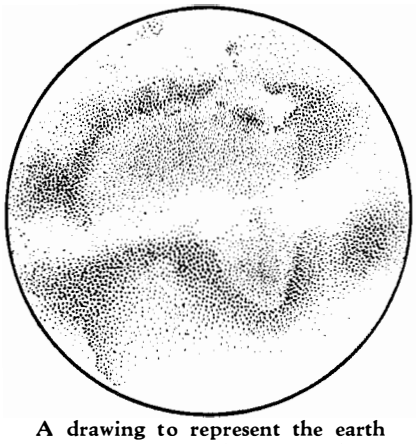
There is but one of the many planets for which we can give precise answers. This, of course, is Mars. His surface is plentifully adorned with permanent markings. A single night's watching shows them moving across the disk as he rotates: The next night shows them back where they were after an interval of a little less than 25 hours and by comparison of drawings made farther apart in time the exact period has been determined as 24h 37m 22.58s. The white snow-caps locate the poles roughly at a glance and measures made on them, especially when they are small in the planet's late summer, give a precise determination.

Jupiter looks larger than Mars with the same telescopic power and has even more conspicuous spots. In a single clear winter night one may watch the planet turn completely around before one's eyes. But when it comes to accurate work it is found that spots close to the equator complete a circuit in 9h 50m, while those in higher latitudes take five minutes longer. Different spots in neighboring zones show somewhat different periods. Evidently they are cloud forms carried by prevailing winds in Jupiter's atmosphere. Even the Great Red Spot, which has remained visible for the past 70 years, has changed in rotation period by several seconds—so that it can not be attached to a solid core though it is probably "rooted" in a region of viscous material where currents are slow.

PROBABLY not many of us realize that the earth, for an imaginary telescopic observer on Venus, would behave in the same way. Its most conspicuous surface markings—after the reflection of the sun from the ocean—would be the great cloud areas that go with storms. In temperate latitudes these move eastward by several hundred miles a day and would appear to the distant observer to complete a revolution in 23½ hours or less. In the trade-wind belts of the tropics the winds blow from the northeast and southeast, and if specific markings could be detected in the sea of broken clouds they would indicate a period of more than 24 hours.

Saturn shows plenty of telescopic detail but this is usually in the form of broad diffuse belts parallel to the equator, with no markings which could be followed as the rotation carries them around. Three or four times in a century conspicuous white spots have suddenly appeared and lasted for weeks or months. One near the equator gave a period of 10h 14m—another, 36 degrees away from it, 10h 38m—so that the winds which drift these clouds must blow even harder than on Jupiter.

Mercury is so near the sun that his surface can be observed only in broad daylight and usually through unsteady air. Under good conditions faint markings are visible—and these by the general consent of observers show that this planet always turns the same face towards the sun as the moon does towards the earth.



A drawing to represent the earth from space. Clouds veil much of the surface except in the trades, and these clouds are excellent reflectors. The dazzling ocean reflection (see the text) not shown here

Venus, though she shows a large and conspicuous form (often a crescent) with a moderate telescopic power, still hides the secret of her rotation from us. Her white surface shows a very beautiful gradation of light, fading out toward the terminator where the sun's rays graze the surface—and nothing else. On rare occasions faint and elusive markings have been reported but they are not definite enough to follow from day to day. With ultra-violet light, Ross has photographed conspicuous dark areas. These change from one night to the next and must be due to some sort of clouds or haze, but they change so much that they cannot be identified after 24 hours. Moreover, there is only an hour or two, at best, in any one night between the time when the sky gets dark enough to permit ultra-violet photography and the setting of Venus into the haze of the horizon, so there is no help here. The spectroscope shows only that the rotation is too slow to get up a measurable speed at the equator. It is certainly much more than a day—indeed more than a fortnight—but anything exceeding a month would be unobservable.

Radiometric measures show that the dark side of the planet sends out an easily perceptible amount of heat—which would not be the case if, like Mercury, Venus kept always the same side toward the sun. If, when the planet appears as a narrow crescent, heat measures were made for different parts of the dark side, we might be able to distinguish the sunset from the sunrise edge and so find out at least in which direction she is turning.

Uranus is so far away and so feebly lighted by the sun that it would be hard to see spots on his surface unless they were large and contrasty, but his rotation can be determined in four ways. First, the planet, when seen from the direction of the plane of the satellites' orbits, shows a conspicuous polar flattening—which can be due only to a rapid rotation. Second, the orbit of the innermost satellite shows a forward motion of the point of closest approach to the planet, which would not occur unless the latter was flattened at the poles. Third, spectroscopic observations indicate an approach of one side and recession of the other at a rate corresponding to a period of about 10¾ hours (Slipher, 1912). Fourth, measures of the planet's brightness by Leon Campbell (at Harvard in 1916) show a variation of about 15 percent, repeating itself in 10h 49m. A more convincing array of evidence could hardly be desired. Yet later photometric observations in 1917 showed a smaller change and those of 1918 and subsequent years show none.

THIS, however, is not real evidence in rebuttal for it is entirely reasonable to suppose that a spot on the planet fairly strongly marked in 1916 gradually faded out, as spots on Saturn have been seen to do much more quickly.

Accurate photoelectric measures of the light of Uranus were made by Calder

Photoelectric Research on Some of the Pocket Planets Throws Light on Their Brief Rotation Periods . . . Some Not Round but Elongated Splinters

at the new Harvard station at Oak Ridge in the winters of 1934-35 and 1935-36. These showed but small fluctuations with an extreme range of 5 percent. To extricate a real but small change in the planet's brightness from the effects of the errors which are inevitable even in these excellent measures is difficult. But Sterne has shown recently that, if the observations are "assembled" on the assumed rotation period of 10h 49m, the measures taken when the planet should have the same side toward us agree with one another decidedly better than they do with those when it should show us another face. There is less than one chance in 20 that this would happen by accident, and the rotation period found 20 years ago is thus confirmed. On repeating the calculations, but assuming the period to be 1½ minutes longer or shorter, nothing but random fluctuations were found; so it looks as if the period were pretty closely known.

Neptune's satellite, too, shows slow changes in its orbit, which can be explained only by polar flattening of the planet—though to a much smaller degree than for Uranus. This indicates a slower rotation, but we cannot calculate just how much slower, for the flattening depends not merely on the rate of rotation but also on the degree to which the density inside the planet increases toward the center. The spectroscopic observations of Moore and Menzel (1928) indicated a rotation period of 15.8 hours and showed to everyone's astonishment that the planet rotates forward (that is, in the direction of its orbital motion) although the satellite revolves around it backward.

WHEN we come to the tiny asteroids, most of these methods fail us. All but a very few appear as mere specks, even with the greatest telescopes, so we cannot hope to see spots on them, detect whether they are flattened at the poles, or feed the light from opposite sides of the infinitesimal disk into our spectroscopes. One recourse alone remains but it is a powerful one. The light of an asteroid can be measured as accurately as that of a star. If it is in rotation we may find periodic changes, provided that one side of it is lighter colored than another. The first instance of this kind to be detected is still the most remarkable. Iapetus, next to the outermost satellite of Saturn, is more than five times as bright when at its greatest apparent distance on the west side of the planet as it appears at the opposite point of its orbit, and maintains this difference year after year. It is clear that this satellite, like the moon, keeps the same face toward its primary. Seen from Saturn it would look queer, for the average reflecting power of the side which precedes in its orbital motion is less than one fifth that of the rear. Several other satellites show similar but smaller variations. Among the asteroids a dozen or more show definite periodic changes in brightness, and many more will probably be found by the time all the 1300 known planets have

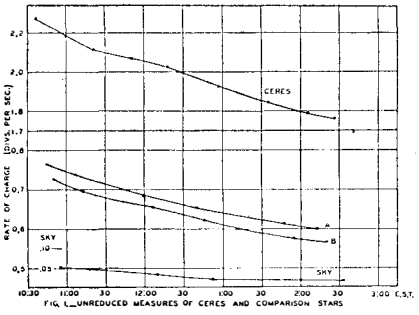


FIG. 1.—UNREDUCED MEASURES OF CERES AND COMPARISON STARS

Top curve shows double wave in light from Ceres, with period of 3h 36 m. Curves *A* and *B* are for comparison stars, to eliminate errors. From an article by Dr. William A. Calder, in the *Bulletin of the Harvard College Observatory, No. 904*

been investigated. The periods are short—the longest so far recorded being less than ten hours and the shortest only two and one quarter. It may seem strange that these small bodies rotate faster than the great planets, but there is a good reason. A body of the low density of Jupiter or Saturn, if set rotating in two and one quarter hours, would fly to pieces—gravity would not be able to hold it against centrifugal force. But a mass as dense as the earth or even the moon would be stable. The asteroids are doubtless masses of rock, and hence dense enough to escape disruption. Moreover, for the smaller ones—less than 20 miles in diameter—the cohesive force of the rock—what an engineer would call its breaking stress—would hold it together more firmly than the feeble gravitation of so small a mass and afford a further safeguard. Slower rotations, in a day or more, may often exist—it is obvious that they would not be likely to be caught by a single night's observations which would infallibly detect a rapid change.

The brightest asteroids show but small changes. Dr. Calder, however, has recently found that Ceres varies by 3 percent in the very short period of 1h 48m. If the little planet is darker colored on one side than the other, this may be the rotation period; but it may be that it has two dark spots on opposite sides—or two bright ones—in which case the true period would be twice as long. It is not at all likely that two dark spots would be equally big and black or exactly opposite to one another. When a long series of accurate observations has been made, if the successive "waves" of the light curve turn out to be exactly similar, it will look likely that the shorter period is correct; but if alternate maxima and minima are unequal, the double period will be right.

The most remarkable variation of all is shown by Eros—perhaps the most famous of the asteroids anyway. In February, 1901, this showed the remarkable range of 1.2 magnitudes—three times as bright at maximum as at minimum—with two unequal waves, in the complete period of 5h 16m. Three months later there was hardly a perceptible change. This would be incredible were it not that the asteroid had moved into quite a different direction from the earth, so that we may well have been looking at it at first from nearly the direction of its equator and later of its pole. The large range in brightness would be hard to explain by the presence of bright spots on opposite sides. It is far more likely that Eros is irregular in shape—an elongated splinter of rock. It is so small that its gravitational attraction must be very weak and quite inadequate to pull it into a spherical shape against the rigidity of the rock of which it is composed.

IN February, 1931, Eros came within 16,000,000 miles of the earth. With the 26½-inch refractor at Johannesburg two experienced double-star observers, Van den Bos and Finsen, examined it carefully and on the first good night were rewarded by seeing a definite elongation of the tiny object—resembling a very close double star. Watching it from hour to hour they found that the angle of the long diameter shifted and completed a revolution in 5h 17m—just the period of the light variation!—proving beyond all question that this asteroid at least is of irregular shape. Had Eros been a double star, the distance between the two (slightly) overlapping images would have been 0."18 that night, corresponding to 14 miles at the planet's distance. In a rough way this may be taken to indicate that the planet is about 15 miles longer than it is broad.

It will unfortunately be many years before Eros comes so close again but at least the rotation of this one asteroid has been actually seen as well as inferred from its changes in brightness.—*Princeton University Observatory, November 4, 1936.*

Movie Cartoons

By ANDREW R. BOONE

COLOR has reached greater perfection in movie cartoons than in real-life motion pictures. This is true not because of technical advances made by the cartoon manufacturers themselves, but because on their stage, which consists of a series of celluloid sheets containing paintings superimposed over a water-color background, they can control both lighting and action with machine-like precision.

The technique of applying color to cartoons, and the mechanics of photographing it, follow definite patterns which have removed the guesswork, characterized in earlier colored cartoons by great blotches which not only tired the eye but in some cases actually caused headaches—to both audiences and producers.

Color directors, who supervise the work of scores of artists in the larger cartoon studios, are charged with the task of providing colors which not only will harmonize, but also will enhance the action and mood of the picture. Action and characterization, as in the days when all cartoons were filmed in black and white, remain the most important of the several elements; but any color which makes those elements "difficult to read" on the screen impairs the beauty of the picture and destroys audience interest. Good color may be accepted without consciousness of its presence; poor color very largely destroys interest in the subject.

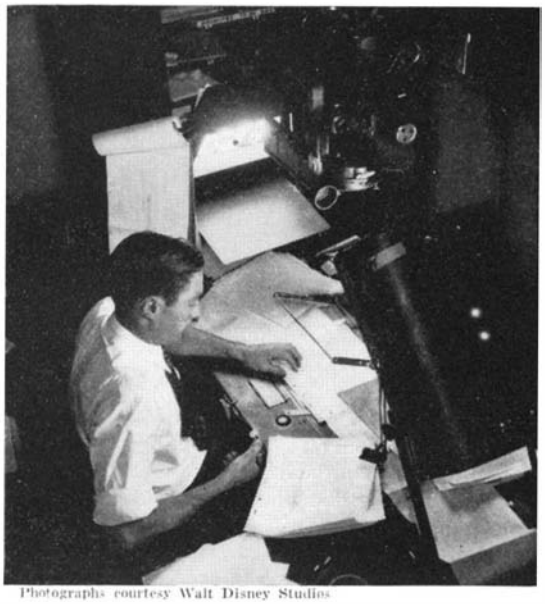
LET us consider color first as a "running story," and not as divided into artist's technique and camera mechanics. In the Walt Disney studio, for example, we find first a "gag-meeting" in progress. This consists of a luncheon which lasts all afternoon, and it is attended by an artist, among others. Here the story idea is organized. What animals shall appear? Are any to be "adapted" from real life? Possibly the color director suggests a character drawn from the rabbit. It is accepted, and a live rabbit is brought to the table for study.

Now, the cartoon artist proceeds on the theory that whereas a painting is easy to "read," colors of varying intensities when thrown in action on a screen often clash. Therefore, he attempts to keep the colors as simple as possible, and at the same time solid, in order to add weight to the characters. Backgrounds are designed not primarily for their pictorial beauty, but to aid the action by providing the proper color mood. To that extent backgrounds perform the same function as sets in feature productions.

In "The Country Cousin," a current release, we see how the color is selected for characters and background, and why. Here two mice (not Mickey) appear. Abner hails from the country, Mortimer from the city. The former wears light blue overalls, the latter black morning dress. Their bodies tend toward brown, for the natural gray of mice does not register well, has little "weight." The brown of the face and hands is warmer, thus accenting those features, as the action revolves around them. The country mouse is gay—therefore light blue clothes; his city relative is restrained and somber—therefore black.

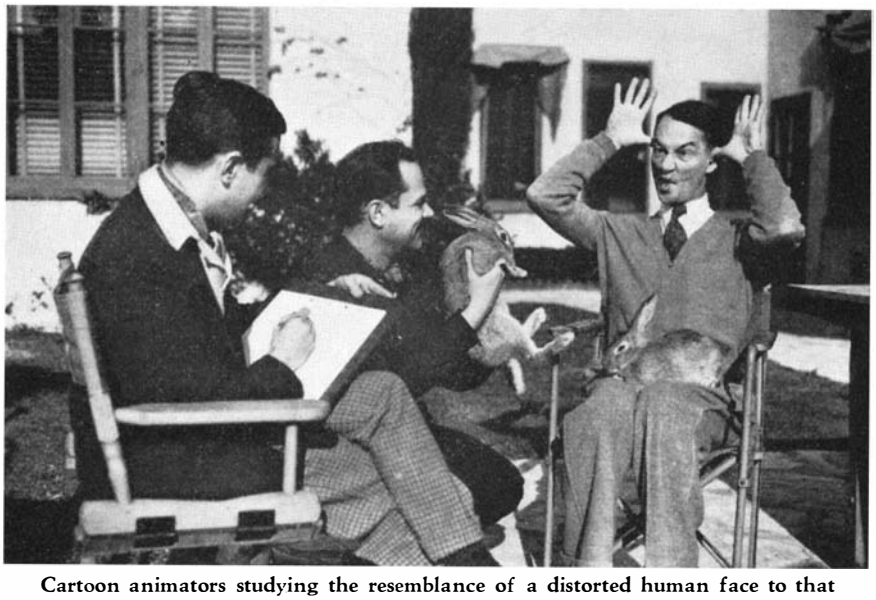
In the background, contrasting shades support the characters—warmer if their clothing and skin are cool, darker if they are light. This applies both to light value and color. Contrast, readability, and solidness are the ends sought in order that the actors may move as a mass and not as spots of color. Now, cartoons do not generally pretend to offer live action. The characters are mainly stylized, and little attempt is made to make them look exactly like live animals. Again, therefore, the country mouse wears red pants, cool yellow shoes (not too potent lest the yellow distract from his facial expressions), and a light, warm face, the expression of which may be easily "read."

So, to get back to the early steps: The characters are first drawn in black and white and animated. After approval by the necessary department heads, the studio color director "sets" the colors in sketches which show all the various articles of clothing the individual characters will wear. Following this, tests are made to determine whether the colors will photograph as they have been visualized. Since 50 stage (background) settings may appear in a single picture, these obviously must harmonize with each other



Photographs courtesy Walt Disney Studios

One of the camera set-ups used for recording on film the antics of movie cartoon characters



Cartoon animators studying the resemblance of a distorted human face to that of a rabbit. Thus they create the stylized characters that will amuse millions

In Color

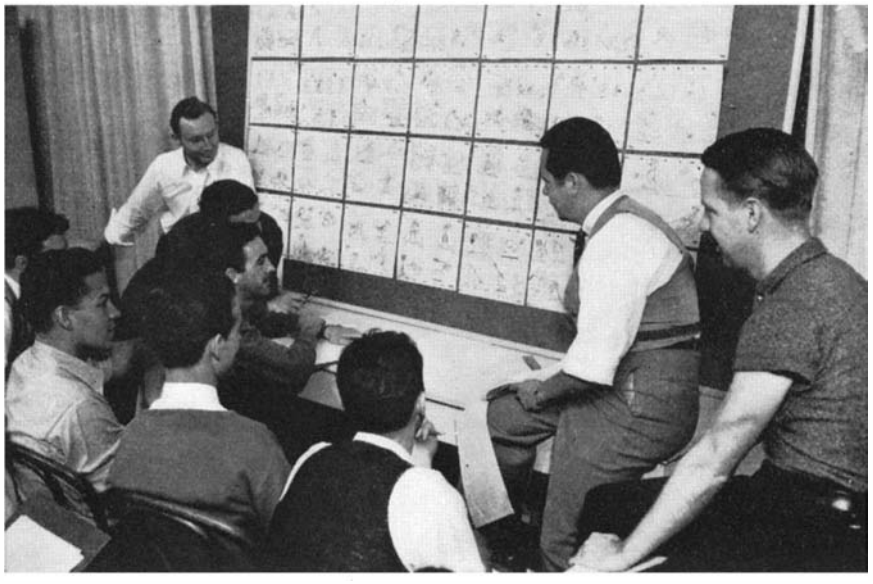
Enhance the Action . . . Simple, Solid Colors . . . Must Harmonize, Not Clash . . . Exposure Becomes a Problem . . . Constant Research a Necessity

and with the characters. These are painted after the color of the characters has been "set."

In the next step, single-line drawings are made. These are traced on sheets of celluloid in ink, and each open area receives a number which relates to a given color. That color may be one of a dozen shades of red, all of which have been tested to determine which one best expresses the idea of the sequence. Following completion of the single-line drawings, artists add the colors by number, building up the character mechanically bit by bit.

With backgrounds and drawings of the action on celluloid—called "cells"—completed, the "picture" is now ready to go before the color camera, which looks straight down on a large table, so fitted that the individual "cells" may be changed rapidly. The movie color cartoon camera is like others used for colored pictures. It has two cranks, one which will expose eight frames at one turn, another to expose a single frame. The cartoon cameraman uses the crank which will expose a single frame as it looks down on and through the celluloid drawings at the colored background. An air pressure device presses the celluloids into firm contact with the background painting, keeping all in focus.

Filling in colors on a "cell" in positions indicated by numbers, as explained in the text



A typical story conference in a cartoon studio. On the wall is a complete series of rough sketches that tell the running story of a movie cartoon in the making

In its simplest form, usually not less than four "cells" will be used. Suppose the mouse is to be photographed doing a bow on a stage. To show this, provided the entire figure is to move, the cameraman places the "cells" over the stage setting, with the figure "cell" second from the bottom. This is done for the reason that the exposure is calculated for the second "cell," no matter whether four or more are used. Thus uniform exposure is maintained on the principal character, while the other "cells" are either slightly overexposed or underexposed. However, only a technically trained critic could detect the difference.

To show the bow, the cameraman has available the background and a series of pictures of the mouse on celluloid. He places the picture of the stage on the table, and upon it lays a picture of the mouse standing erect, covering this with unpainted "cells." The mouse now appears to be standing on the stage. A single photo is taken, the celluloid painting is removed and replaced by a second painting showing him leaning slightly forward. This procedure continues for 24 frames, or 18 inches of film, to complete a simple bow.

IN a more complex scene, one involving two or more characters and properties, such as a tree, one or more paintings are provided on each of the four "cells." Five "cells" will be used for a crowd scene. On the bottom cell will be painted a property, particularly if it is to enter the action. While the main action usually will be confined to the second "cell," when several characters are present some will be painted on the third. To facilitate movements and save unnecessary painting, the body of a character may be painted on the second, its head and arms on the third. Darkened characters or props which can stand longer exposure without "burning" are placed on the fourth.

Mechanically, this process differs little from filming cartoons in black and white. Artistically, color opens a broad field of interpretation, for emphasis of situation. As in life, red denotes warmth, blue cold, a streak of yellow down a character's back fear or cowardice.

Constant experimentation goes on behind the closed doors of cartoon laboratories, for color, when it reaches the screen, does not always reproduce what the unaided eye has seen. You see a halo around a candle, but what colors will reproduce that scene for the screen? A character walks under the direct rays of a light. What tones will give the perfect illusion? Tests, an infinity of tests on short strips of film; tests involving thousands of colored drawings will provide the right answers. Only by this means do cartoons approach perfection in color, the greatest field which has yet been opened to them.

OURSELVES AND THE FEEBLE-MINDED

By G. H. ESTABROOKS
Professor of Psychology at Colgate University

A FRIEND of mine adopted a child and in this case he "led with his chin"; so old Mother Nature passed him a jolt which has left him grouchy for ten years. Strange to say he was a doctor and should have known better. The little boy at the time of adoption was about three years old, an orphan from good farmer stock and the picture of health. He still is as husky a specimen as we could wish, but at the age of 13 he is in grade five, several years behind his proper place. Intellectually he is in the ranks of the feeble-minded—high grade feeble-minded, to be sure—but he has not and never will have normal intelligence. He may be able to complete grade seven by the age of 16 but he could never manage high school, and college would be absolutely out of the question. A child like this in a doctor's family, with its educational traditions, is nothing short of a tragedy.

And it was quite unnecessary. Ten years ago we had intelligence tests which could easily have spotted the condition. Today these have been even more refined and anyone who adopts a child without first checking up on its brain power is just asking for trouble.

You must not confuse the feeble-minded with the insane. Insanity could be detected in only a very limited number of cases at the age of three. But then, insanity is not generally inherited; it is the result of education and home conditions. If an adopted child should later develop a nervous breakdown, there is a strong probability that you are to blame. It would happen just as readily in the case of your own child. But the picture is quite different with the feeble-minded: either the condition is inherited or is present very shortly after birth. The insane, generally speaking, have a good brain and a normal intelligence up to a certain age. Then one of many things happens and they go "crazy." The feeble-minded just never did have normal brains to start with, even at birth. As a result, our intelligence tests can detect the condition as soon as it is well enough developed to measure—probably by the end of the first year, certainly by the fourth or fifth.

AND it's just bad news, for nothing can be done about it. The child can be placed in a home, can be trained to the limit of a very limited ability, in one type of case his intelligence can actually be raised, but a cure is hopeless; hopeless because intelligence depends on the brain, which in this case is not normal.

We divide the feeble-minded into two broad groups, the "hereditary" cases and the "clear sky" cases. The first are due to poor stock. Genius tends to beget genius, while the feeble-minded tend to have offspring which fall into their own class. Nor do the exceptions disprove this. You all know of cases wherein brilliant parents have stupid children; wherein genius springs from the slums. Away back in 1865 an Austrian monk by the name of Mendel outlined a law of heredity which still bears his name. We cannot explain that law here, for it is very complicated. Suffice it to say that it not only permits but even requires these curious exceptions.

Let us consider this hereditary group, since the problem here is relatively simple. First of all, how do we detect its members? This involves the famous intelligence test and the intelligence quotient. It consists of a series of problems so graded that the lowest are easy for a three-year-old, the highest may trip up a college graduate. For example, take the repetition of numbers. If I ask a boy of four to repeat after me the five digits 6, 4, 8, 1, 2, he cannot do it. The average child of ten can, and you as an adult should perform the task very easily. But if I raise the number to seven digits you will have trouble; and if I then ask you to repeat them backward, you will find it practically impossible. Should I ask you to define 80 out of 100 such words as "cat," "strike," "ready," you might feel almost insulted, but should I make the list contain words like "nematode," "polydactylism," and "shagreen" your indignation might be due to a totally different cause. A child of five is likely to give the wrong answer for such a simple problem as: "What should you do if you find your house on fire?" You can be just as easily stumped, but the task has to be on a somewhat higher level—consider the income tax return.

You can see from these very simple examples that it would be possible, given time and money, to draw up a series of intellectual tasks so graded in difficulty as to cover the entire range of human ability, from Einstein down—or up, if there is an "up." Then it would also be quite possible to find how high the average five-, ten-, or fifteen-year-old child could climb on the ladder. This would give us our yardstick. We could then measure you against this scale, no matter what your age, and say that you have the intellectual ability of a child of seven, fourteen, or of a genius. This we term your mental age (M.A.), which is quite distinct from your real or chronological age (C.A.).

We can now determine your intelligence quotient—I.Q. This we get from the formula $(M.A.\div C.A.)\times 100=I.Q.$ Suppose your son is 10 years old but has a mental age of only seven. His I.Q. would be $(7\div 10)\times 100=70$. This would place him in the "moron" group of the feeble-minded. On the other hand, a mental age of 17 would give, in this case, $(17\div 10)\times 100=170$, or genius. One hundred is, of course, always the average I.Q. and we never allow the C.A. to go above 16, on the theory that mental development stops at that age.

SHOULD your I.Q. fall below 20 you would be styled an idiot, below 60 an imbecile, from here to 80 a moron; and above that normal, in various degrees of dullness or superiority. All this may sound complicated but actually a good "tester" can give a child the famous "Binet" test and classify him very accurately in an hour. This is the most time-consuming of all tests. We generally use a "group" test, wherein we take the children—or adults—in groups up to 100 or more at a time. This procedure is not quite as accurate as is the time-consuming, individual Binet, but yields very good results for all that.

That type of feeble-mindedness arising from poor heredity is society's greatest problem. Unfortunately it has not a great deal of interest for us at present. The picture is simple. Feeble-minded beget feeble-minded, the children of normal parents tend to be normal, while the offspring of genius tends to be well above the average of the race. Such exceptions as occur are easily explained by Mendel's Law.

However, almost half of the feeble-minded fall within the second group, the "clear sky" class, and this offers a totally different picture. If you, as a normal member of society, deliberately marry an individual who is feeble-minded, then your blood is on your own head. However, these clear sky cases arrive in all families, irrespective of parental intelligence, and offer a problem which medical science and psychology have not been able to solve. This great and unpredictable class divides itself into several smaller groups, all of great interest and all presenting

very special and interesting problems.

First we will consider the cretin. In the front of your neck, straddling the windpipe, is the thyroid gland. This is the great "pep" gland of the body and secretes a substance, thyroxine, which is absolutely essential to normal life. Its presence hastens metabolism—in other words, speeds up the engine. If in your case as an adult, the thyroid should suddenly cease to function, you would immediately lose most of your drive, start putting on weight, and in six months' time be a sad caricature of your present self—fat, lazy, and lacking all ambition. This occurs in some types of goiter. On the other hand, should this gland suddenly begin working overtime, as it does in the case of exopthalmic goiter, our picture is just the opposite: metabolism is accelerated to such an extent that the body literally burns up, using energy faster than it can be absorbed, so that the individual becomes very thin, nervous, highly excitable, and finally dies of exhaustion unless effective treatment is used.

IT sometimes happens that the thyroid gland is absent or defective at birth. We then get the cretin, a pathetic little idiot, fat, infantile, with a bronzed skin, little hair, and less brains. He seldom grows over five feet tall, the sex organs are quite undeveloped, he cannot talk, feed himself or learn ordinary habits of cleanliness—all through the absence of thyroxine, a condition which slows up the entire body development.

This particular kind of case does hold out a certain amount of hope. We can inject or feed thyroxine, prepared from the glands of sheep. This will to a certain extent replace the natural secretion and cause an improvement in the condition. The deficiency must be detected early and treated consistently, for any marked improvement. Even so, it is doubtful whether such a child ever becomes "normal" and a "cure" is never effected. The gland always remains defective—you merely supply the substance it secretes. You do not cure the disease in the sense of restoring the thyroid gland to health. Every institution for the feeble-minded has its quota of cretins who go through the regular course of thyroxine treatment. The fact that they are still there is mute testimony to the difficulty of obtaining any real improvement.

Another familiar figure in these institutions is the microcephalic or the "pinhead." As the name suggests, his main difficulty is one of shortage. There just isn't room in his tiny skull for normal brains. He usually rises to the level of the imbecile, can frequently do rough manual work and is a very good natured sort of individual who seldom offers problems of a disciplinary nature. The microcephalic presents an exasperating problem, in that we have not the least idea what causes this particular clear sky type. It simply arrives without the slightest excuse and leaves a problem against which we are helpless.

Somewhat different is the case of the macrocephalic or hydrocephalic, sometimes referred to as "water on the brain." The chief outward manifestation of this condition is too much head, and the cause seems to be somewhat the same as water on the knee. At an early age, sometimes before birth, and when the skull bones are still very soft, spinal fluid begins to collect in certain brain cavities. The pressure is sufficient to force out the brain and with it the skull, leaving the huge and often misshapen head of the hydrocephalic when these bones finally do harden.

Several diseases, such as meningitis, appear as a cause of this condition. Apparently they irritate the secreting membranes inside the brain, just as a blow on the knee may cause water. In the majority of cases we cannot locate the cause, as is also true with the knee, but it is probably due to a shock of some kind. A cure is pretty hopeless. Draw off the fluid and more promptly returns. as in the leg. Some cases are reported where brilliant and daring operations have effected a cure, but these are distinctly in the minority. Whatever the injury to intelligence—and it may range from practically nothing to complete idiocy—treatment is very unsatisfactory. We can only hope that the great advances made in brain surgery may some day find a cure for this condition.

Mongolian idiocy is a fourth well recognized type of clear sky case. The child looks somewhat like a little Chinese. Yellow skin, slant eyes, straight hair, round head, and short limbs yield a caricature of the mongol. The sufferer always remains a dwarf, is quite unable to read, write, or take care of himself, and sexually is altogether undeveloped. We haven't the slightest idea what causes the condition, and can do nothing whatsoever to effect a cure. Just one of many cases wherein science has made little progress.

BIRTH injury is now recognized as another cause of feeble-mindedness. A baby's skull is very soft and the brain, even if well protected, is a sensitive organ. The bones of the head have not united at birth but can be moved separately. Under these circumstances a very difficult delivery, especially if instruments have to be used, may easily result in brain injury. This seems especially true in cases of premature birth or where the baby is very small. Apparently the skull gives even less protection to the brain in these cases. The effects of birth injury are largely what one would suspect, depending, as they do, entirely on the area affected. They run through all the grades of feeble-mindedness, but include as well certain paralyses and even emotional upsets resembling insanity which are due instead to injury in certain areas. Treatment of these cases is extremely difficult, almost hopeless. A great deal of research is being devoted to these birth injuries and perhaps the future will give better news.

The above five groups are generally accepted as representing the clear sky cases of the feeble-minded. There may be other minor classes beside. For instance, certain research leads to the suspicion that an excessive use of X rays before birth may have very bad results on the child's mentality. Be this as it may, we can say roughly that about half the feeble-minded are due to "poor stock" and the other half to these unpredictable cases.

We cannot discuss the broader social implications involved in this situation, owing to lack of space. Just what does it mean, however, to you as an individual? We have a saying in college that all problems should be settled in the Admission's Office. In theory, a director of admissions could choose a freshman class which would be ideal and never cause any trouble. Actually, of course, he can't, but he can do a lot.

So with you. The admissions office is the marriage altar. If you choose a partner of inferior mentality or one from a highly neurotic stock, you are more or less "asking for it." On the other hand, if this partner is the equal of yourself, you have taken every reasonable precaution and are safe within very broad limits. But only within these broad limits. We can offer absolutely no guarantee that you will not be saddled with one of the clear sky cases, no matter how good your stock and that of your partner. After its arrival you must face the further fact that medical science can do practically nothing to relieve the condition. All of which may seem pretty discouraging, but it is the picture as it exists today.

WE can, however, offer very definite service on the matter of adoption. A good child psychologist can spot the graver cases of feeble-mindedness by the end of the first year. At three years he is more accurate, and at five he can almost predict the college grades. Make no mistake in this matter of adoption, for it can result in tragedy. A child of three looks very "cute," is healthy, and talks a blue streak. So—what the devil! —everyone knows that mental tests are bunk, and you want him very badly.

But take it easy. If your family has a good educational tradition, and if that child happens to be sub-normal—a condition which you yourself might easily overlook—the future won't be too happy for either of you.

INDIUM—A METAL ARISTOCRAT

By SIDNEY J. FRENCH
Assistant Professor of Chemistry, Colgate University

THE scene is Paris, the right bank. The time is Spring, 1940. The young man's fancy, irrevocably bound to love, now turns to jewelry. He would buy the lustrous pendant reposing in the modernistic window before him. He steps inside. The pendant is presented for his inspection. "Are you sure," he asks, "that this is white gold?" "Ah, no, Monsieur," replies the clerk, "that is not white gold. It is the newest thing in precious metals, indium. Fortunately we can sell it to you at a lower price than white gold. But if you prefer, we can give you the same thing in a gold setting." But the latest mode and price are indeed desirable to this young man. "I'll take it," he says quickly, and turns over the proper number of francs. Cheated? No! For the clerk who sold the pendant, the man who bought it, and the girl who received it so happily, none of them could guess that he or she would live to see indium become one of the most popular of the aristocratic metals.

Had this young man attempted to find an indium pendant in 1930 his search would have proved fruitless, for there were no indium pendants. There was, in fact, so little of the metal available that he would have paid 270 dollars for an ounce of the almost unknown metal. In 1936 he could buy it for less than 30 dollars an ounce, with gold quoted at 35 dollars an ounce. In 1940, what? Just what is the future of this remarkable metal which has risen like a new star to join the galaxy of semi-precious metals? What can be done with a metal softer than lead, lighter than zinc, more lustrous than silver and as untarnishable as gold? What can be done with a metal which melts at a lower temperature than tin? These questions confront science and industry at the present moment when indium, from a mere name and number on a table of atomic weights, becomes a tangible, useful, and desirable metal. Today, exploitation and experimentation; tomorrow, sales promotion and advertising. Today, the laboratory; tomorrow, the market. This is the course of all new materials. This is the path indium must follow.

THE future of any new material may be divided into two parts, the predictable and the unpredictable. Accidental discoveries not now foreseen constitute the unpredictable. The predictable future is determined by facts already known. The known facts lead to the inevitable conclusion that indium will play an important rôle as a metal of luxury for it has all the qualifications of such a metal. Used alone, it is unsuitable for jewelry, for, like gold, it is very soft; but alloyed with small amounts of silver or copper it gives a hard, durable, lustrous surface which remains undimmed in air. It alloys

William S. Murray, President, The Indium Corporation of America, with over 200 ounces of indium

equally well with many other metals including gold, tin, cadmium, lead, and zinc. To each of its alloys it lends its durable properties of non-corrosion. Already patents exist covering precious metal alloys containing gold, palladium, silver, copper, and indium for use in dental castings and jewelry and covering alloys of silver and indium.

In addition to its use in the form of alloys, indium can also be plated on suitable metal surfaces. When first plated, the surface coating is soft and dull. If the plated object is heated, however, the indium, because of its low melting point, sinks into the underlying metal, giving a durable surface alloy which will take a high polish. This high luster and durability of a silver-indium surface alloy has found unique application in reflectors to increase reflecting power and lengthen the life of the reflector. In dental amalgams, indium is being used with silver and to replace silver.

Other almost unique uses of indium depend on the very low melting point of the metal. The fact has been known for a long time that when two appropriate metals are melted together an alloy may be found which melts at a lower temperature than either metal taken alone. The addition of a third and even a fourth metal may depress the melting point still farther. In this manner, bismuth, lead, tin, and cadmium, all low melting metals, form an alloy which melts below the boiling point of water. It occurred to the writer a short time ago that the addition of indium to these four common metals should produce an alloy melting at a very low temperature. In practice, it was found that the addition of indium produced an alloy melting far below the boiling point of water. In fact, the alloy melted at 116 degrees, Fahrenheit, not far above normal body temperature. This liquid alloy may be brought into direct contact with the body and allowed to harden in place without discomfort.

THIS alloy may therefore well find uses in art for taking impressions of the features of living persons in place of the more unwieldy and slow hardening plaster of Paris. For example, a finger or foot may be partially immersed in the molten alloy. The alloy is then chilled to promote rapid setting, thus greatly reducing the time required for immersion and permitting the formation of a faithful impression. Impressions of the feet and hands of artists could be obtained for posterity with a high degree of perfection. Three-dimensional finger prints or foot prints might have decided advantages over the present ink and paper prints used in the detection of criminals.

But the objection may well be raised that such molds would be both costly and perishable, since the alloy is expensive and slight accidental heating would melt the mold. Such objections are easily answered, for the alloy mold need not constitute a permanent mold. It is merely placed in a suitable plating bath and plated to the desired thickness with copper, silver, or other metal. The plated mold is then placed in hot water, whereupon the alloy melts off, leaving a cast of durable, inexpensive metal. The alloy is thus recovered for further use.

Since the alloy has such a low melting point, it may also find possible use as a spraying metal to cover objects of art. The molten metal is sprayed under pres-

Softer than Lead, More Lustrous than Silver, as Untarnishable as Gold . . . Has Risen Like a New Star in the Galaxy of Semi-Precious Metals

sure over a plaster or wooden object to form a continuous metallic coating. If desired, then, other metal may be plated over the alloy or the object may be gently warmed to give a smoother finish.

Still another possibility which presents itself in the field of art is the use of such an alloy for etching. Lines and figures can be engraved in the alloy surface with an electrically warmed pen. The softened parts of the metal may then be worked by the artist as desired with bare hands to build up figures in relief. The object may then be plated, the alloy melted out and the mold thus obtained used for making permanent casts.

The fact that such alloys can be molded by hand should make possible the building up of objects of art, much as a sculptor builds up a clay statue. Mistakes might be erased by the application of heat. From such models, permanent casts could be made by plating.

For making seamless hollow vessels of odd shape, such low-melting alloys can be poured into a suitable cast, the cast removed and the remaining mold or core of alloy plated with cheaper metal; the plated mold is then warmed up and the alloy poured out through a small opening.

ANOTHER suggested use of such an alloy is in surgery. The alloy, impregnated in cloth or some other soft matrix and heated above 116 degrees, Fahrenheit, becomes soft and pliable. This is placed around a fractured or broken limb while the surgeon manipulates the bones into place. The cast is then cooled in position and sets to a rigid condition holding the broken members in place. When it is desired to remove the cast, hot water bottles are applied and the whole again becomes pliable. There is no pulling, breaking, tearing, or chipping of plaster or plaster impregnated cloth. There is likewise no pain for the patient.

Finally, such low melting alloys may find use for controlling temperatures, and for automatic fire alarms and control systems.

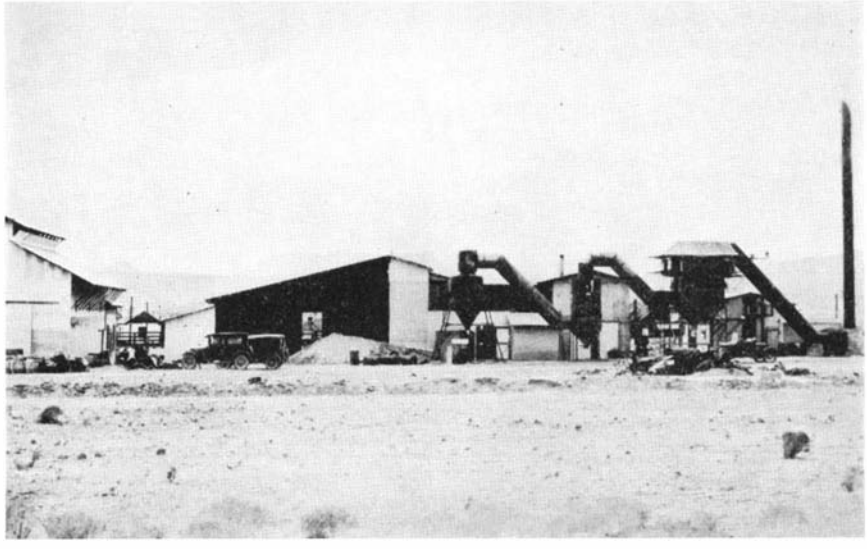
If the present is any indication of the future, indium is on its way upward in use and downward in price. Still, nature has sprinkled this aristocratic metal but lightly over the surface of the earth and it must therefore ever remain a member of the semi-precious caste. As metals go, it is young, for it is not yet a century old. It may be interesting, now that the present has been unfolded and the future predicted, to turn to the past; for indium has had an interesting history.

In 1863, Ferdinand Reich was studying some ores with his spectroscope. He was looking for the metal thallium, which should write its spectrum signature with a prominent green line. But he couldn't find the green line. He saw the lines of zinc and lead in his ore but none for thallium. But what was that very prominent line near the violet end of the spectrum? He rubbed his eyes and looked again. Could it be potassium? Impossible. He got out his references and checked. No known element had that particular signature. But he wasn't certain, because he was colorblind and had to rely on the position of the line instead of the color. So he called in his assistant, Theodore Richter. Richter saw the line too, and he saw another fainter line. Unquestionably they were the lines of a new element begging to enter the world of known elements.

No name could be more appropriate than indium for this element which wrote its signature with such a bold *indigo* line. So, *indium* it became. Then started the laborious and time-consuming task of getting some of the new element out of the ore. They precipitated, dissolved, roasted, purified, and plated. Months later they were rewarded with a small sample of the pure metal. And what a metal! In 1867, Richter exhibited two samples of the new metal to the French Academy of Sciences. Each sample was about the size of a lead pencil and Richter placed a value of 40,000 dollars on them. But indium did not come into fame overnight. Who could play with a metal worth 20,000 dollars an ounce?

More than 50 years passed and indium remained but a name, a number, and a blue line. Few museums could boast of a sample. The price fell, however, for in 1924 indium was valued at 300 dollars an ounce—merely a paper value, for there wasn't an ounce available from a supply house in the whole world. When Mr. William Murray, of Utica, New York, attempted to purchase 10 grams (⅓ of an ounce) of the metal for experimental uses in 1924 he couldn't find 10 grams. Finally he got one gram from Germany, at a price of ten dollars. Within ten years of that date, however, he was able to display more indium than had been produced altogether in the 50 preceding years. He had a total of more than 250 ounces of the interesting metal. Valued at the price of 1864 it was worth more than 4,000,000 dollars, at the 1924 price, 100,000 dollars and the 1934 price, less than 7000 dollars. Moreover, it was not a paper price, for the 250 ounces were there in his laboratory for anyone to purchase. In 70 years, the price of indium had fallen 1000 fold.

FOR three quarters of a century indium has been a curiosity for scientists to play with. It has been but a name and a number among the 92 elements. No longer, however, is it merely "Element number 49," writing its signature with a blue spectrum line. It is a metal, available and desirable. It is here to stay. Its future is in the lap of the gods and the hands of keen-sighted industry. Tomorrow we may awake to find ourselves indebted to this metal for safety, comfort, pleasure, and luxury. Tomorrow the word indium may be as common to our vocabulary as the word chromium is today. And so, another member will have been added to the ever growing society of metal aristocrats.



Indium recovery plant in Arizona. The building at the extreme left houses the refining equipment, the central one a rotary furnace. To right, dust collectors

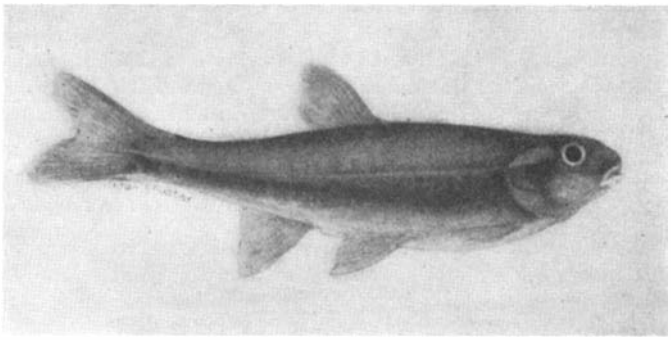
FISH AND PHYSICIANS

A Fish that has Flopped into One of the Biggest Scientific Ponds of the World—Cancer Research ... Some very Important Revelations Have Resulted

By HARRY PELHAM ROBBINS
President, Memorial Hospital for the Treatment of Cancer and Allied Diseases

FISH and physicians work together today in seeking the cause and cure of cancer. One reason why fish are helpful in the unremitting quest for the control of cancer, which still ranks second in the list of causes of death, is that they themselves are subject to cancer. Their use in various reactions and experiments has come to play an important rôle in study of the disease.

When Memorial Hospital was founded in New York City 52 years ago, for the treatment of cancer and allied diseases, it is certainly likely that the founders, far-seeing though they were, had not the slightest idea that fish would some day play a part in its history. They were thinking more of surgery, nursing, and opiates. But the story of study and treatment of cancer in this and other institutions is not complete without reference to the contribution which fish have made to advancing knowledge and effective treatment. The record includes the saga of a poor fish which has become very valuable. This humble and obscure member of the piscatorial family has emerged as a sort of Cinderella in Science Land, and become much sought after. The recent discovery of this small American fish, the rosy-sided dace—or to use its scientific name, *Leuciscus vandoisulus*—which may serve as a diagnostic test for a malignant form of human cancer known as melanoma, directs attention to the many services which fish have rendered in the field of cancer. But we are getting ahead of our story of the poor fish which has become a very important fish.



The rosy-sided dace. This small fish proved to be the much-sought-after subject of experiments on the cause of cancer

The trout family, too, are playing their part. About 1904, epidemics of thyroid cancer in artificially bred trout nearly ruined the trout breeding industry in several localities here and abroad. The thyroid gland in fish consists of many islets of gland tissue scattered about the gills and throat. The cancer caused a rapid enlargement of all these islets, so that the fish choked to death or died from ulceration of the enlarged glandules. At first it was thought that the disease was of infectious nature, and the late Dr. Harvey Gaylord endeavored to prove this origin by elaborate experiments conducted at the fish farm of the Buffalo State Institution for Cancer. However, the conclusion was reached that the cause was really overfeeding of the young trout with a badly balanced diet and in the general chemical pollution of the waters. With the fish in well watered streams and on a correct diet, the disease was eradicated. Yet thyroid cancer still occasionally appears in sporadic cases in several kinds of fish.

About this same time zoologists began to notice the occurrence of various kinds of cancer in fish. In 1904 Marianne Plehn, of Munich, recorded several cases of cancer of the skin, bones, and internal organs of fish which she studied in Germany. After that, reports of cancer in fish became more numerous as attention was called to the matter, and it soon became apparent that, while cancer is comparatively rare in fish, it may affect almost any variety, and under almost any conditions. In 1933 Alexander Haddow and Isobel Blake, of the Scottish Fishery Board, collected from the literature about 50 different types of tumors which had been observed in as many different kinds of fish.

HERE we also introduce frogs as co-workers with fish and physicians. In fish and frogs, as in man, the growth and functions of the organs are largely under the control of the glands of internal secretion. One of these glands, the thymus gland, which lies just above the heart, stimulates the growth of youthful or embryonal cells. When ordinary tadpoles are fed on thymus they soon develop into giant tadpoles.

Another of these glands is the thyroid, which tends to restrain growth but to make it more adult in type. This fact was discovered by Dr. J. F. Gudernatsch, working as a member of the Memorial Hospital staff, when that work was being conducted partly at Cornell University Medical College. It came about in this way: Between 1880 and 1890, thyroid extract was sometimes used in the treatment of cancer, and occasionally good results were reported. The Memorial Hospital staff observed some of the apparently good results and decided to investigate the reasons, if any existed. To make a long story short, Dr. Gudernatsch's crucial experiment consisted of adding a minute quantity of thyroid extract to a small aquarium containing tadpoles. He found that the tadpoles were transformed into frogs almost over night. This experiment demonstrated the differentiating action of thyroid extract which causes young cells to hurry up and become adult cells, but at the same time restraining growth. In this way the restraining action of thyroid extract on cancer cells was explained. Unfortunately, however, this action is not strong enough to render thyroid extract an effective agent in the treatment of cancer.

Now enter radium and X rays to join the fish, frogs, and scientists. Among the major problems of cancer research is the mode of action of radium and X rays, of which comparatively little is yet definitely known. Yet these agents are a very important means of curing cancer in its early stages. Fish eggs are very susceptible to X rays and radium rays and the effects are easily traced in these simple structures. Many investigators have subjected the eggs of various varieties of fish to different forms of radiation and have determined what effects follow. In this way many curious and important

variations have been discovered in the behavior of the eggs at successive stages of development. Some are radio-sensitive and others radio-resistant. These experiments have shed considerable light on the mode of action of the rays and on the factors making cancers susceptible to radiation.

They have also demonstrated some of the adverse effects of radiation. Dr. C. R. Stockard found that chemical injury of eggs, or young embryos, sometimes leads to the production of one-eyed monsters by injuring the delicate mechanism of the embryo eye so that, while the fish might grow up to normal size, it would have only the one eye of the cyclops. In 1925 Dr. Hinrichs, of the University of Chicago, noted the formation of monsters in Fundulus fish following exposure to ultra-violet rays.

Dr. Oppermann, of Germany, in 1913 studied the effects of radium treatment on the sperm and the fertilized egg of the trout. He noted head, eye, and tail defects as a result of the treatment. In America, Dr. Charles R. Bardeen, of the University of Wisconsin, was the first to show that fish eggs fertilized by radiated sperm developed various types of deformities in the fish hatched from such eggs.

IN 1906 Dr. Tur, of France, studied the action of radium upon the embryos of the common dogfish. The embryos that developed were smaller than the normal and were markedly defective, having practically no central nervous system. Dr. Bohn, of France, in 1903, and Dr. Schaper, of Germany, in 1904, used radium on the young of frogs, toads, and newts. In 1913 Dr. Hertwig repeated the work with frogs' eggs and radium-treated sperm cells. All these investigators noted faulty development of the skin, blood, and nervous systems which varied with the amount and duration of exposure.

Warned by the results of these studies, physicians now use proper precautions when employing X rays or radium in the case of pregnant women, especially in the early months of gestation. Yet many women have borne healthy children after having been cured of tumors of the pelvic organs by radiation treatment.

Funny family, the fish! They live mostly at low temperatures, so the processes of digestion and assimilation of food and the growth of cells lack the stimulus of the heat which higher animals enjoy. Hence the organs of fish contain large quantities of growth-stimulating substances, ferments, and vitamins, on which growth and energy depend. It is the presence of these agents, especially vitamins, to which cod-liver oil owes its medicinal value, effectiveness in preventing rickets and in stimulating general nutrition. Furthermore, cod-liver oil used in the prevention and cure of rickets probably also reduces the tendency to some forms of tumor growth, especially those affecting the bones.

But here is where the real color comes into the story of the unknown fish. Most fish and batrachians (frogs and toads) are highly pigmented; that is, are characterized by a wide variety of deposits of pigment which protect them against their enemies and against the effects of sunlight. In fact, pigmentation is a more important function and more elaborately developed in these animals than in any other species, except the insects.

Some very important revelations regarding the control of the function of pigmentation, both in lower animals and in man, have resulted from experiments on fish. These experiments center about the influence of the pituitary gland on the behavior of pigmentation. The pituitary gland is an organ of internal secretion which presides over many functions of the body, including growth of tissues, sex characteristics, and especially pigmentation. It is the central signal tower of the system of glands of internal secretion. It acts mainly by stimulating other glands according to their needs. It is located in a protected bony recess in the base of the skull.

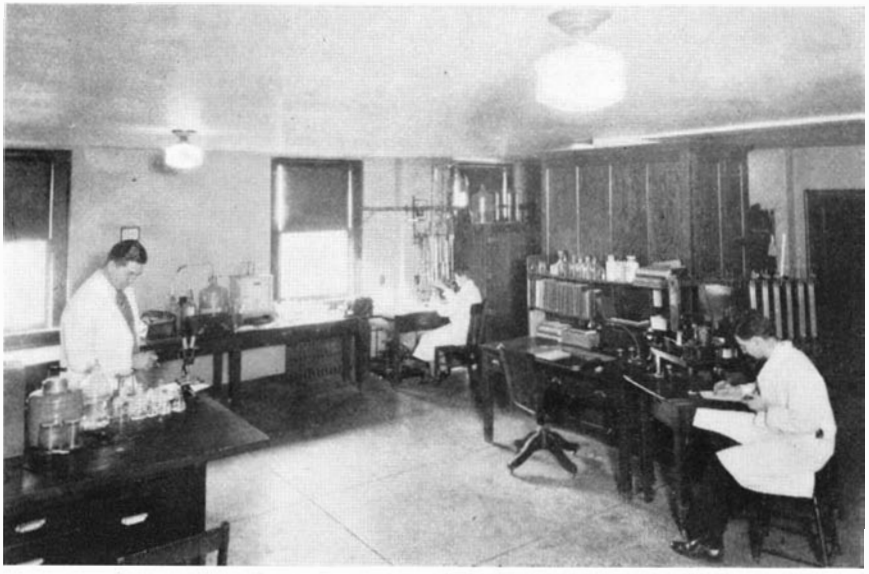
THE first indication that the pituitary gland had anything to do with pigmentation was obtained by Dr. Evans and Dr. Smith of California. They removed the gland in tadpoles, which are pigmented, and found to their astonishment that these tadpoles lost their color and became silvery. Indeed, they were albinos—almost free from pigment. They could not produce pigment when deprived of the pituitary gland.

The next important observation was long delayed. In 1932 Dr. Bernhard Zondek in Berlin isolated from the middle lobe of the pituitary gland a special secretion or hormone which had a remarkable action on the pigmented skins of

Memorial Hospital in New York—its complete name being "Memorial Hospital for the Treatment of Cancer and Allied Diseases." First institution of its kind in America

THE accompanying article has to do with research on cancer conducted at Memorial Hospital in New York City, the first special institution of its kind in the United States. Last year it maintained 110 beds and accepted 3200 patients for treatment. A daily average of 325 patients come to its clinics. About one third of the work is free.

Last year the Hospital received a gift of 3,000,000 dollars from the General Education Board, founded by John D. Rockefeller, Sr., to build a new home in New York, and the new structure is to rise near the Cornell University Medical College (with which the Hospital is affiliated) and the Rockefeller Institute for Medical Research. Dr. James Ewing is president of the Hospital's medical board. — *The Editor.*



Quiet but systematic activities in the Biophysics Laboratory, Memorial Hospital

many fish, and which he called "intermedin." Many agents cause a similar effect on pigmented fish, but after many trials Dr. Zondek found a fish, commonly known in Germany as the *Elritze (phoxinus)*, which apparently reacts alone to intermedin and is therefore a test for this hormone.

When a minute amount of intermedin is injected into an *Elritze*, the black spots on the back become shrunken and darker, while brilliant red spots soon appear about the ventral fins. This sharp change in color is very similar to that which occurs naturally during the breeding season, and the reaction to intermedin is not so sharp during the breeding season.

BUT what have white frogs and red *Elritze* to do with cancer? This question remained to be answered by one of the workers in the laboratories of the Memorial Hospital, where many cases of a fatal form of pigmented cancer are seen. This worker concluded that, if intermedin has such a remarkable influence on pigment cells in fish and frogs, it might be found active in a malignant tumor composed of these pigmented cells in a human being, and therefore might be present in excess in the tissue of pigmented cancers and probably also in the blood and urine of such patients. After observing many such cases, he proved that precisely such conditions do exist. He found varying quantities of intermedin in tumor tissue, in the blood and in the urine, as well as in some other tissues. Using certain precautions, he was able to show that the test for intermedin in the German fish *Elritze* was of value in the diagnosis of pigmented cancer.

But the *Elritze* is found only in Germany. Its importation to the United States, alive for experimental purposes, offered many difficulties and was expensive. It became highly desirable to find some American fish which would serve the same purpose. So the inquisitive doctor consulted New York fish dealers, showing them an *Elritze*. They had never seen such a fish. He was greatly aided by the experts at the New York Aquarium, who told him that a very similar fish could be found in Maryland. The physician laid aside his microscope and white coat, packed his grip, bought a pair of rubber boots and headed for Maryland. Wading the stream in hip boots, he finally discovered the fish. It was the rosy-sided dace *(Leuciscus vandoisulus)*, the American cousin of the German *Elritze*.

Experiments with this fish at Memorial Hospital proved that it reacted as did its German cousin. So far as known, it is the only American fish which does so react, and thus far it has not reacted to any agent except intermedin. It has been found in several small southern streams.

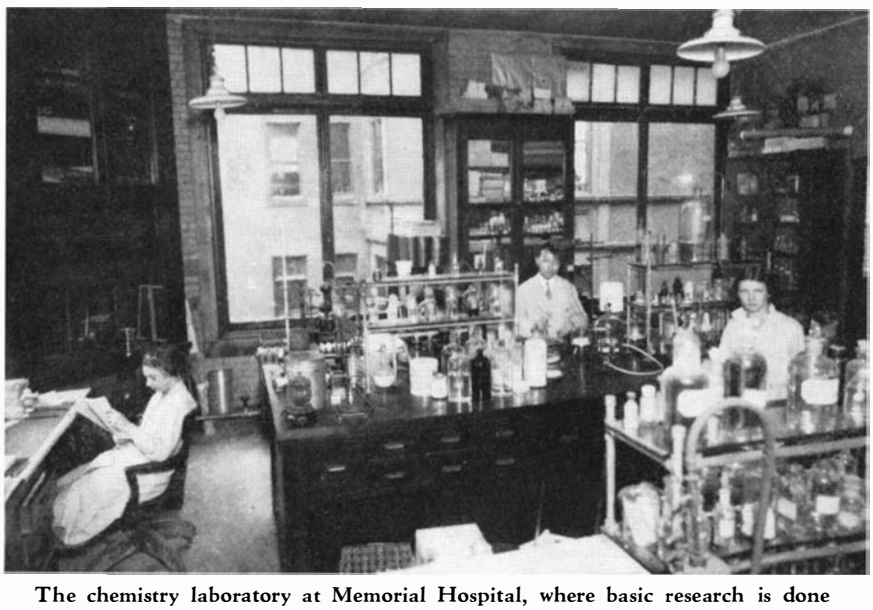
If any fisherman or fish dealer wishes to find a market for fish, and to do a service to humanity, all he has to do is to supply science with these rosy-sided dace or some other American fish which will react only to intermedin. This fish, unknown and hitherto quite unimportant to the fish world, has flopped out of the little pond of obscurity into one of the biggest scientific ponds in the world—cancer research.

There is a lot more yet for the doctors and the rosy-sided dace to demonstrate about cancer. That intermedin actually figures in the origin and growth of pigmented cancer remains to be shown, but experiments already conducted show that intermedin increases the growth of a pigmented cancer in a mouse about 50 percent. Certain small fish themselves suffer from a fatal form of pigmented disease known as melanosis. Dr. Myron Gordon of Cornell University has been studying this disease for some years and has demonstrated many of its peculiar features, including quite pronounced Mendelian hereditary characteristics.

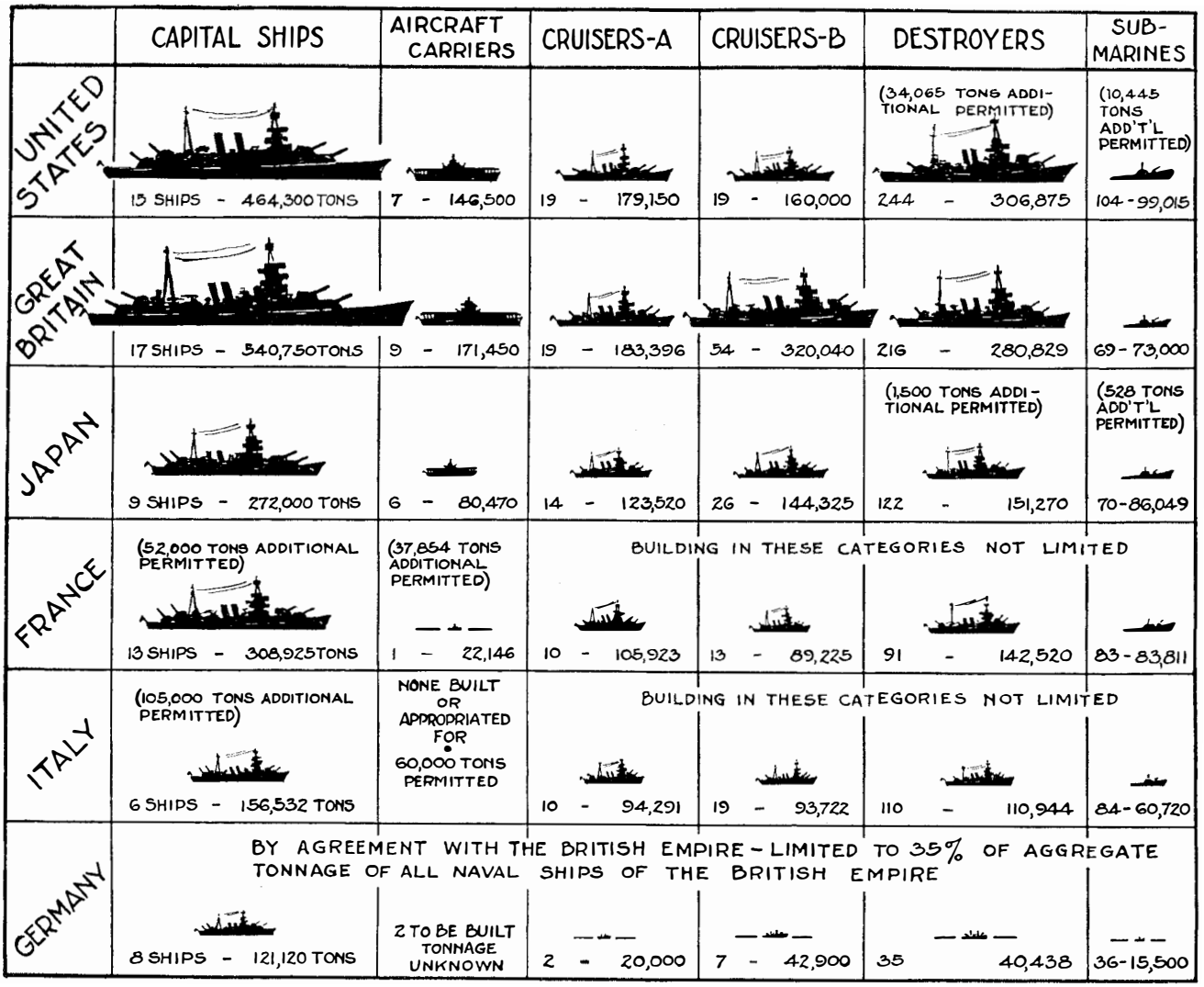
IT IS not unreasonable to expect additional revelations regarding pigmentation and diseases involving it, and that fish may be employed in numerous other relations to increase the present knowledge of cancer.

The pleasant task of telling in a somewhat popular vein the story of a very worthwhile achievement has fallen to a layman, but without that tireless perseverance of medical and research workers, carried on with the spirit which is so characteristic of those engaged in the cancer field, this story could not have been told. For such contribution as Memorial Hospital has made there is a just feeling of pride.

The work described in this article is only one of many research projects which are being carried on at the hospital. Thirty-five workers in pathology, chemistry, biology and physics laboratories are engaged continually in study of the causes and treatment of cancer. Such research is an important function of a modern cancer institution.



The chemistry laboratory at Memorial Hospital, where basic research is done



STATUS OF WORLD NAVIES

Recapitulation of Treaty Navies as Washington Naval Limitation Treaty Expires December 31, 1936

GERMANY is the newcomer in this review of ships and tonnages of world naval powers. Since the Versailles Treaty limited her navy so rigidly, she was not even considered in the Washington Treaty of 1921, nor in the London Treaty of 1930, which imposed limitations on naval construction among the other five nations shown above. By reason of her abrogation of parts of the Versailles Treaty and her subsequent agreement with the British Empire, as noted on the drawing, her naval status once more is of concern.

As the Washington Treaty expires, some feel that the future of naval limitations is but a forlorn hope, though others—for example, Admiral Standley of our navy—are more optimistic. Yet naval limitations has a history of several failures. In 1921, capital ships and aircraft carriers were limited by the United States, Great Britain, Japan, France, and Italy. The Geneva Conference of 1927, attempting to impose limitations on smaller ships, was a complete failure; while the London Conference of 1930 limited cruisers, destroyers, and submarines for the United States, Great Britain, and Japan. The United States "leaned over backward" in observing these treaties, but our disarmament by example did not work.

In December, 1934, Japan announced her intention to terminate the Washington agreement at its expiration December, 1936.

Japan demands parity with Great Britain, Germany becomes a factor in naval questions, France builds ships to offset Germany's rising strength, Italy feels that she has a greater responsibility in the Mediterranean and has started an active naval building program. The United States has indicated her intention to build if others do.

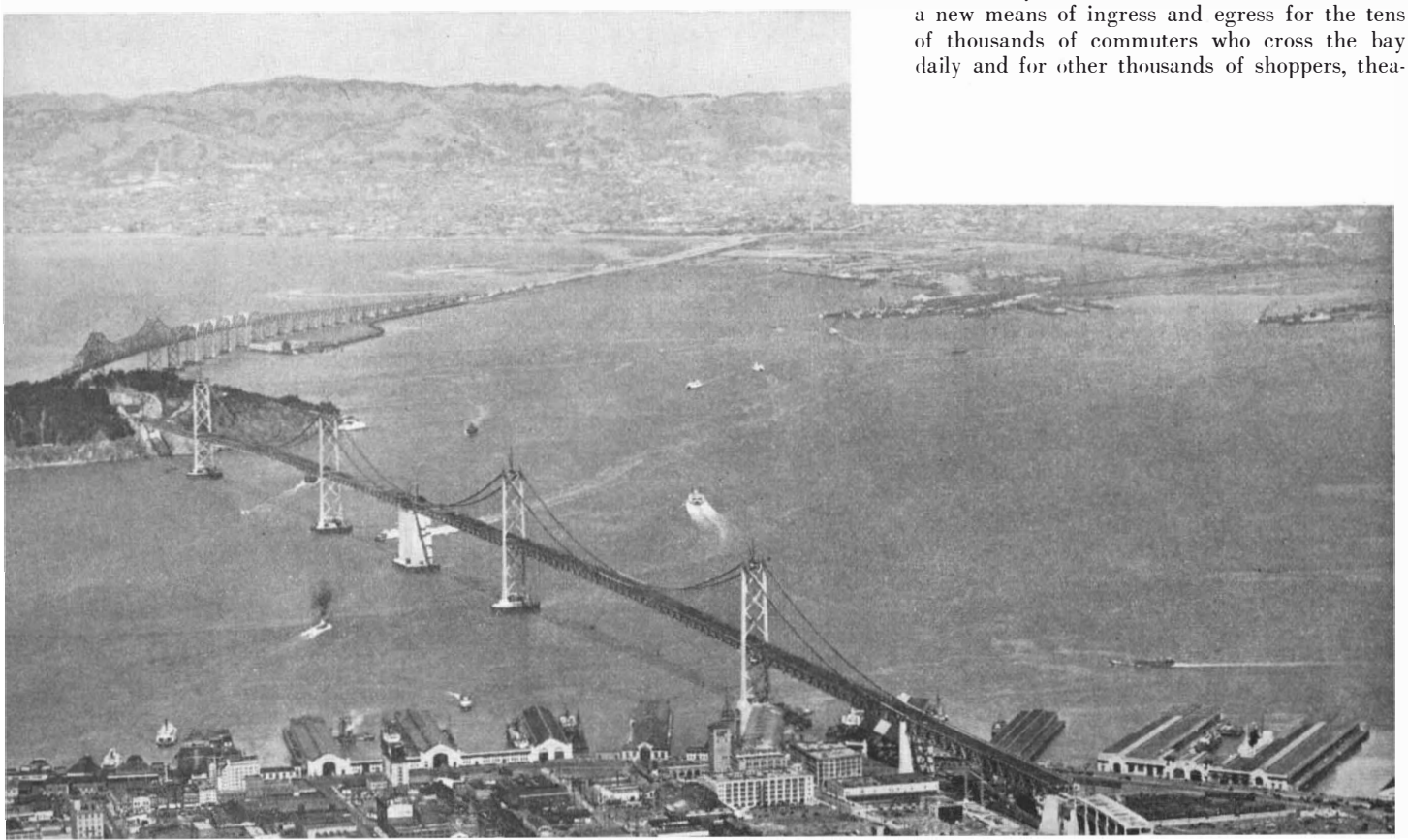
Both Japan and Great Britain are discussing construction of battleships, though in all fairness, it must be noted that the figures indicated in the column above for Great Britain include tonnages for capital ships, cruisers (B), destroyers, and submarines that were not laid down before expiration of the Treaty. Great Britain will also dispose of four of her 19 cruisers (A), three to be converted into cruisers (B). It should be noted further that there is included above obsolete tonnage (as of December 1935) in the following approximate amounts: United States, 320,000; British Empire, 327,000; Japan, 200,000; France, 200,000; Italy, 137,000; and Germany, 34,000.

—F. D. McHugh.

The two views, above and below, of the San Francisco-Oakland Bay Bridge were both taken from the San Francisco end, but from different angles. They show the structure nearing completion just prior to the opening. In the photograph below may be seen, at the lower right, the main approach and the "on" and "off" ramps

World's Longest Bridge Now Open

MOTORISTS now may drive from Atlantic City, New Jersey, directly into San Francisco, California, without leaving the Lincoln Highway (U.S. 40). This is possible with completion of the 9.1-mile San Francisco-Oakland Bay Bridge, dedicated November 12 when a horse was ridden across the structure from Oakland to San Francisco in violation of state laws. To appreciate the immensity of the project, which was commenced in May, 1933, one must understand that the bridge unites San Francisco County on the west with Alameda County on the east, thus providing speedier transportation across San Francisco Bay for 1,221,000 persons of these political groups, and uniting also the residents of nearby San Mateo (on the west), Marin, and Contra Costa Counties (north and east). On the east side of the bay the cities of Oakland, Berkeley (home of the University of California), Albany, Emeryville, and Piedmont are directly affected by the project. Thus San Francisco, second largest United States seaport in imports and exports, seventh United States industrial city, financial center of the west, obtains a new means of ingress and egress for the tens of thousands of commuters who cross the bay daily and for other thousands of shoppers, thea-

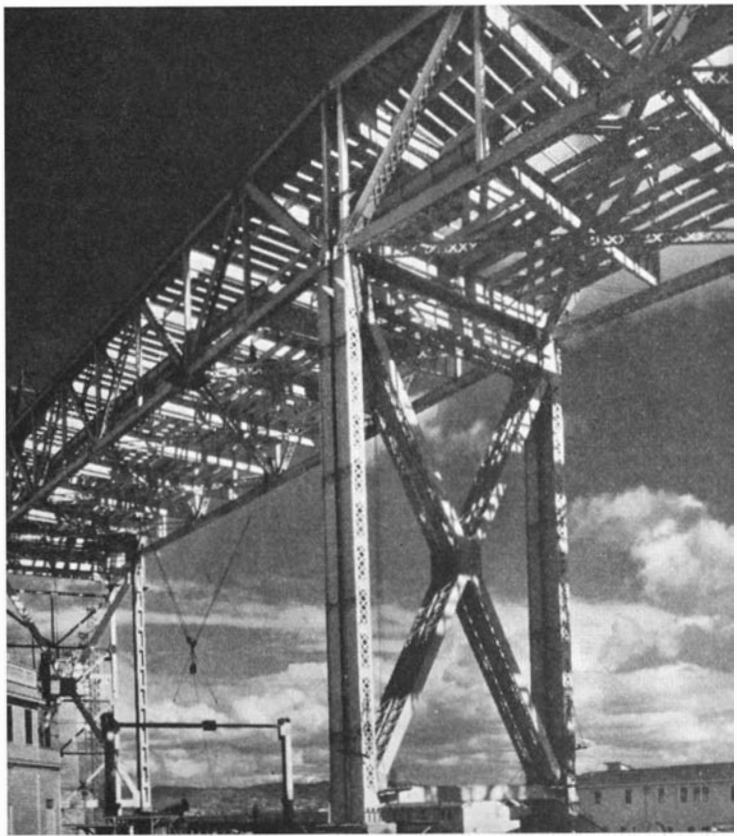


Only Four Years Building . . . Unites Five Counties . . . Completes Highway from Atlantic City to San Francisco

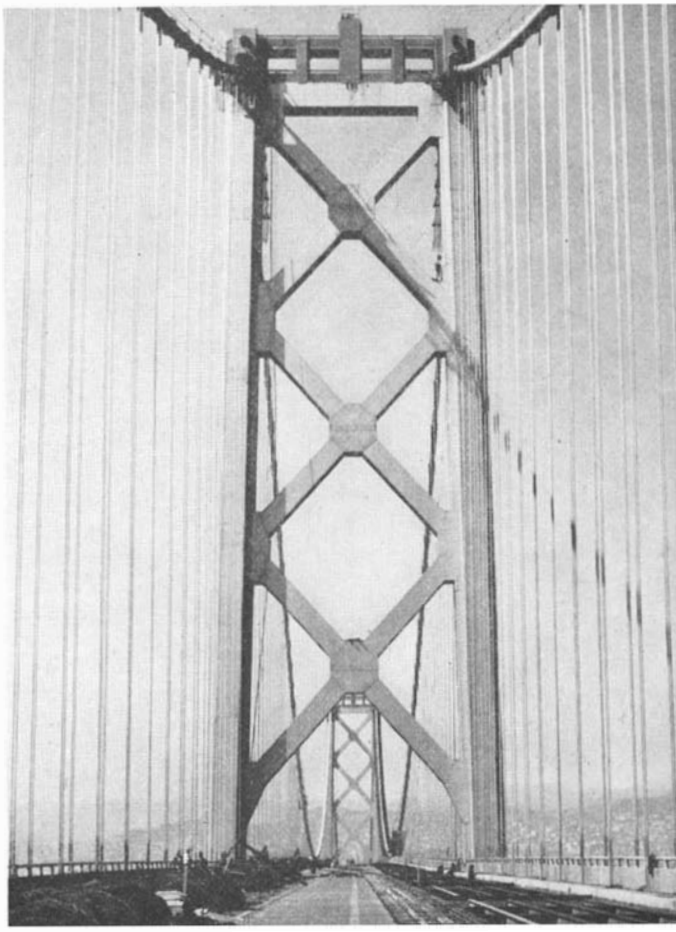
ter-goers, and tourists. The bridge, which is owned by the state and operated by the Department of Public Works, cost 77,200,000 dollars, which will be paid for from automobile, truck, interurban electric train, and passenger tolls. Facilities for steam trains have not been provided. The bridge extends from Fifth Street, in down-town San Francisco, to a traffic distributing structure 6.9 miles distant on the Oakland shore, where three approaches are provided, the entrance from the most remote being 9.1 miles from San Francisco. The west section, stretching from San Francisco to Yerba Buena Island in mid-bay consists of twin suspension spans, with a center live load anchorage pier, totaling 10,450 feet in length. The Yerba Buena "span" is 2950 feet long, of which 540 feet goes through solid rock. The East Bay section consists of one 1400-foot central span cantilever, two 511-foot anchor arms, five 509-foot fixed spans and fourteen 291-foot fixed spans to fill. The bridge carries two levels, the upper for fast autos, the lower for trucks and interurban railway. Across the main channel, on both sides of the central anchorage, the spans stand 214 feet above high water. Whereas vehicular traffic already is using the bridge, electric railway crossings will not commence until January, 1938.

Motorists entering and leaving the Oakland end of the bridge will use this distribution structure on which there will be no right-angle crossings or left turns

One of the breaks in the bridge structure, designed to allow for expansion and contraction due to temperature changes, is shown in the photograph below. The spans may move as much as nine inches. Note that even the cross braces are separate units



Below: **One of the completed towers of the suspension spans with all cables in place. An aerial beacon will top the structure**



Oil Emulsions

A Research Step Toward a Comprehension of Living Protoplasm . . . Chemicals Imitate Simplest Forms of Life . . . How To Demonstrate

By Dr. P. A. YOUNG
Formerly Research Botanist, Montana Agricultural Experiment Station

PROTOPLASM, the carrier of life, is the only living emulsion. However, certain inanimate emulsions act alive. Thus, besides the extremely complex emulsion of protoplasm, we are much interested in the simpler emulsions that we use in foods and industries. For example, milk, butter, and mayonnaise dressing are emulsions commonly used for foods, while orchardists use petroleum oil emulsions as sprays to kill insects.

Interest in emulsions is stimulated not only by their vital and industrial importance but also because some artificially made emulsions and colloidal systems show movement, enlargement, and shapes so amazing that they appear to be alive. I made such a life-like, artificial emulsion by mixing water, petroleum oil, and the automatic emulsifier called "cresoap." This cresoap is a mixture of soft soap and cresol.

It is easy to watch emulsions make themselves and act alive; the experiment may be conducted as follows: 10% of cresoap is dissolved in automobile cylinder oil. Then a drop of this miscible oil is placed on a microscope slide, and beside the drop of oil is placed a drop of water (Figure 1). For high magnifications, place a cover-glass, supported by fragments of glass (V, Figure 2), over a drop of oil and then let water run under this glass to touch the oil.

To see the phenomena of emulsification, place the glass slide on a microscope, and dim the light. Then stick a needle into the drop of water and push one edge of it until it touches the drop of oil. Fast, extremely interesting action follows while the oil and water emulsify in each other before your eyes.

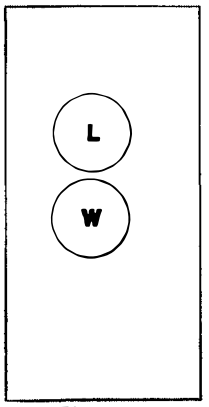


Figure 1

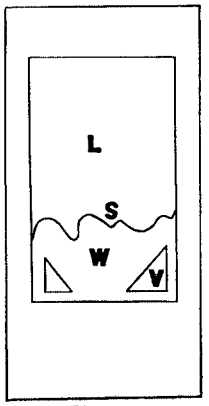


Figure 2

A thick black wall (the main interface, Figure 3, S) appears instantly when the oil touches the water. Then the oil suddenly squirts through holes in this wall and within three seconds it disperses millions of globules of oil in the water, as an atomizer sprays droplets of water into the air. This makes an oil-in-water emulsion, because an emulsion consists of globules of one kind of liquid suspended in another kind of liquid in which these globules do not dissolve.

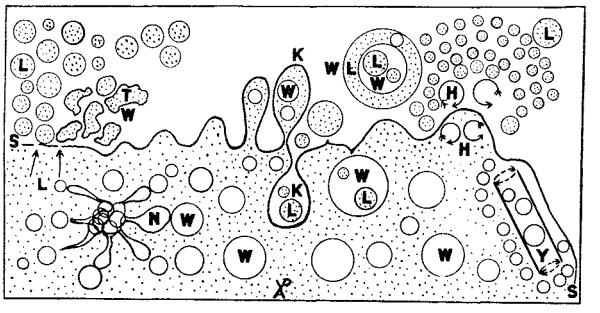


Figure 3: **Drawing of phenomena of emulsification, magnified 250 times. The formations and actions indicated by letters on the drawing are fully described in the accompanying text**

However, some of these streams of oil do not instantly form fogs of oil in the water (Figures 4, 5). Instead, the streams of oil become large masses that move like the tiny animals of naked living protoplasm called amoeba (Figure 3, T).

DURING the first few seconds, the oil and water violently mix themselves and isolate a large mass of water in the oil. Then the mass of water thrusts out long necks (Figure 3, N) and soon globules of water are cut off into the oil, much as a living fungus called a mildew grows a thread that cuts off little reproductive cells called spores. But the mildew slowly forms its spores or seeds by vital processes, while, in contrast, the mass of water passively responds to surface tension by which suspended liquids become spheres. It is not alive.

The interface (Figure 3, S) between the drops of water and oil then begins serpentine undulations and even makes big bulges that become knobs (Figure 3, K). Many of these bulges become constricted at their bases and cut off large globules of oil in the water, and spheres of water in the oil. Besides the simple globules of oil and water, the bulging interface forms very many complex globules. Knobs containing emulsions are cut off and thus make complicated globules in the oil and water (Figure 3, L, W).

In water, the most complex oil globule contains a large sphere of water, and inside this sphere are little oil globules that dance rapidly as though alive. Thus, they resemble bacteria that similarly dance in water. However, the living bacteria that swim are recognized when they move in straight lines. In contrast, dead bacteria and similar microscopic particles only dance in one place and do not go anywhere. But if they are not alive, how can they dance? The tiny oil globules and dead bacteria dance because they are moved when water molecules bombard them. This is called the Brownian movement, and is imitated and exemplified by the hula dance of the grass skirts.

Suddenly, when making the experiment, two whirlpools will start to swirl in opposite directions beside the interface, and as they swirl, layer after layer of oil globules appear in the water across the wall (Figures 3, H; 4, 5). Also, cylindrical currents roll in the oil beside the interface (Figure 3, Y; 4). These cylindrical and horizontal currents evidently cause emulsification.

When I dissolved a red stain in the oil and a blue stain in the water in trying to make the emulsion easier to understand, the opposite result happened. The blue emulsion was so complex that it took three years to understand it. The blue stain reacted with the cresoap and

THAT ACT ALIVE

produced a separate emulsion of blue globules in both oil and water (Figures 5, 6) besides everything shown in Figure 3. Most of the blue spheres were inside oil globules. A peculiar change occurred when these oil globules adhered to glass. The oil globules became egg-shaped while the inclosed blue spheres became marginal masses and zebra-like stripes (Figure 7).

It is very interesting to comprehend the size of particles suspended in water, such as the silt in a river or the cream in milk. Emulsified oil globules are some of the smallest of visible objects. In my petroleum-oil emulsions, the largest oil globules are 1/1000 of an inch in diameter, while the smallest ones visible are 1/250,000 of an inch in diameter. It is difficult to imagine such small things, but let us try to visualize the size of the smallest oil globules. If we arranged 15,000 of them in a row, they would extend all of the way across a pin head. And if we arranged only a million of these oil globules on a square, we could hardly see the grease spot.

THE function of science is to describe natural phenomena, but discoveries are more interesting and useful when we try to explain how the phenomena happen. Soap is the key to the mystery of emulsions. When water touches the miscible oil, the cresoap rapidly makes a broad black wall (the main interface) between the oil and water. As the cresoap then dissolves in the water and the surface tensions change, the main interface wriggles and the horizontal and vertical currents rotate in emulsifying the oil and water in each other.

The dissolved soap has the remarkable power of accumulating as a tough sphere (interface) around each globule of oil. When oil globules are so protected,

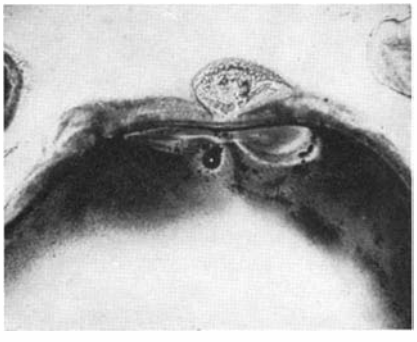


Figure 4: **Showing emulsification of oil in water (below black wall) and water in oil (above the black wall). Magnified approximately 20 times**

they bump together and bounce away from each other like rubber balls, for the spheres of soap act like rubber membranes. Also, each oil globule bears a negative electric charge by which it repels the other globules. Thus, their static keeps them apart.

Emulsions that were forming exhibited flowing and revolving movements resembling those that I have often seen in living protoplasm, as when protoplasm flowed into organs of the alga, Vaucheria. Other research workers also have exhibited remarkably life-like structures, movements, and enlargements of inanimate chemicals. These phenomena are

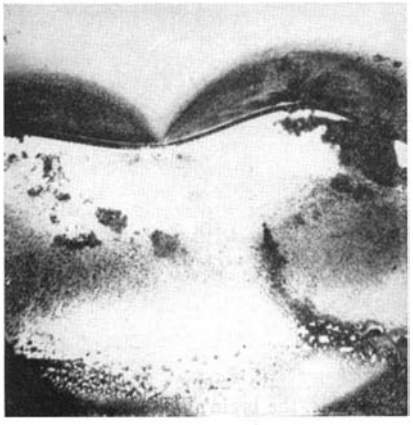


Figure 5: **Two horizontal swirls with water spheres in oil above the black line and oil globules in water below. Magnified about 20 times**

interesting, but let us clearly recognize the fact that these man-made materials are not alive, and can exhibit only passive responses to the laws of physics and chemistry. As a living creature, man transmits the life he inherits, but man has never created life.

Far transcending man's imitations, protoplasm really performs the following characteristic living functions: It responds to stimuli but often responds differently to the same stimulus. It moves voluntarily and produces living appendages with which it swims, runs, or flies. It digests foods, grows from the inside, and builds living tissues from synthetic chemicals including the infinitely complex proteins that characterize the species. Protoplasm and the green chlorophyll of plants use light energy in making sugar from carbon dioxide and water, thus supplying all of the food in the world. And most marvelous of all, protoplasm precisely reproduces its species.

Although non-living chemicals do not

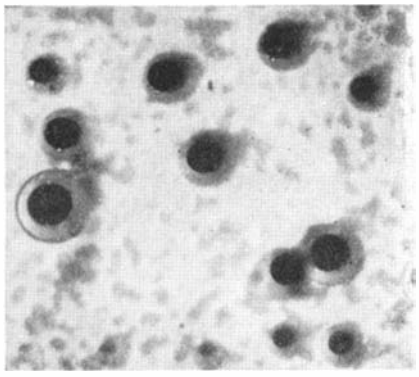


Figure 6: **Blue globules inside oil globules emulsified in water. 300x**

really perform the fundamental functions of life, we learn much about life by studying inanimate materials. Like them, living creatures also passively react to environment, as in being moved by a machine or water.

Clearly, inanimate chemicals can imitate only the simplest forms of life. A drop of compressed, salty gelatine may superficially resemble the living protoplasm of an amoeba, and chemical flowers growing by accretion in solutions of salts slightly resemble plants, but it is easier to distinguish a living man from his brazen images in statues.

Research work with forming emulsions has increased our knowledge of the emulsions used in our foods and industries. The better we understand these simple emulsions, the better we understand the bewildering complexity of protoplasmic emulsions, and comprehend how greatly living protoplasm exceeds the imitations of life.

A research worker approaches the boundary of knowledge to study the laws of Nature. He starts with dimly comprehended mysteries, and feels gratified when his years of work net discoveries that help people in understanding these mysteries. It is helpful to recognize the extreme difference between magic and science. Man does well to approach with humility the study of Nature, and especially the study of protoplasm which is the most profound of earth's mysteries.

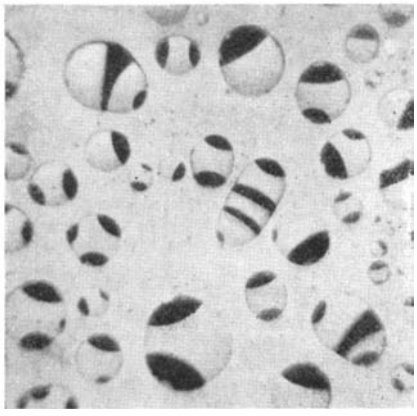


Figure 7: **Zebra-like stripes on egg-shaped oil globules adhering to glass. Magnified approximately 200 times**

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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Australia Claims Oldest Live Thing

QUEENSLAND, Australia, claims to have the oldest living thing on earth. It is a macrozamia, a tree about 20 feet in height and estimated to be more than 12,000 years old.

In the Tamborine Mountain reserve there is a whole grove of macrozamia, the youngest of them being three feet in height and 3000 years old. When Professor Chamberlain, of Chicago University, was appointed to collect data concerning macrozamias in various parts of the world, he travelled all over the globe, and the largest specimen he had seen prior to coming to Queensland was between six and seven feet in height and was found in South Africa.

He was amazed, therefore, when he found in the Tamborine Mountain reserve a grove of macrozamia which measured over 20 feet in height, and whose ages he estimated to be between 12,000 and 15,000 years. The largest macrozamia cone which Professor Chamberlain had ever seen, weighed 85 pounds as against the South African record of 35 pounds, and contained 151 seeds. These were sent to America. One seed was planted in each of America's 151 national parks. Now each of the seeds has germinated, so that a descendant of Queensland's macrozamia is now growing in each of the national parks of America.—*Australian Press Bureau.*

Not as majestic as our sequoias, but older—this Australian macrozamia is more than 12,000 years old

Telepathy's Reality

"THERE are many obvious ways in which the brain's level of performance could be raised," said Professor Julian S. Huxley, leading British biologist, recently. "If for all the main attributes of mind the average of a population could be raised to the level now attained by the best endowed ten-thousandth or even thousandth, that alone would be of far-reaching evolutionary significance. Nor is there any reason to suppose that such quantitative increase could not be pushed beyond its present limits.

"There are other faculties, the bare existence of which is as yet scarcely established. These too might be developed until they were as commonly distributed as, say, musical or mathematical gifts are today. I refer to telepathy and other extra-sensory activities of mind, which the work of Rhine, Salter, and others is now forcing into scientific recognition."

CAR AGE

ACCORDING to the American Petroleum Institute, the average motor car now in use is nearly five years old.

Cheaper Cyclopropane

CYCLOPROPANE has been widely adopted during the past few years as an anesthetic despite the fact that its cost has been in the neighborhood of 20 dollars a pound. The reason for its high cost has been the fact that the only practicable method for its preparation used as a raw

Courtesy Mrs. Hilda Curtis, Mt. Tamborine, Australia

The cone top of a macrozamia tree

material tri-methylene glycol, a minor impurity in glycerol produced by the soap industry. Not only is this raw material expensive but the process for its conversion to cyclopropane is difficult and consumes bromine which itself is not cheap.

The success of the new anesthetic in the hands of the medical and dental professions encouraged research workers at Purdue University to seek a cheaper method for its preparation. As a result of their efforts, cyclopropane is now prepared on a much larger scale than before, using propane, a gas abundant in natural gas and plentiful around petroleum refineries, as the raw material. The common propane consists of three carbon atoms in a straight chain with eight hydrogen atoms attached to them, while in cyclopropane the three carbon atoms form a ring to which six hydrogen atoms are attached. To start this game of ring-around-the-rosy one hydrogen atom at each end of the chain is replaced by a chlorine atom and subsequently the two chlorine atoms are removed under such circumstances that the two end carbon atoms join hands. This process, which is now in successful operation, consumes cheap raw materials, chlorine and propane, and provides an ample supply of cyclopropane for use as an anesthetic.

Cyclopropane is preferred to ethylene as an anesthetic and may be used in some cases where other anesthetics might cause trouble. —*D. H. K.*

Electric Bed Cover

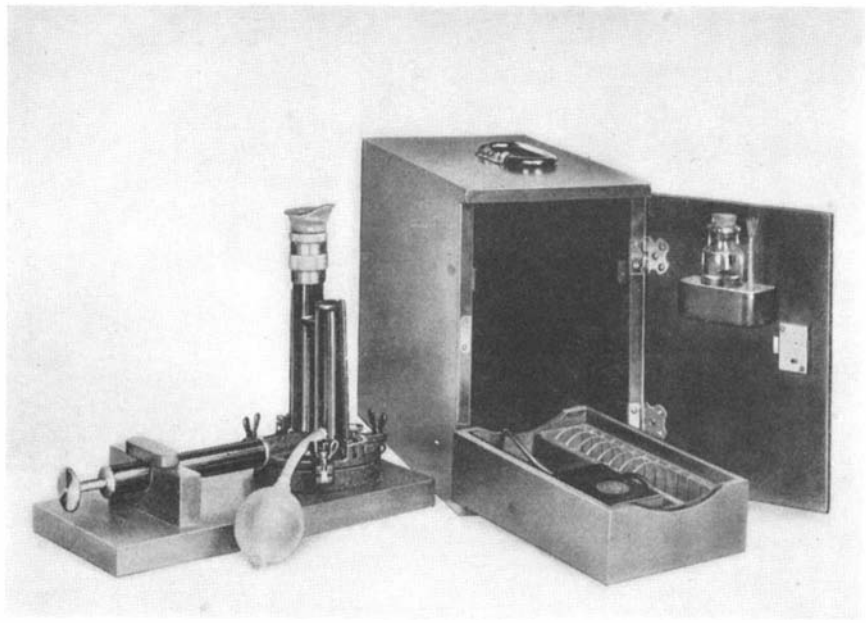
A SOLUTION for the problems of wintertime's impatient sufferers who either wear themselves out beneath a heavy load of blankets or wake shivering under too few has been found in the new electric comforter developed by W. K. Kearsley of the General Electric research laboratory. Plugged into a household circuit, the electric comforter obviates the necessity for any other form of covering, yet automatically keeps the sleeper comfortably warm regardless of any changes in the temperature of the room. Unlike ordinary heating pads, the comforter will give a gentle warmth over a large area, replacing the heat loss from the bed. It is not designed to give concentrated heat at any given point. The new aid to sleeping comfort has been developed and completely tested in actual use over a period of many months.

The electric bed cover folded; the control box is on the night table

The comforter is composed of two thicknesses of a lightweight material. Between these two outside coverings, many feet of fine, flexible, conducting wire have been sewn in a zig-zag pattern. Both ends of the wire are brought to a terminal at the end of the comforter which is used at the foot of the bed. From this terminal a cord leads to a small control box which contains an adjusting mechanism, a thermostat, and a transformer. The control box may be located on a night table near the head of the bed and its extension cord plugged into a nearby convenience outlet. On the face of the box is an on-and-off switch and a control knob which regulates the amount of heat produced by the comforter.

The electric comforter has several safety features. It cannot get too hot, nor can a person get an electrical shock from it. A transformer in the control box changes household current to 23 volts and makes the comforter a safe, low-voltage device. Inside the comforter are several small thermostats which are capable of opening the circuit and shutting off the current in case unusual temperatures result from such abnormal usage as piling up or rolling the comforter while the current is on. Once a user has set the rheostat on the control box at the desired place, the main thermostat will maintain that temperature regardless of changing weather conditions.

Sample electric comforters have been made in both single and double bed sizes. The length of material necessary for tucking in at the foot and sides of the bed is not heated. The comforter can be washed like a blanket. The electrical energy consumed depends upon the room temperature, averaging about that of a 100-watt household lamp.



The dust counter equipment complete with its carrying case. *Below:* Using the dark-field microscope viewing-and-counting system. Note the sampling pump

Dust-Control "Meter"

FOR use in determining the degree of danger of dusty operations, Bausch & Lomb have developed and are offering to industry through the Willson safety service organization, an instrument which simplifies in a remarkable manner the problem of dust control.

There is nothing to set up where a dust count is to be taken as in the case of other available equipment. The operator can enter the room, take the sample, and leave in less than 15 seconds without interfering with routine or interrupting production. Requiring no technical supervision or skill to operate, daily or hourly checks of dust conditions (sometimes a necessity for protection against unjust claims) can be made readily without fuss or bother.

This new dust counter combines in one unit the necessary air-sampling device and a dark-field microscope viewing-and-counting system. No accessory laboratory equipment is needed. Suitably cased for transporting, the complete outfit weighs but twelve and a half pounds.

Windburn Is Sunburn

WIND alone does not burn the skin. Cases of windburn, so called, are really cases of sunburn in which the wind has helped the sun along by making the skin more susceptible to the ultra-violet rays of

Photographs courtesy of *Flight*

The monoplane in which Squadron Leader Swain set a new altitude record

the sun. Wind-tunnel experiments supporting this belief are reported by Dr. W. H. Crew of New York University and Dr. C. H. Whittle of Addenbrooke's Hospital, Cambridge, England.

In one of the experiments, one of the investigators exposed his forearm to the blast of a 40-mile per hour wind in an experimental wind-tunnel. The forearm was covered by automobile tire inner tubing except for a small area about one inch square where the rubber was cut away, leaving the bare skin exposed to the blast. No ultra-violet light was present.

"During the half-hour exposure to the blast the skin exhibited 'goose flesh,'" the report states, "but at no subsequent time was there the slightest evidence of reddening or chapping of the exposed area of the skin."

Cases of wind having caused burning of the skin are due, in their opinion, to the wind's having made the skin more susceptible to the ultra-violet rays by changing the temperature and moisture of the skin and by suppressing perspiration. Perspiration, they found in other experiments, can provide some protection from the actinic rays of sunlight.—*Science Service.*

World's Altitude Record

RECORDS, whether of speed, altitude, or duration, pass from nation to nation, with the exchange bringing no ill feeling. For many years the world's altitude record was held by the United States. Then it passed to France. Now it has been gained by Great Britain, with the sole result that Americans will be all the more determined to excel their previous efforts.

The latest altitude record was set by Squadron Leader F. R. D. Swain of the Royal Air Force, when he reached a height of 49,967 feet.

His machine, specially built for the flight, was a Bristol low-wing monoplane, equipped with a Pegasus engine, provided with a powerful two-stage supercharger. The propeller, four-bladed, was over-size so that it could function in thin air. To climb to great heights, the plane must have a large wing area and spread, as well as power maintained to the greatest heights. The first requirement explains why the Bristol Type 138 is the largest single-seater airplane ever built. Its wing span is 66 feet, its gross weight 5310 pounds, and its loading per square foot only 8.5 pounds with a total wing area of approximately 620 square feet.

Squadron Leader Swain in his hermetically sealed high-altitude suit

But interesting as the airplane was, with every possible device to secure lightness, insulation from cold, and so on, the more interesting part of the equipment lies in the means which made it possible for the pilot to live, in reasonable comfort, at great heights.

The pilot wore a special suit of rubberized fabric, fitted with a helmet of the same material with a large curved double window of transparent plastic material. Inside this suit the pilot was isolated from all external conditions. He breathed oxygen in a closed circuit, fed at the required rate. The gas entered the helmet at the right side of the face. The outlet was on the left, and from this came the gas containing the exhaled breath. The gas then flowed to a canister filled with chemicals which absorbed the carbon dioxide and moisture of the man's breath, and left the oxygen sufficiently pure to be recirculated.

Besides being supplied with oxygen, the pilot had to have his helmet and suit supercharged. The pressure suit maintained the pilot's body at two pounds to the square inch above the pressure of the external atmosphere. This gave the flier the equivalent of flying with oxygen at about 43,000 feet altitude, the maximum practical height without supercharging.

But in spite of the electrically heated clothing, the oxygen supply, and the "supercharged" suit, Squadron Leader Swain had a terrible experience. He spent three hours and twenty minutes on his journey to a level nearly twice as high as the peak of Mount Everest. For about two hours he flew near the 50,000 feet level. The duration of his journey under these highly artificial conditions explains fully the loss of strength which he experienced and his terrifying adventures. The cockpit cabin windows and the window of tough transparent plastic material in his helmet glazed over and he could see nothing, not even the instruments on the panel in front of him. This worried him a good deal. He could not read his compass, did not know the direction in which he was traveling, and therefore flew erratically. On the descent he felt suffocated and had the impression that he was running short of oxygen. He thought of opening the cockpit cover and pressed the lever which should have opened the cover. Unfortunately this did not work. Finally he got hold of a knife and cut open the window of the helmet at 14,000. With the rush of fresh air he felt better immediately.

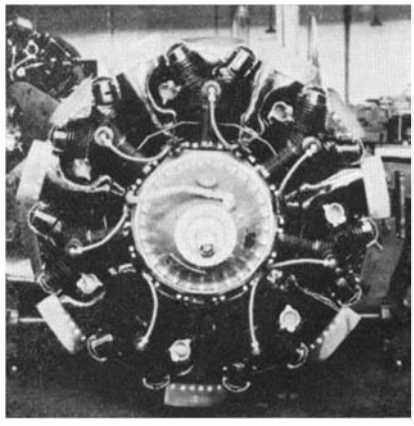
The Air Ministry is of the opinion that even this record can be improved and announces: "It is hoped that after further experience with this new aircraft and its novel equipment, still greater heights may yet be reached."

Of course, such records serve not only to thrill the world but to provide scientific information for stratosphere flying in the future.—*A. K.*

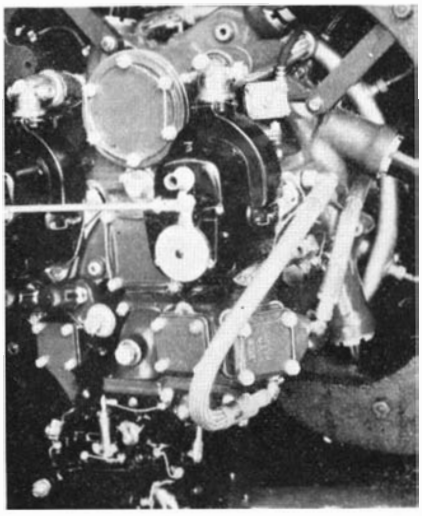
Complexity of the Modern Aircraft Engine

THE most astounding feature of the modern aircraft engine, besides its reliability and lightness for a given power, is the complexity of its functions. And every six months or so the engineers add another.

Thus, among many other things, the Wright Whirlwind engine now has to operate the governor of the Hamilton Standard constant speed propeller as well as drive the fuel pump and a vacuum pump for the op-



Front view of a Whirlwind engine, showing flexible oil line at nose



Rear view of engine showing the accessories described in the text

eration of the automatic pilot or the artificial horizon.

To carry out these three functions most readily and simply, a "three-way drive" has been incorporated in the rear end of the Whirlwind engine. The new accessory drive, attached below the right magneto at the fuel-pump drive location, is a gear box using beveled gears with three outlets. The right hand outlet of the three-way drive takes the Hamilton Standard governor pump and regulator; the left hand outlet a vacuum pump; and the lower outlet the fuel pump. The photograph shows the complexity of the rear end, with magnetos, drives, oil lines, and what not, all crammed into the smallest possible space.

The front view photograph shows the very latest embodiment of the Wright Whirlwinds. They seem to change and advance continuously. Our readers will perhaps note the flexible oil line which runs from the constant speed propeller governor to the nose section. Oil lines, unless very short, are invariably flexible in aircraft practice—as they should be in view of the tremendous power and inevitable vibration.—*A. K.*

LIGHTER AIRPLANES

IN 1925, less than 10 percent of the structural weight of aircraft built in the United States was of aluminum or aluminum alloy. By contrast, this metal and its alloys now constitute over 70 percent.

Aircraft Engine Science in Review

THE design and construction of the aircraft engine require ingenuity and mechanical skill of a high order, but they also require a tremendous amount of fundamental knowledge and many laborious calculations. While scientific reports and papers on aircraft engines stream from the laboratories, there are comparatively few books on the subject. Probably this is because the active designers are too busy designing to find time to write. We welcome, therefore, an addition to the literature on this subject in Domonoske's and Finch's "Aircraft Engines."

The great increase in power of the aircraft engine is in good part due to a better understanding of detonation and the use of higher octane fuels. Hence the chapter on "Detonation and Antidetonants" is most interesting reading. At present, 100 octane fuels at reasonable prices are actually in sight. The combustion processes of the cylinder are now studied in the most thoroughgoing fashion, and the chapter entitled "Combustion Processes in Aircraft Engines" deals interestingly with such topics as flame propagation, the influence of mixture ratio, and so on.

We are constantly mentioning supercharging in these columns. A chapter devoted to "Supercharging" really gives the key to the maintenance of power, the altitude control of supercharging, and similar problems. Have our readers realized how difficult it is to cowl an engine, yet cool it properly without increasing the head resistance? Or how to design the fins so that they may give the required cooling, be closely spaced, be integral with the cylinder, yet be capable of practical manufacture? The book covers these questions admirably, is a fine text, yet it is of real interest to anyone wishing to acquire a real knowledge of the engine designer's art.—*A. K.*

Roadable Autogiro

QUITE recently Jim Ray, veteran pilot and Vice-President of the Autogiro Company of America, landed his 'giro in a small downtown park just north of the Department of Commerce building, Washington, D. C., folded back the rotors over the fuselage, engaged the tail wheel with a transmission from the engine and drove comfortably through crowded streets to the door of the Department.

The "Roadable Autogiro," as it is called, was specified by John H. Geisse, designed by Messrs. Larsen and Stanley, and built by the Autogiro Company in an effort to solve that irritating difficulty of private flying—the long distance from the landing field to the owner's home. The new craft meets this difficulty by its "roadability"—its ability to operate on the highways.

Above: **The roadable Autogiro in a city street.** ***Below:*** **Side view of the 'giro with the two vanes folded ready to be run along any highway**

As the 'giro is still undergoing final acceptance tests, very little information has been released to date. Our two photographs and the following brief description will suffice, nevertheless, to give a fair idea of its characteristics.

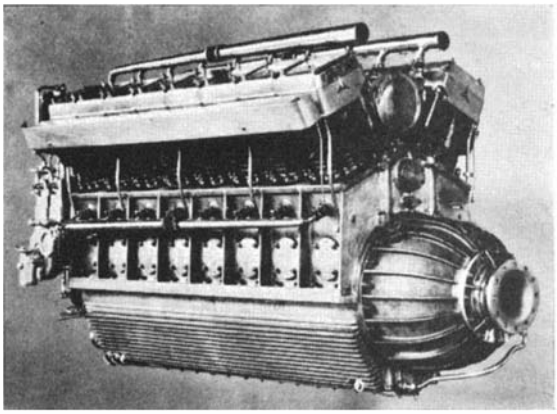
A two-bladed rotor is employed, with no fixed wings. The rotor is of the type in which control is achieved by tilting, and, although a rudder is provided, it is only to be used in emergencies. By loosening two pins, the blades may be folded back and fastened down at the tail in the space of a few minutes. The engine, which is placed in rear of the cabin, is provided with three transmissions. One long transmission shaft from the front end of the engine leads to the forward propeller. In this transmission a clutch is provided so that the propeller can be disconnected from the engine for road work. Another drive leads to the rotors and can be used for starting purposes, when the rotor blades have to be brought up to speed. A third drive from the rear of the engine leads to the tail wheel which serves for propulsion on the ground. One or two of the three transmissions can be put into simultaneous operation as required.

Pilot and passenger sit side by side in an enclosed cockpit of generous dimensions. With the engine in the rear, visibility is excellent. Since the landing speed is only 20 miles per hour, and the take-off run is only 150 feet, small fields can be used, and large airports are no longer necessary. The top speed is only 90 miles an hour, which is slow for flying, but there is no reason why this speed should not be increased in subsequent models.

It is impossible to say what service experience will show. But at any rate here is a thoroughly interesting and worthwhile experiment.—*A. K.*

The "Hindenburg's" Diesels

THE *Graf Zeppelin*, when built eight years ago, was equipped with five 450-horsepower Maybach gasoline engines. When the *Hindenburg* was designed, it was quite properly decided that Diesel engines burning heavy, non-inflammable fuel oil should be employed. The safety and fuel economy advantages of the Diesels are obvious. One of our photographs shows the



One of the 12-cylinder, V-type, water-cooled Diesel engines used in the *Hindenburg*. With a cruising output of 800 to 900 horsepower, these engines are capable of a maximum output of 1200 horsepower

Daimler-Benz 12-cylinder, V-type, water-cooled Diesel as finally developed.

Here are the specifications of this sturdy prime mover: A cruising output of between 800 and 900 horsepower; a fuel consumption of not more than .396 pounds per horsepower hour; a maximum output of 1200 horsepower for emergencies. Thus there is an enormous reserve of power.

The motor is reversible so that the propellers need no variable pitch mechanism. Because of inclinations in flight, two oil suction pumps are provided. Compressed air bottles are used for starting.—*A. K.*

"Old-Timers" in Aviation

THE "old-timers" in aviation are still relatively young men. The pioneers were young almost without exception, and flying is only a young art after all. The early American fliers were a remarkable body of men—daring, adventurous, romantic. They have had varied and curious careers. Some, like Glenn L. Martin, have achieved not only fame, but also leadership in the industry. Others have become purely "has-beens" whose sole connection with aviation is in gossip at the flying fields or at the meetings of the Early Birdmen. Others, without achieving fortune, have steadily and creditably pursued careers in this field, with solid reputation as one of their rewards.

Two fine examples of these early fliers are Richard H. Depew, Jr., and Beckwith Havens, who recently celebrated their 25th flying birthday. Both learned to fly in 1911, with Mr. Havens as the senior by a few months. Both have flown every type of plane, under all sorts of conditions. Captain Depew estimates that he has flown 119 types in all. He is known as one of the most conservative pilots, though one of the most courageous. It is his conservatism which explains the fact that he has never been injured in an accident, even though he was an Army test pilot during the war.

To "take a chance" is the American motto. These men illustrate the wisdom of a contrary attitude of mind. The two pilots are partners at Roosevelt Field, engaged in selling a well known and popular make of private airplane. It is interesting to contrast, in the photographs, the pusher Farman in which Captain Depew made his first flight to the modern Fairchild by the side of which the two men are standing. The rough wooden propeller of the Farman has given place to a finely shaped blade, metal tipped, protected with a spinner. The engine is completely cowled in with only a small opening at the front end for cooling. There is still some external bracing, but the forest of struts and wires has disappeared. The pilot and passengers sit in an automobile-like cabin instead of being exposed to the airstream. It is interesting to note the horizontal surfaces placed at the front of the Farman and the skid to guard against nosing over. The front skid will never come back, but a front wheel to serve the same purpose is being employed today and may indeed become very popular.—*A. K.*

Flying Doctor

COLONEL Lindbergh's remarks before the German Aero Club, pointing out the terrible destructiveness of modern aircraft, really hurt. Thus every man vitally concerned with aviation is apt to note with pleasure any humanitarian service that aircraft can render. From Australia comes an item of welcome news. With a total population numbering less than that of New York City, Australia embraces an entire island continent. Thousands of people may have no neighbors nearer than a hundred miles or more. Therefore, the Commonwealth of Australia, thanks to the imagination of the Rev. John Flynn, a Presbyterian minister, has established an aerial medical service. Cheap radio transmitting and receiving sets have been developed, which are portable and can be put into action as soon as the aerial is hung to a tree. Thus the flying doctor is enabled to keep in touch with a vast region. The flying doctor in Western Queensland carries complete medical equipment in his airplane, flies on an average 20,000 miles a year and attends directly to about 250 patients including the aboriginal natives. Sometimes treatment is directed by wireless; sometimes patients are rushed by plane to hospitals.—*A. K.*

STRATOSPHERE

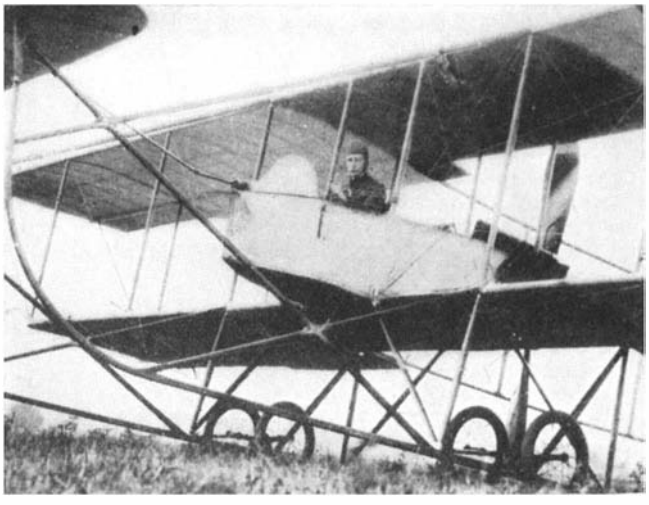
ALTITUDE records of over 100,000 feet into the stratosphere have been made by balloons carrying scientific apparatus. This is more than twice the height reached by record-breaking airplanes.

Larger Flying Boats

THE Glenn L. Martin and Sikorsky companies were the pioneers in the construction of the Pan American *Clippers*. No doubt it was a great disappointment to these companies that Pan American should have placed its order for six even larger *Clippers* with the Boeing Aircraft Company. Boeing, a newcomer to the large flying-boat field, is a splendid organization, however, and will certainly live up to its great opportunity.

The new Boeing *Clippers* are still in the design stage, with the engineers busily testing in the wind tunnel and making calculations of performance, strength, and so forth. Nevertheless, the first of these aeromarine giants will be ready by the fall of 1937.

The boats will be much larger than either the Martin or the Sikorsky ships, will have a gross weight of more than 82,000 pounds,



"Old-timers" Depew and Havens with a modern plane, and the pusher Farman flown by Captain Depew in 1911

and will carry 60 passengers with sleeper accommodations for 40. They will have the enormous wing spread of 152 feet, a length of 109 feet, and an over-all height of 28 feet. Speed will be close to 200 miles an hour.

Naturally, the very highest degree of streamlining will be employed. The monoplane construction will be of the high-wing, internally braced type. Metal will be used throughout.

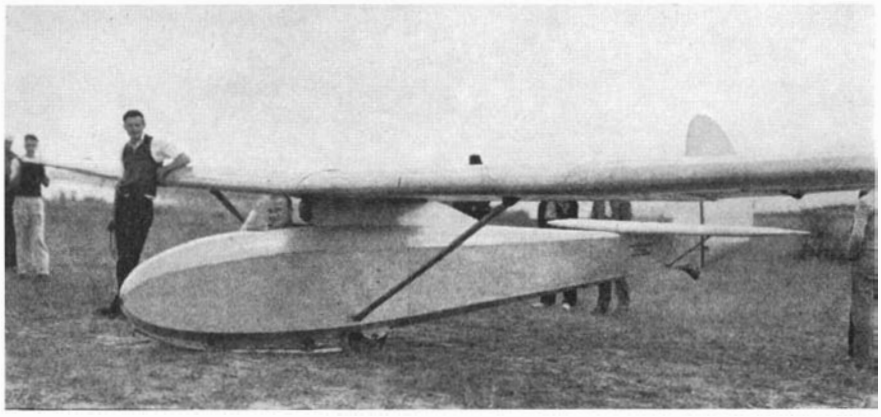
The specifications for the Boeing flying boats were written by the engineers of Pan American after service experience with the older *Clippers*, and the terms of the specifications settle, at least temporarily, the following argument: Should wing-tip floats be employed for lateral stabilization, or should sea wings, which are short stub-wings placed on the side of the flying-boat hull. Apparently stub-wings have won the day. The obvious arguments in their favor are that they are sturdier in rough water, provide more planing area, and offer less aerodynamic resistance.

As regards accommodations, the new boats will contain two full decks. The upper deck will house an elaborate control cabin, crew's quarters, and baggage compartment. The lower deck will contain luxurious day and night passenger accommodations, galley, lavatories, and dressing rooms. Passage-ways will be provided through the wings to the engine nacelles to permit servicing and inspection of engines during flight. Soundproofing, heating, ventilation, seating, lighting, and so on are now thoroughly well understood and will most certainly be provided in the most approved manner.

Our flying boats may some day rival ocean liners in size and comfort; they surpass them enormously, as our readers know, in speed.—*A. K.*

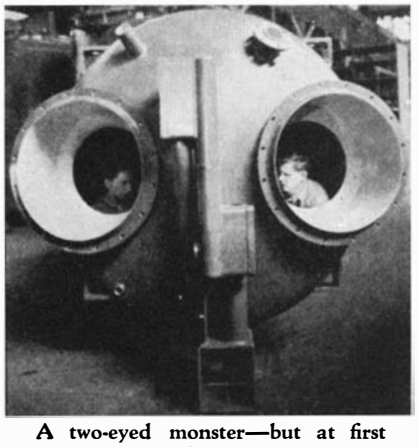
Reviving Glider Interest

THE meeting of the Soaring Society of America at Elmira was a great success and will do much to increase interest in gliding, which remains the real sport of aviation. The world's distance record of 158 miles made by Richard C. du Pont remained unbroken, although Henry Nicoll Wightmann of Upper Montclair, New Jersey, made a good flight of 135 miles this year. Mr. du Pont secured another world's record, however—a distance of 37 miles from point of departure and return. In this type of flight, for which the pilot announces his intention beforehand, the pilot on the outgoing trip rides a favorable wind and is supported by thermal currents. But the return trip is a much trickier proposition; the wind currents may now be adverse, and great skill is required.



R. C. du Pont in his imported sailplane *Göppingen I*

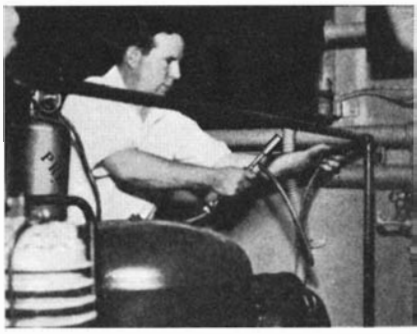
Mr. du Pont made his round trip record in a German built sailplane, the *Göppingen I*, which is illustrated in one of our photographs. Gliders do not change radically in form. The *Göppingen I* is merely the fine flower of streamline design, with very long span and high aspect ratio, minimum external bracing, and so on.—*A. K.*



A two-eyed monster—but at first glance only—for a closer examination will show that it is the tank of a large oil circuit breaker that has been laid on its side to assist the workmen who are installing the bushings and internal mechanism. This unusual photograph was taken recently in the Philadelphia works of the General Electric Company

Gas—Alert!

WE have always been warned against searching for gas leaks with a flame, yet a gas leak detector recently developed employs a flame as its agent of detection. The difference is that this detector is to be used only in searching for leaks of the non-combustible halide gases, which have, in recent years, been widely adapted to both domestic and industrial refrigeration. Since these gases are relatively odorless, tasteless, and colorless, some such device is necessary to discover leaks while cooling units are being installed and also during servicing.



Looking for gas leaks with a flame!

The Prest-O-Lite halide leak detector consists essentially of a handle with a needle valve and a burner which includes a suction nipple for attaching a rubber hose. A chimney with a copper reaction plate fits on top of the burner. The detector is furnished ready for mounting directly on a gas tank. The detector flame is adjusted so that the top of the cone is level with or slightly above the chimney. The flame when so adjusted heats the copper reaction plate and the detector is then ready for locating leaks.

The suction tube is used to explore around places where leaks might occur. The rapid flow of acetylene through the burner causes refrigerant gas near the open end of the suction tube to be drawn into the burner where it decomposes into free acids. These acids, coming into contact with the hot copper reaction plate, cause instant color change in the flame. A green tint indicates a small concentration of gas. When a large amount of gas is present, the flame assumes an intense violet color.

If the leak is sufficient to give considerable refrigerant gases to the atmosphere, the flame will burn with the characteristic green or violet color and might not show the exact source of the leak. In this case the leak can be located by the variation in intensity of the color of the flame. After the source of the leak has been passed, the flame clears almost instantly.

Utilizing By-Product Ammonia

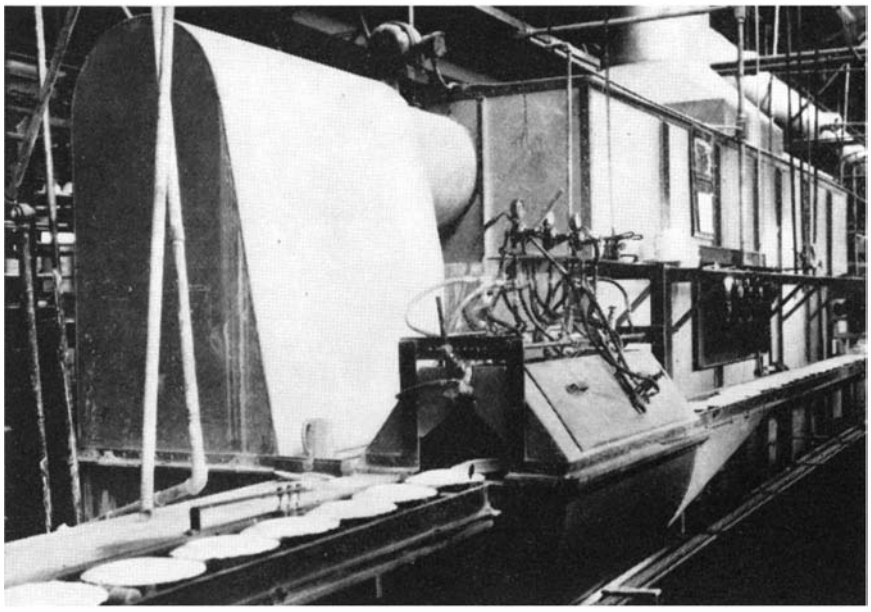
SO cheap has synthetic ammonia become as the result of development of the industry in many countries that manufactured gas plants have had difficulty in profitably disposing of the ammonia they produce as a by-product from coal distillation. In England a committee of the Institute of Gas Engineers has been studying the possibility of using this ammonia as a fertilizer in the form of ammonium bicarbonate.

Ammonium bicarbonate can be made during the process of removal of undesired carbon dioxide from the gas and at a lower cost than ammonium sulfate. Experiments are now under way to determine the value of the new product as a fertilizer ingredient. Present indications are that ammonium bicarbonate can be applied to the soil in such a way that all its ammonia content is utilized with no injury to plants.—*D. H. K.*

Too Few Flowers Planted for Perfume

MANY plant flower beds for color and decorative masses, kitchen gardens for utility, herb gardens for savor, but only a few plant for perfume in the garden or in cut flowers.

Women of Martha Washington's time knew how to save the delicate scent of rose petals by putting them in jars with salt, or they made a potpourri of different flowers. They gathered damask, roses, and lavender and dried them to make linen



Old settling chamber (background) and new precipitator in a china plant

closets sweet, or used violet water. They liked the scent of lilies-of-the-valley and lilacs.

It is possible to plant shrubs and vines and flowering annuals and perennials to add to the fragrance of the garden—roses, English violets, carnations, and little clove pinks, and some of the fragrant peonies for indoor vases, say floriculturists in the United States Department of Agriculture. There are so many fragrant annuals and perennials for the home garden that a choice depends on preference and climate.

The perfume garden is so planned that one group of plantings is succeeded by another, each with its own appeal, such as sweet alyssum, mignonette, pinks, perennial phlox, sweet heliotrope, stock, and some of the nicotianas. Nasturtiums have a spicy fragrance. The leaves of rose geranium are both fragrant and spicy and may scent a fingerbowl or flavor a mild jelly.

The United States Department of Agriculture has a number of free bulletins with many references to flowering plants with delightful perfume.

FARMING

FARMING was founded on death, in the opinion of Dr. Walter S. Landis, vice-president of the American Cyanamid Company. Flowers and fruits, placed on ancient graves, dropped their seeds on "cultivated" ground, thus showing primitive people that cultivation would provide more luxuriant growth of plants.

"Pay Dirt" in a China Plant

RECAPTURING four tons of china glaze a week (valued at six cents to two dollars a pound, depending upon type), ten electrostatic dust precipitators newly developed by Westinghouse and installed by Pangborn Corporation on five automatic glazing machines in the Homer Laughlin China Company, will soon pay for themselves out of savings. In addition, floor space and cleaning time are but one tenth formerly required by the settling chambers, which the 98 percent efficient electrostatic units replaced.

With each automatic machine spouting five dishes a second, or 8000 dozen daily, and spraying eight gallons of liquid glaze mixture a minute, the huge settling chambers previously salvaged 1200 pounds per week of expensive ingredients from the excess spray; but cleaning was a difficult, time-consuming, and unhealthful task. The present electrostatic glaze-saver snares particles as small as one micron in size, collects an extra 400 pounds of glaze per week, makes available 300 square feet of additional floor space per machine, and the deposited material is collected by merely hosing-out the ionizing chamber with water.

In operation, the glaze collected on the precipitator plates falls back into the booth and is immediately fed into the recirculating glaze; the only cleaning necessary is to remove at the end of a day the small quantity of glaze which has collected on the plates.

New in principle and invented by Westinghouse researcher Gaylord Penney, each of these self-contained electronic precipitators first ionizes incoming particles with 15,000 volts direct current and subsequently attracts the charged particles to deposit plates by a 7500 volt direct current electrostatic field in the collector assembly. Operation cost is negligible, each unit when operating at full capacity consuming but 75 watts.

Such units promise unlimited application for industrial air cleaning and offer hitherto unattainable operating efficiency.

NEEDLES

PERHAPS "the very hairs of your head *are* numbered," but now the needles on a pine tree have also been counted. Dr. A. L. MacKinney counted 325,000 needles on one tree, or a total of 4000 square feet of leaf surface which, if spread out, would cover the floors of 25 ordinary rooms.

Good Diet Aids Anemia Prevention

A GOOD diet throughout life will aid in prevention of anemia, Dr. George R. Minot of Boston City Hospital told nutrition experts at the meeting of the American Dietetic Association in Boston, reports *Science Service*.

Young maidens who "foolishly feed upon trash" were recognized as particular victims of this weakening malady back in the mid-17th Century, Dr. Minot pointed out, but it is only within recent years that medical science has gained a clear recognition of the importance of nutrition in warding off this disease.

Dr. Minot, who shared in the Nobel prize award for discovering a life-saving treatment of pernicious anemia, admitted that wide gaps of knowledge still remain to be filled. But it is known, he said, that anemias may arise because the body lacks or cannot make available at least three classes of dietary substances. These are iron, vitamin C, and a mysterious substance contained abundantly in liver and, to a less degree, in certain other organs. It is this last mysterious substance which, if absent, makes normal blood formation impossible and

Dishes passing through the electrostatic precipitator one at a time

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leads to so-called pernicious forms of anemia.

Important as good diet is in prevention of the anemias, other conditions play a part, Dr. Minot explained. Growth of the individual and physical functions, such as the bearing of children by women, may enhance the deficiency of iron that leads to an anemic condition.

WORK

THE Classified Telephone Directory for the Borough of Manhattan, New York City, indicates that the ways of earning a living, in New York at least, have increased from a total of 1800 in 1911 to 7300 in 1936. These new lines of endeavor are judged from the number of headings in the Directory.

Spread It or Slice It

A PROCESS for manufacturing Bel Paese type cheese, a soft, very white variety of recent European origin, has been developed by scientists of the Bureau of Dairy Industry. Bel Paese is the copyright name held by the Italian manufacturer who originated it.

Similar cheeses have been marketed in Europe under the trade names of Fleur des Alpes and Schoenland. Comparatively small amounts to the Bel Paese type have been imported to this country. It has sold here at prices ranging from 60 to 85 cents a pound.

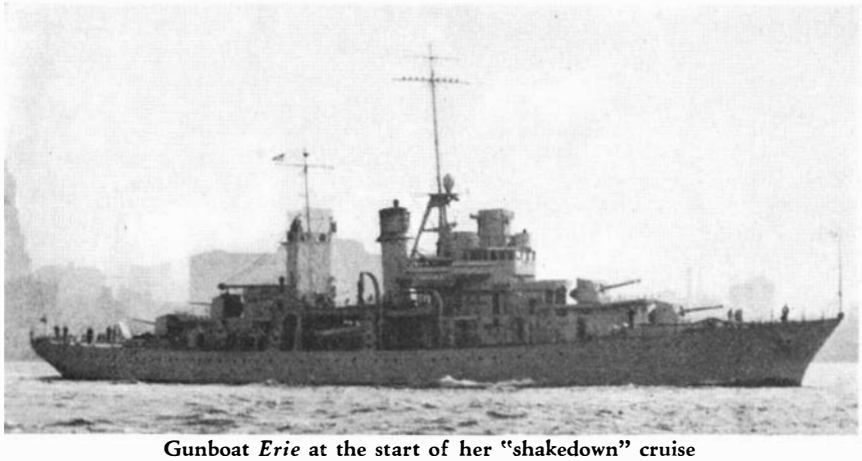
This type cheese, as made by the bureau's method and already under commercial production in Pennsylvania, has a characteristic mild, slightly salty, lactic flavor, and a soft, waxy texture which makes it desirable for both slicing and spreading. Its price is somewhat lower than that of the original.

Formidable Gunboat

A NEW type of ship was added to the United States Navy recently when the 2000-ton gunboat *Erie* sailed for her "shakedown" cruise in European waters. She had already made a number of short cruises, but this 8500-mile cruise across the Atlantic was the first extended one. After her final checking over in the Navy Yard at New York, she will go through her official trials and will then be assigned to the Special Service Squadron in Central American waters.

First of her kind, the *Erie* is a radically different type and is, in effect, a small but formidable cruiser, capable of performing important convoy, patrol, and independent service during wartime. A sister ship, the *Charleston*, is being completed at the Charleston Navy Yard.

The *Erie* mounts four six-inch guns, and carries a scouting plane. She will later mount 1.1 inch anti-aircraft guns. Manned by a total of 185 officers and men, she easily attained her designed speed of 20 knots in her trials.



Gunboat *Erie* at the start of her "shakedown" cruise

Using "Carrier Call," a telephone service on the electric light line. *Below:* Close-up of the combination transmitting and receiving unit

Plug into Light Socket and Talk

OBVIATING the necessity of special wiring circuits, a new inter-communication device was recently demonstrated before the editors in our offices. This device—the Carrier Call—operated via "wired wireless," the waves carrying voice or other signals being conducted over the electric light wires. Restricted to the electric light circuits, the operator of one instrument can talk only to the instrument tuned to his same frequency and connected to the same electric light circuit.

The Carrier Call boxes utilize several radio tubes, operating on direct or alternating current. The voice is picked up by a dynamic speaker-microphone, when the instrument is set in the "transmit" position (by means of a small lever on the front of the cabinet). When the instrument is used for reception, it gives loud-speaker volume. A flip of a switch changes either of the tuned-pair of instruments from transmitter to receiver. A signal tone for calling the other party can be sent even if the other instrument is set in the "transmit" position.

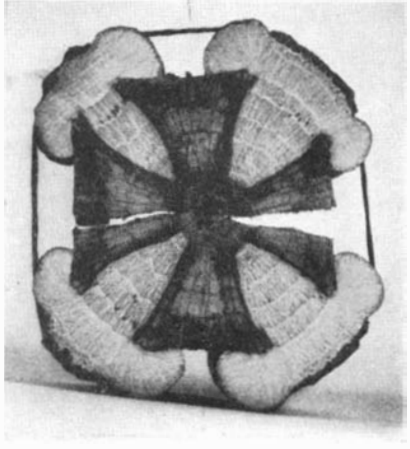
Easily portable, the instrument can be set up ready to operate in something under half a minute, making it useful in factories or plants where non-permanent two-way talk circuits are desired. The microphone is so effective that ordinary conversation registers, differing from telephones or other standard installations which require the speaker to be close to the instrument before his voice will be picked up.

The most famous use of one of the earlier Carrier Calls installed is that of a family in Westchester County, New York. Here the mother has one instrument located in the bedroom of the year-old infant in the family. The other instrument *follows* the family around the house. At dinner, it is plugged into the light circuit in the dining room. Every sound in the bedroom upstairs can be plainly heard, yet none of the sounds in the dining room are carried back to disturb the sleeping infant.

More elaborate instruments than the original Carrier Calls are now being planned for use on freight trains, operating over the rails of the railroad, or through the coupling system between the cars. With equipment of this type engineers will be in constant communication with the caboose, or with dispatchers at stations along the road.

A Mystery in Wood—The Maltese Cross

THE photograph and story of this interesting enigma in wood was sent to the magazine *American Forests* by Christian Jensen, Secretary of the Oklahoma State Park and Forestry Association, at Norman. The specimen came from near Collinsville, Oklahoma, and Dr. Paul B. Sears, Botanist of the University of Oklahoma, gives the following as the probable explanation of the phenomena.



A Maltese Cross in wood

"When the trunk was seven years old it was squared by means of an ax or adze.

This process cut into the wood on four sides, removing bark and cambium. At the corners, however, small patches of living bark and cambium were left. The wood segments whose cambium and bark were destroyed immediately died and took on the color of heartwood. This was due to the fact that the inner bark serves as a source of food for live cells in the wood, the food being passed toward the center by means of the wood rays.

"At the corners, however, the wood remained alive and white because the rays there could secure food from the inner bark. Growth was continued at the corners because the cambium was left in place. This growth produced an annual layer at each corner which partially healed over the dead wood forming the Maltese Cross. At that stage the trunk was cut. Had the tree been allowed to stand, it is likely that the healing would have been complete."

Inventor Lauds Patent System

HEADED by Dr. Charles F. Kettering, a group of noted scientists, chemists, physicists, and inventors recently assembled in Washington to celebrate the Centennial of the American patent system. In this connection Dr. Leo Hendrik Baekeland, famous inventor of Velox photographic paper and Bakelite resinoid, lauded the American system of granting patents as being responsible to a large degree for inspiring and encouraging initiative and growth of American industry. He stated:

"The United States was the first country to have a real patent system for the protection of new inventions. Britain's earlier patents were merely granted as a special privilege or favor to certain industries, regardless of whether these industries were new or old. Few people realize how intensely our American patent system has contributed to the industrial and scientific development of our country. Our industries have become leaders in many branches of technology, although most of them started from very humble beginnings. They could scarcely have survived the crucial pioneer stage of early attempts if our patent system had not furnished them a period of protection against powerful or unscrupulous interests, ready to rob inventors of their brain work and initiative. Under this system individual initiative has been stimulated and encouraged, resulting in the industrial leadership which this country enjoys today."

Modern Transportation Brings New Injuries

NEW types of injury have been created by new means of transportation, and rare types have become common, according to Dr. John J. Moorhead of New York City, reports *Science Service*.

Nearly two thirds of the injuries are due to vehicles, Dr. Moorhead said, while only one fifth occur in industry. Because of increased use of the automobile and airplane in transportation, he went on, the doctor in the most remote hamlet may be called upon at any time to treat grave injuries of some leading citizen of our country.

"The initial care given to the injured may determine the entire outcome," he pointed out. "Immediate treatment usually means easy treatment and early recovery." In addi-

tion to early treatment, he advised that shock and hemorrhage should be immediately treated and pain promptly relieved. Anesthesia should be used more generally than it now is, he said.

Treating injuries, according to Dr. Moorhead, "is in the gadget stage of development, but complicated and fancy apparatus is more of a burden than a benefit. Safety first is the slogan in traumatic surgery; next is speed and next simplicity."

ALUMINUM

WE think of America as being aluminum-conscious, but Germany now leads the world in the production of this light metal. Her 1935 production of 70,500 tons was greater than the combined production of the United States and France.

METHANE AS MOTOR FUEL

METHANE, the principal constituent of natural gas, is being collected, compressed to 3000 pounds per square inch, and sold to motorists in Italy in cylinders for use as a fuel. The amount so used is equivalent to a little more than 700 gallons of gasoline per day but even this is considered important in reducing Italy's necessary imports of motor fuel.—*D. H. K.*

"TEST TUBE" BABIES—A MEDICO-LEGAL DISCUSSION

IS a "test-tube baby" legitimate or illegitimate?

The practice of artificial breeding of human infants is so new that a question of the legitimacy of the child has not yet been brought to trial.

Two New York physicians who have been working in this field—Drs. Frances I. Seymour and Alfred Koerner—have foreseen some of the legal difficulties that may arise.

1. The child's rights as a legal heir may some time be attacked.

2. The husband, some years later, may tire of his wife and try to divorce her on the grounds of adultery, giving proof of his own sterility throughout the marriage.

3. The donor of the paternal fluid may be threatened with blackmail.

4. The doctor involved may be sued as having brought about the artificial paternity without due authorization.

The two doctors have worked out schemes to prevent such happenings and they present them to the medical profession in the *Journal of the American Medical Association.*

In the first place, these physicians have prepared in legal form a "Consent for Artificial Insemination." This must be signed by both husband and wife, their fingerprints being affixed to the margin.

These consent blanks are signed in duplicate, notarized and witnessed. They are then separated and placed in vaults of separate banks and forgotten unless some legal complication should arise.

The consents legitimatize the child under the present laws of New York state and establish it as the legal heir of the family unit.

When the couple comes to sign the con-

sent blanks the man is given a physical examination to determine his sterility—which, of course, has already been established by some physician—and the fingerprint record identifies him as the husband and not as some third person presented by the woman as her husband, in case she had it in mind to deceive her real husband.

This procedure also "acts as a mental binder on the husband in that he knows that he can never deny having authorized the creation of his wife's child," the doctors state.

To protect the donor, or artificial parent, the doctor insists that he deliver his specimen for the test tube to a different address than that to which the woman comes and at a different time.

The simplest method Drs. Seymour and Koerner have employed is to hospitalize both donor and woman during the period in question. In this way the donor has no possible way of knowing who the recipients are and no one can learn his identity by spying.

Notarized permission from the donor's wife stating that her husband may take part in this scientific venture is also suggested. Otherwise the procedure may possibly be construed as a violation of the state laws against adultery.

The surgeon who does the artificial insemination should not later be the obstetrician who presides at the baby's birth, Drs. Seymour and Koerner warn.

The expectant mother should choose an obstetrician who is unfamiliar with the unusual circumstances of the pregnancy. He can then in all good faith make out the baby's birth certificate under the direction of the parents and give the child a document irreproachable in the eyes of the law. This may be a subterfuge, the medical authors say, but it is a necessary one. Never, they warn, must the child be allowed to discover any irregularity in his creation, for this would cause an inferiority complex.

Never under any circumstances should a relative be used as the donor, they further urge. If the husband says he would like his brother to act as donor so that the child might resemble him, this should not be considered. If the mother was informed or later found out who the actual father of her child was, she might transfer her affections to the brother. If the brother's wife was informed or later discovered the truth, she might make trouble. The brother might grow fond of the child and sue for its custody, and a jury might be inclined to favor him.

In selecting a donor, says Drs. Seymour and Koerner, it is a good idea to choose one whose blood group corresponds with that of the husband, as the courts sometimes decide questions of paternity by this means.

A father could of course avoid all legal complications in regard to inheritance of real property by instituting formal legal adoption proceedings, the physicians state. However, this is the last thing he wants to do, as he wishes to conceal the fact of the cross-insemination of his wife.

In the midst of their medico-legal discussions, Drs. Seymour and Koerner pause to state how the test-tube type of paternity may easily strengthen the bonds between legal husband and wife. The mother after bitter years of disappointment over her childlessness admires the broadmindedness of her husband in permitting artificial in-

(*Please turn to page* 53)

THE AMATEUR TELESCOPE MAKER

Conducted by ALBERT G. INGALLS

NO crutch is required by the one-legged telescope shown in the present (fourth) edition of "Amateur Telescope Making," at page 144, Figure 15. Until the following communication reached us we knew of nobody who had actually made that telescope. Russell W. Porter of Pasadena, California, now reports as follows:

"Not content with merely suggesting a new and untried mounting for a telescope, as I did in the fourth edition of 'A.T.M.,' I have taken the bull by the horns and made one (Figure 1). Members of the 'Hundred-to-One Shot' Club (100^{-2} Club) recently took it out into the Mojave Desert for a night's try-out. [*Editor's Note:* The Club named has been heard of before, though our resolving power fails to define its exact outlines from this distance. It appears to be a conglomeration of TNs and other highly intelligent people supposedly addicted to things scientific, who trek to various godforsaken places within motor radius of Pasadena, fry steaks, eat smoke and ashes and put up with one another's theories about the secrets of the universe, measure the sun's altitude with sticks and strings to make sure that orb is not getting lost, concoct new mountings, sleep in the sand, sit on cactuses, dodge side-winders, and get all tired out resting up. They do these things well in California.] Surprisingly, it developed no serious drawbacks, and proved at once its convenience as a support for a Cassegrain tube assembly.

"The optical parts are an 8″ primary and secondary, contributed by Byron Graves, slightly modified by an aluminum coat applied in vacuo by Dr. Strong. The mirror is about *f*/3.5.

"The mounting is portable, and may be quickly assembled or taken down and packed in a box that goes easily into a car.

"The leg (arm of fork) *A* was hewn out of sugar pine. In assembling, it is slipped over the tapered end of the polar axle *B*, and drawn home with butterfly nut *C*. Likewise, the tube goes on the other end of the leg, but here the connection is the stud *D* and circular track which makes the declination axis.

"The polar axle consists of two parts that telescope, namely, *F* made of 2″ Shelby tubing, and *G*, of 1″ solid steel rod. The steel point *H*, at the end of the solid shaft, defines the lower (thrust) bearing of the polar axis, the north bearing being merely a cradle of V-block *I*, attached to the two detachable legs *J*, *J*. With the telescoping polar axle, and open upper V-block bearing, the lining up of the polar axis with that of the earth is easily accomplished on any terrain. The steel point found that a dimple in a boulder (shown in the sketch) made a reliable south bearing.

"Slow motions in Dec. and R. A. have long tangent arms bearing against screws *K* and *L*. The R. A. arm, having a hinge at *M*, can be transferred from one leg to the other, as desired.

"The instrument is completely counterpoised. The advantage of getting rid of one arm of the fork (but at the same time doubling the strength of the other) is in the room thus made available in the vicinity of the gooseneck eyepiece when the telescope is directed to the northern heavens.

"Graves supplied the tube, complete. [Graves, in the picture (Figure 2) is the second figure from the left, under the 'western' hat, who is doing the heavy looking on while several members of the aforementioned club are on their knees, getting the latitude within a mile, by means of shadows, under Porter's guidance and using only a piece of string. Porter reclining.—*Ed.*]

"The only machining on the mounting itself was done on a simple drill press.

"We detected some vibration and, by tapping different parts of the mounting, thought we had located it either in the wooden arm itself or the two legs supporting the V-block. These vibrations can be eliminated by increasing the cross-section of the arm and legs.

"Now that the one-legged mounting has gone through the fire of a Mojave Desert test, and survived, I feel no hesitancy in recommending it to any one who may lack a machine shop but wants a convenient, portable support for his Cassegrain telescope."

FROM time to time puzzled workers have asked us why "Pyrex" mirror disks usually come with a ring on the back which either stands above the rest of the back surface, like *a*, Figure 3, or below it, like *b;* also why the sides of the disks are slightly tapered instead of parallel; and why the face of the disk is usually concave. Many ask why there are bubbles in the glass.

Mere inspection of the disks themselves is likely to leave the worker without the answers, but a few minutes' observation at the shops of the Corning Glass Works, when disks are being molded, would quite readily provide them.

(*1*) *The ring:* The disks are pressed in a cast-iron mold having a cross-section essentially like that shown at *c*. The "gatherer," as the workman is called, tries to pour into the mold just enough molten glass to fill it. Now it is quite easy to fill a receptacle rather exactly with some ordinary liquid, such as water, but not so easy to do it with molten glass. Still more difficult is the "Pyrex" brand glass from which the smaller telescope disks are made, for this has a relatively high melting point—about 2800 degrees F.—and it is impracticable to reduce it to the convenient fluidity of water. Instead, it is "worked" as a thick, slowly crawling mass, the amount poured into a given small mold being better describable as a gob than a liquid. However, the experienced glass worker, even then, can estimate the size of gobs fairly closely—he has been estimating gobs all his life. So he pours in his gob.

Next, this gob man claps on the metal ring *d*, and then down comes the plunger *e*, to force the reluctant molasses-in-January to fill out the mold by means of pressure. Now, if the gatherer's gob was estimated just a trifle too small, we get what is shown at *a*; if too big, we get *b*.

(2) *The non-parallel edges of the disk:* These represent the "draw," just as in a molder's pattern. If the metal mold were given a parallel side the cooled disk would be difficult to remove.

(*3*) *The concave face of the disk:* This represents shrinkage of the glass after cooling. Shortly after the plunger is raised, the disk, already pretty cool—for while it is difficult to bring "Pyrex" glasses *up* to

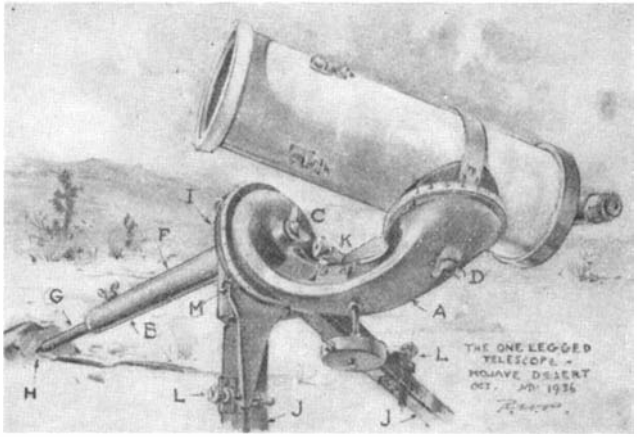


Figure 1: Porter's portable, one-legged mounting

Photo by O. S. Marshall

Figure 2: Hundred-to-One Shots worshipping the sun

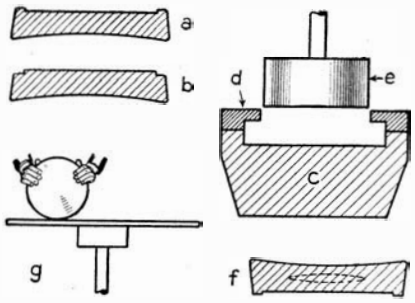


Figure 3: **The why of it**

the temperature where they work easily they drop in temperature with alacrity—is slid out by inverting the mold, and what we now see is a disk that is dark all around the exterior but still has a red hot lens-shaped part in the middle, something like *f*. As the disk, now lying on its back, goes on cooling and contracting, the center "falls," just like an unlucky cake. Now, if this "cake" would only be so kind as to fall *the same amount* in each case, the fall could easily be compensated by making the inside of the mold *c* a bit deeper at the center, thus attaining the desired flat-faced disk. But glass isn't a much more obliging performer than pitch—and you know what that means.

(4) *The bubbles:* In a low-viscosity fluid like water or, say, beer, the bubbles rise rapidly to the surface, but in the viscous molten "Pyrex" glasses the smaller ones cannot make the grade fast enough, and so they get frozen in before they reach the top. A lot of good scientific gray matter in the glass industry has been worn down thin on this old, old problem but the bubbles we still have with us. Even in the much more easily melted crown glass used in fine photographic lenses it is impossible to eliminate them all.

Speaking of these same bubbles, what to do about them when they are broken into in grinding is something else again. Obviously their fragile edges ought to be reamed out, so that fragments of glass will not become detached and cause bad scratches. Just how to do this is something we cannot advise, never having had the experience. If a dozen workers who have actually done it would report what they learned, the published accounts would be useful to the next fellow and the next.

NOW for some of the cussing about ordinary plate glass disks. For years we have heard complaints that these were not truly round; one man claimed his was a triangle. Here is how these disks come to be sub-polygonal. First you have a slab of plate glass. On it the glass worker scratches a circle. Next he puts the slab in a sort of clamp, so that it is held horizontally with an edge overhanging. He grabs a man-sized pair of tongs—about a yard long—and begins rapidly breaking off hunks of glass. In 60 seconds or so he has a sub-angular disk with bulges around its periphery. He takes this to a slowly rotating horizontal metal plate, like *g*, on which a stream of water steadily brings down coarse abrasive and, holding it in his two hands he rapidly grinds off the bumps. He has no gage but his eye, though that is pretty fair. It could of course, be done on a centered arbor, giving a true circle, but then the disks would cost more. Naturally, a truly circular disk is more satisfying to the user's sense of

Figure 4: **Using remote control to regulate the speed of the telescope**

neatness. Optically the shape, whether round or the shape of Texas, makes no difference. Mechanically a round disk is not liable to flexure due to its shape, but an irregular shape, if bad enough, may be.

One amateur claimed a disk that wasn't quite round—and they may vary a sixteenth inch or more—caused flexure that altered in different positions of the telescope. He was from Manchuria—and we are from Missouri.

THE Dr. Calder, around whose work Professor Russell's article is built this month, is one of the amateur telescope making fraternity—a former physicist who, after making a telescope, made more, and shifted from physics to astrophysics for good.

PRESENT and former radio "hams" abound among amateur telescope makers and these, as well as others, will take interest in a telescope drive (Figures 4, 6) described by Wilbur Silvertooth, 273 Ximeno Avenue, Long Branch, California.

"The driving system to be described was designed in an effort to secure all of the desirable refinements essential to a perfected unit without recourse to the usual complicated mechanisms. While constructed for a moderately sized telescope, the principle is equally applicable to larger instruments where its conveniences would be more readily felt.

"The gear train has been reduced to the simplest form. It consists of a 100-tooth worm gear connected with the polar axis through a friction plate; the worm is shafted in common with a 144-tooth spur gear which meshes with a 10-tooth pinion on the shaft of the motor. This synchronous motor, which turns one revolution per minute, is available commercially in both 50- and 60-cycle models.

"With such a gear system the polar axis will rotate once in 24 hours when operated on the regular line, the accuracy being a function of the stability of the supplied frequency. By interposing some method of frequency control between the line and the motor, the rotational speed of the telescope may be varied. Numerous complicated systems of motor-generators, tuning forks, pendulums, etc., have been tried; all having the disadvantage of added moving parts and limited flexibility.

"By substituting for such devices an electronic frequency changer, these drawbacks are eliminated; while such decided advantages as remote control, complete flexibility, inexpensiveness, and silent and vibrationless operation are secured. The only moving parts are the control dial and the motor armature.

"The small remote control contains three potentiometers. Two are employed to set the range of frequencies to be covered, as well as the location of those frequencies in relation to the one being altered. The third is employed as the actual control, covering the band as set by the initial dials.

"Considerable experimentation was done

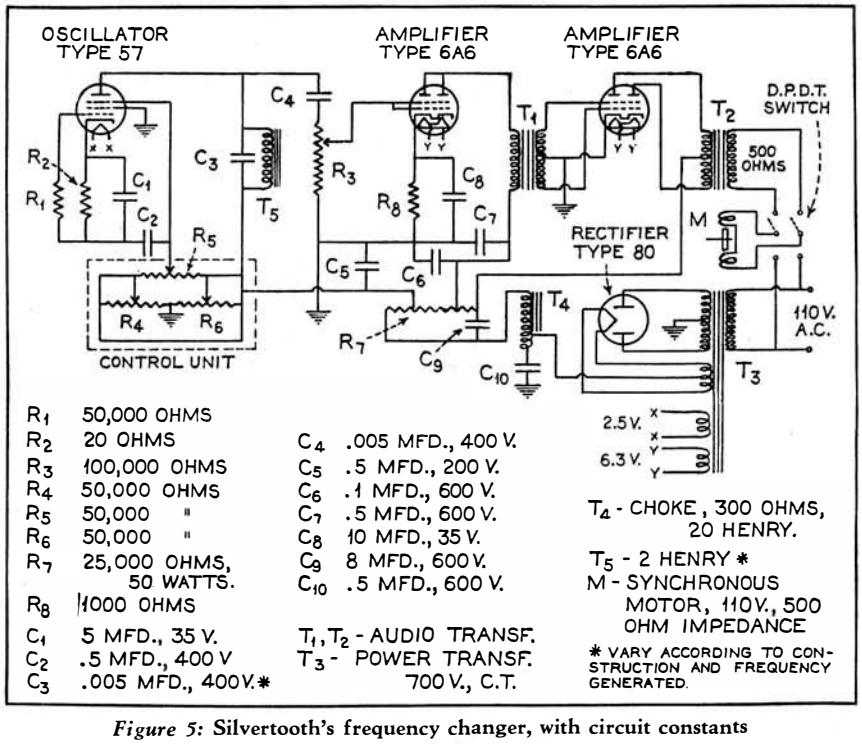


Figure 5: **Silvertooth's frequency changer, with circuit constants**

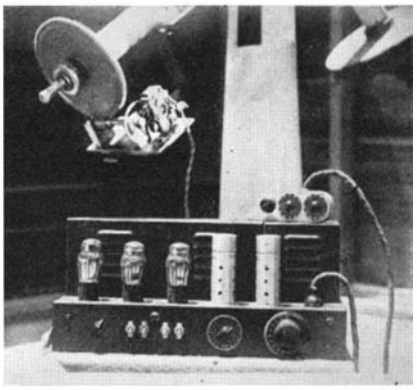


Figure 6: **Complete driving system**

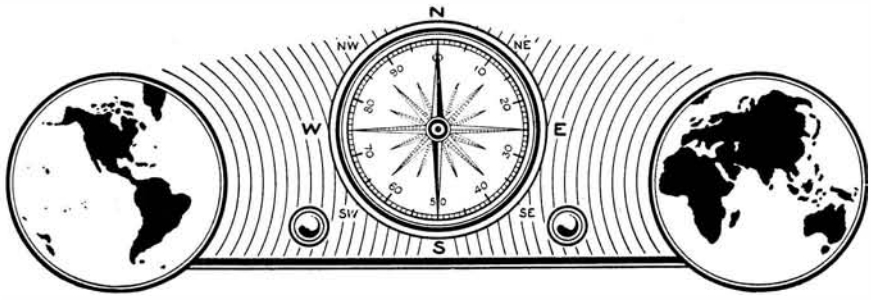
in order to secure a stable oscillatory circuit. The one described and finally decided upon shows no tendency to drift when compared with either the line frequency or harmonics of standard laboratory oscillators. Additional refinements of switching arrangement make it possible to change from the line to the unit from the remote control. Other switches on the unit make it adaptable for various purposes. The circuit was designed by Ed. Sawyer, the gearing arrangement being made by Mr. Edward Lester. Any further information or details of circuit constants will gladly be supplied by the writer."

In further explanation of this drive, Mr. Silvertooth adds the following, in a letter.

"The speed of a synchronous motor is dependent on the frequency (oscillations per second) of the voltage supplied to it. If this frequency is changed, the speed of the motor will also vary. In the described electronic frequency changer this is done by changing the frequency of an oscillating circuit. Variable resistors are employed to do this. The rest of the equipment is merely to amplify the output of the oscillator sufficiently to run the motor. With a different amplifier a larger motor could be used if this were desirable. The condenser C_3 and choke T_5 must be selected to yield the desired frequency. This is the only part of the device that might require adjustment. It is not necessary to use the fundamental frequency of the condenser and choke; any one of a number of harmonics may be employed.

"Since sending you the description I have completed another driving unit of the same general description, and it functions equally as well as the first refined system."

ABOUT that book—"Amateur Telescope Making—Advanced," more can be said next month than now, as there has been delay due to difficulty in getting proofs back from some of the authors. We begin to think authors are almost as bad a lot as editors, but this is not meant as an insult. The chief difficulty in making announcement of a book in a magazine is that you cannot do it *as of* the time the reader will receive it. As this is written, on Nov. 25, the last remaining author writes from England that the "next ship" will bring his corrected proofs. All the corrected galley proofs must then go back to the printer for alterations. Back come page proofs, again to be read (over 300,000 words). Only then can one say to the printer: "Print, bind, ship." It is a complicated business. Even the above omits most of the slimy details.



WORLD-WIDE RADIO

Conducted by M. L. MUHLEMAN
Editor, *All-Wave Radio*

MIDGET CATHODE-RAY TUBE

THE typical 1937 all-wave radio receiver employs an electron-ray tube as a visual tuning indicator. With television supposedly hovering in the background, it is not beyond presumption that the radio manufacturer may capitalize on the growing public consciousness of radio-vision by installing cathode-ray tubes in the 1938 receivers, now that a practical miniature tube of low cost is available.

Be that as it may, the new type 913 low-voltage cathode-ray tube of the high-vacuum, electrostatic type, introduced by RCA Radiotron, could well be used in a radio receiver as a visual tuning indicator and at the same time produce the fascinating patterns of the wave-forms of speech and music as they are traced by the finger of the electron beam on the fluorescent screen of the tube. Moreover, when used under the proper conditions, such a tube will indicate the approximate operating efficiency of a receiver and show up faults that may develop in the receiver circuits.

In the meantime, the new midget cathode-ray tube will be of interest to the engineer, the licensed radio amateur, the laboratory worker, and the advanced listener. It will perform all the principal functions of the larger, more expensive cathode-ray tubes, and requires a much lower operating voltage—250 volts minimum, 500 volts maximum. Such potentials are readily obtainable from inexpensive power-supply units of approximately the same type as used in the average radio receiver.

In appearance the RCA 913 is quite different from other cathode-ray tubes. It is constructed like the all-metal receiving tubes except that the end of the metal shell is replaced by a fluorescent viewing screen about one inch in diameter, as shown in the accompanying illustration. It is provided with two sets of electrostatic plates for deflection of the electron beam, similar to the larger tubes. The brilliant luminous spot produced by the beam is a greenish hue.

The RCA 913 is well suited for laboratory work where a large viewing screen is not required and where compactness and portability of the equipment may prove to be an important factor.

With no more than an adequate high-voltage supply with a simple filter, the tube provides an excellent visual indicator for an amateur transmitting station. When properly connected to the transmitter, trapezoidal patterns can be obtained that will show the degree of modulation and provide immediate indication of improper adjustment. Complete wave envelopes can be produced by the addition of a simple sweep circuit.

The advanced listener interested in the study of the character of radio signals will find the midget cathode-ray tube of great value. A complete and inexpensive oscilloscope can be constructed and operated in conjunction with the all-wave receiver to show degree of modulation, points of resonance, fading conditions, signal interference, and so on. For that matter, such a unit is a complete laboratory in itself, and can be put to many other interesting uses.

New midget cathode-ray tube that holds great possibilities for various applications in radio experimental work. See the text

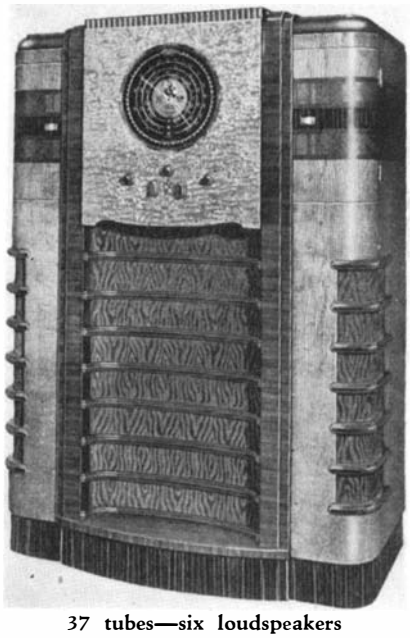
W2XAF OVER LONDON

SOARING over London in an airplane at 250 miles an hour between the hours of midnight and 3 A.M., Harry E. Bowbyes, member of the Royal Air Force, writes the General Electric Company that "out of the dark blue came a sweet voice from across the Atlantic—the Burns sisters singing on a program being broadcast by short-wave station W2XAF." Flyer Bowbyes said he had rigged up a short-wave receiver in his plane and that during the lonesome hours of the early morning thought he would try it. One of the first stations tuned in was W2XAF.

CROSLEY 37-TUBE RECEIVER

A SUPER-POWER radio receiver employing 37 tubes, equipped with six loudspeakers, and having a power output from 50 to 75 watts, has been introduced by the Crosley Radio Corporation.

Four chassis are required for the arrangement of the equipment. The first is devoted to the tuning of radio signals and has a continuous frequency coverage from 540 to 18,300 kc, divided into three bands. The second chassis embodies the audio power amplifier. The third chassis furnishes the power for the amplifier and the fourth pro-



37 tubes—six loudspeakers

vides the power for the field coils of the loudspeakers.

One speaker is 18 inches in diameter and is used to reproduce the bass sound frequencies. There are two 12-inch speakers for the mezzo or middle musical range. Three smaller high-frequency speakers reproduce the treble or high-frequency range of the higher notes and overtones.

The receiver is said to have an audible frequency range from 20 to 12,000 cycles. It is equipped with volume expansion, bass compensation, and six-step tone control, in addition to volume control for each audio range—bass, mezzo, and treble. The receiver is also equipped with an automatic tuning system.

Relief for Short Waves

THE International Broadcasting Union, representing all the leading broadcasting organizations of Europe, has recommended in its proposals for the Bucharest radio conference that a minimum of 10-kilocycle separation be adopted for short-wave stations.

The separation, which is uniformly observed in this country, "is necessary to insure good reception," the union states, and adds: "It is necessary to consider a greater separation corresponding to two or three channels of 10 kilocycles between stations which can be received simultaneously with a field of the same order of strength in the same region."

If such a recommendation is adopted, much of the present inter-station interference in the short-wave bands will cease. Most nations, including the United States, realize that the value of short-wave broadcasts cannot be fully gained so long as the programs are subject to a veritable barrage of heterodyne whistles. It is to the best interests of each country, therefore, that each station be separated from the next by a frequency band sufficiently wide to eliminate the overlapping of carrier side-bands. A separation, or "guard band," of 10 kilocycles has been found adequate in this country.

Our own Federal Communications Commission has not been slow in recognizing the value of short-wave broadcasts, and has taken steps toward cleaning up conditions in this country. A new ruling provides that no United States short-wave broadcast station may operate with less than 5000 watts power and that each station must reduce the frequency tolerance of the transmitter from .03 to .01 percent. This ruling insures reliable operation of each station and, in consequence, more consistent reception of short-wave broadcast programs.

It is interesting to observe that, under the new F.C.C. regulations, stations that have been "experimental relay broadcast stations" are now to be known as "international broadcast stations," the new name being significant of the service rendered. It is the aim of the F.C.C. to place emphasis on the foreign service of United States short-wave broadcast stations and to encourage programs of international scope.

The reference to "international scope" has not been clarified, but it is inferred that the phrase is not intended to imply propaganda.

Clear Channel, High Power

AMONG important broadcasting recommendations made at the allocations hearing of the Federal Communications Commission, the Radio Manufacturers Association (RMA) strongly urge maintenance of clear channels, high power, and expansion of short-wave broadcasting.

Clear channel and super-power broadcasting were the principal subjects in controversy among broadcasting groups and interests at the Washington hearing. The RMA declared in favor of present clear channel broadcasting as a public service, for removal of present restrictions against increase of power, and that the Commission establish minimum power requirements.

These measures, if enacted, will improve general broadcast reception conditions. Aside from the fact that the "service area" of a broadcast station is increased with an increase of power, there is the added advantage to the listener of a reduced noise background.

Selectivity and Band Spread

MANY owners of all-wave receivers confuse selectivity with the degree of band spread made available. There is no connection between the two. Selectivity is the ability of a receiver to separate electrically one station from another. No amount of selectivity will permit the complete separation of two stations whose frequencies overlap, as often occurs in the short-wave bands. But a modern receiver, with good selectivity, should be able to pull in one station free of interference from another if the stations themselves are actually separated.

A receiver without band spread *appears* to tune sharply because the stations are crowded together on the dial scale. But this is no measure of receiver selectivity. Another set having ample band spread would appear to tune broadly whereas it might well have greater selectivity than the receiver without band spread.

The band-spreading feature is provided only as a means of ease in tuning. The fact that one station may occupy one or two degrees on the band spread dial scale does not indicate that selectivity is poor.

CAMERA ANGLES

Conducted by JACOB DESCHIN

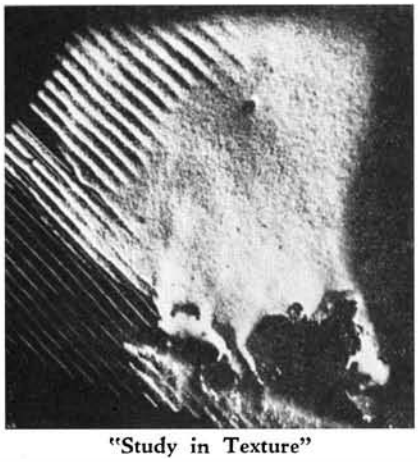
Winter Photography

WINTER usually means snow pictures and snow pictures mean strong contrasts. To expose for the shadows and let the highlights fall where they may is a rule to be heeded with extreme moderation and in many instances to be ignored. At no other time of the year is the decision in this regard

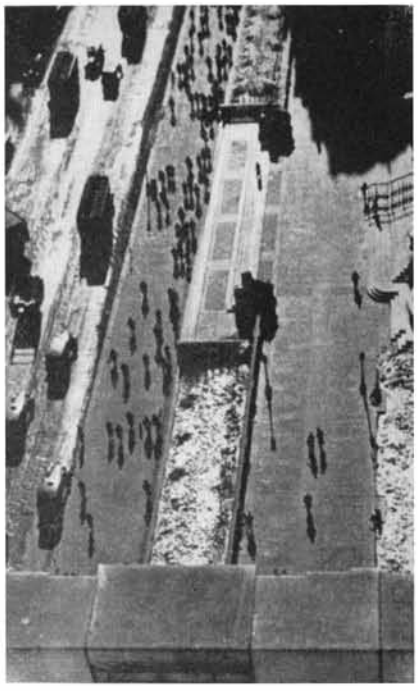
"Looking for Company"

to be reached so carefully as in snow-time; at no other time is overexposure so easy, unless a reliable meter is used. On the other hand, down-right overexposure in order to catch something interesting in the shadows, as in "Looking for Company," in which an ordinary background is allowed almost to disappear in order to record the interest inherent in the lone sparrow on the branch of the leafless tree, seems, to this department, at least, legitimate. After all, rules are only guides; they should not be our masters, else photography would be a sorry thing, indeed, monotonous and dull and completely void of imagination.

To show the texture of snow is very desirable and if we confine our activities in this connection to the early morning or late afternoon hours, when the lighting is soft and diffused, we can achieve considerable success, provided we choose the right viewpoint to show it off—that is, against the light —expose fairly correctly and develop with care to prevent blocking-up. "Study in Texture" is an attempt with a 35-mm camera to catch an effect in the early morning. Favorite subjects in this connection are broad expanses of snow "dunes" in the city park, with the trees casting long shadows, a "close-up" of a snow bank freshly fallen and before it has had time to freeze up and harden into lumpiness, the virgin snow on a park bench or window sill. Since snow texture in a photograph depends so much on a fairly close or average-distance viewpoint, exposures made from a relatively high altitude,



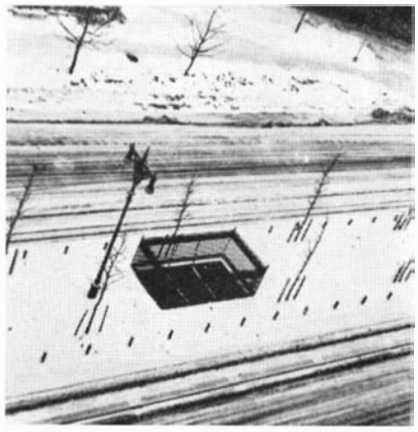
"Study in Texture"



"Winter Shadows"

as in "Deserted," which was photographed from the roof of a six-story building, and "Winter Shadows," shot from the twenty-second floor of a skyscraper, cannot be expected to give more than the impression of snow.

Snowfall is the silhouettist's paradise. What an opportunity for sharp, black outlines against white backgrounds! Exposing for the shadows offers no problem to him; he measures carefully the strength of the light reflected from the snow and photographs the snow after having arranged his "silhouettes" of trees or benches or what-not in a suitable composition against it.



"Deserted"

It is this department's opinion that too much stress has been placed on getting texture into snow for the reason that if snow is photographed for itself alone (as it must be if texture is to be achieved) it is simply a matter, as we have said above, of proper lighting and exposure. But what of the many interesting subjects that are met with in a snow setting and that could not adequately be recorded if we exposed for the snow and

"Falling Snow?"

let the shadows take care of themselves? What of birds feeding in the snow, for example? Indeed, there is a time for texture and there is a time for pictures in the snow and while the two may sometimes be reconciled, common sense and the ability to select must decide the issue.

Concerning the often-discussed photography of falling snow, the accompanying illustration, "Falling Snow?" shows what happens when this is attempted at other than a high shutter speed.

A New Picture Market

An opportunity on a platter is offered to amateur and professional alike by *Life*, successor to the old humorous journal of that name. Willard D. Morgan, formerly of E. Leitz, Inc., announces that he has been placed in charge of this magazine's picture requirements, and from the announcement it would seem that pictures are about all this magazine will buy. The publication will continue as a weekly.

"The whole purpose of this magazine," writes Mr. Morgan, "is to present the latest information in pictures. . . . In brief, this new magazine will use photographs by the hundred, and they will cover everything which has reader interest. The typical candid type of picture, pictorial shots, news photos, the strange and the common subject in a new light are only a few suggestions; outstanding cover pictures and photographs in natural colors will also be in demand in large numbers. A booklet of instructions will be prepared later for distribution to all amateurs and professionals interested in this new publication. The magazine will pay for all pictures used and it will consider each photographer as a professional just as soon as he is able to produce pictures which can be purchased for publication."

Mr. Morgan adds that he "will be personally interested in receiving letters regarding the sale of pictures to this new market" by readers of Scientific American and intends to answer all these letters personally and inform the writers about the requirements of this magazine.

He writes that his "job will be to locate photographers in every city who will be in a position to produce pictures for *Life*" and to this end is interested "in obtaining the following information from all amateur and professional photographers for my files":

1. Name and address.
2. Type of photographic equipment available.
3. Time available for photographic work.
4. Types of pictures you are interested in taking.
5. Subjects and places you have photographed.

Also any additional information that may help Mr. Morgan to determine what kind of pictures you are in a position to offer *Life*. Mr. Morgan should be addressed care of *Life Magazine*, 135 East 42nd Street, New York, N. Y.

Casual Models

The accompanying "Gamin" and "In Pensive Mood" are presented as reminders that the streets are full of good youthful subjects who can without great difficulty be persuaded to come in and have their pictures taken. It was this department's good fortune one day to find four interesting Negro boys in a theater lobby in animated debate as to ways and means of getting enough cash together to get by the ticket chopper. Although time pressed and there were many things to do, the impulse to ask them to pose for this

"In Pensive Mood"

"Gamin"

department's camera was irresistible and, since a cash offer was made, they accepted without a moment's hesitation.

With flood and spotlight and a fast lens to catch the right moment, it was fairly easy to get a group of unusual portraits which would not be possible under the condition of lighting and locale in which the boys were found. There must be a few of our fellow-hobbyists who have at one time or another had the experience of coming across an unusual type and wished that they could get a shot under proper lighting conditions. While granting that children are easier to persuade to come inside for a picture, adults are not as difficult in this regard as might be supposed. There is always a tactful way of putting it over, depending on the person approached, and there are few, barring inability to spare the time or down-right incurable modesty, who will refuse a well-addressed invitation.

We are Hung

THOSE of our readers who had the charity to see something worth while in our picture "Leisure" in the September 1936 issue of this department may be interested to know that it was accepted for hanging, under a changed title ("Sunday"), in the National Salon of Photography in New York City in November under the sponsorship of the Oval Table Society of that city.

Many fine prints were submitted by some of the best workers in this country and from the relatively small number accepted for hanging it would seem that the judging was quite severe. Prints were submitted in two sections, the pictorial and the technical, the percentage of acceptances in the former being 14 percent, that in the latter 45 percent. The total number of prints submitted in both groups was 2070, of which only 351, or 17 percent, came through successfully.

All-Metal Enlarging Easel

FOR those experiencing "easel trouble," a new all-metal enlarging easel has recently been introduced in sizes 8 by 10 inches and 11 by 14 inches. It is called the Bee Bee and its distributors declare it to be precise and substantially built, offering "complete protection against the annoyances heretofore experienced by photographers when using easels wholly or partly made of wood." The inner margins are ad-

justed simultaneously with one lever, and extremely wide, sliding clamps offer rigid support for the 1½-inch masking bands.

THE MAN BEHIND THE CAMERA

IT may prove monotonous to some of our readers to hear so much about the fact that it isn't the camera, but ——. Nevertheless, we cannot resist the temptation to report that we have it on good authority that Cecil Beaton, the famous English photographer, who created those remarkable photographs for *Vanity Fair* and is now doing the same thing for *Harper's Bazaar*, did most of his pictures for *Vanity Fair* with a 3A Kodak and turned to a professional 8 by 10 studio camera only after much urging and persuasion. Any comment we might make on this bit of Walter Winchellism would be too obvious, so we shall let it stand as it is.

MARKET GUIDE

A NEW guide to picture markets is called "The Universal Photo Almanac and Market Guide" which, in addition to other useful information, contains a market guide which lists "thousands of newspapers, magazines, syndicates, calendar manufacturers, and others who buy free-lance pictures."

VISCOSE SQUEEGEE

A VISCOSE squeegee for wiping surface water from negatives to permit quick drying without water spots has been introduced by Fink-Roselieve Co., Inc. This company, which has made life easier for the darkroom worker by bringing out a concentrated acid liquid hypo called Fixol, a concentrated universal developer called Quinolin, and an exposure compensating fine grain developer called GDX, offers in the viscose squeegee a very convenient darkroom tool. It consists of a bent cadmium plated handle on each end of which is a section of viscose sponge. By squeezing the handle the sections of sponge may be used to wipe the wet film strip.

OVER-PRINTING

ONE of our readers has chided us for not having divulged sooner the trick of over-printing a negative in order to pro-

"Manhattan Monolith"

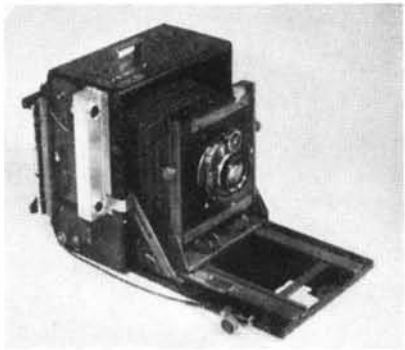
duce a picture strikingly different from that produced by printing the negative by normal exposure. We thought and still believe that most of the followers of this department are already familiar with this procedure, of which one of the most usual examples is that of over-printing a sunset scene to make it look like a moonlight picture. "Manhattan Monolith" is our contribution in this field—the negative was over-printed to provide a semi-silhouette against a fairly bright sky.

EXPOSURE METER

AN inexpensive exposure meter based on scientific measurements of light intensities for the various months of the year, the different times of day, weather conditions, subject-matter, and speed of the film used, is now on the market. Known as the "Quick-Set" Meter, it is only 4 inches long by 1½ inches wide by one eighth of an inch thick. By moving one slide to the position corresponding to the speed of the film being used and another slide so that the mark corresponding to the month and hour is opposite the mark indicating existing light conditions, the meter instantly shows the full range of shutter speeds with the corresponding diaphragm openings.

RANGE FINDER FOR GRAPHIC

"AMATEURS and professional photographers who use larger film and plate cameras need no longer envy the speed and accurate focusing facilities of the miniature camera," writes Kenneth M. Swezey, of Brooklyn, N. Y. "A coupled range finder, just developed for the Speed Graphic by the Kalart Company, may be attached in a few minutes by anyone handy with tools, and may be quickly adjusted for lenses of any focal length. In use, the photographer merely sights through the range finder and adjusts the regular focusing screw. When the two images of the object to be taken coincide, he may press the release, confident that the object is in sharp focus."



New range finder on Speed Graphic, and, *below*, the range finder in use

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 41)

semination. The husband, in case he is anxious for an heir, is happy that his wife will resort to this unusual step to make up for his deficiencies.—*Science Service.*

Induction Speeds Hardening of Metal Surfaces

ELECTRICAL induction now hardens metal surfaces in a new process which definitely will make tremendous economies possible in a wide diversity of industries. The development, announced to the trade as the "Tocco Process" by the Ohio Crankshaft Company, was hailed in automotive circles as a great forward step which will quicken production methods and improve the quality of crankshafts for all kinds of engines. The method not only reduces "hours of surface hardening time to seconds but produces a scientifically regulated, exact result—superior in many ways to the surface produced by the old, wasteful, furnace treatment formerly used," it is claimed.

For the Tocco-hardening, a high-frequency current at high voltage is transformed into low voltage with high amperage. This current passes into inductor blocks which surround but do not actually touch the bearing area it is desired to harden. The inductor block current induces a current in the surface of the metal, the induced current being the heating factor.

Set-up for surface hardening only the wearing parts of a crankshaft

When the area to be heated has been thus subjected to an accurately controlled, high-frequency current for the correct length of time, the electrical circuit is opened and simultaneously the heated surface is quenched by a spray from a water jacket built into the inductor block. When all the main, intermediate and pin bearings are hardened, the entire shaft is drawn at a low temperature to remove strains. Then a final grind completes the shaft.

The combination of instantaneous pressure quenching and a split-second heating cycle produces a surface hardened zone blending gradually into the core with no sharp line of demarcation and consequently no opportunity for spalling.

The steel to be used in a crankshaft which is to be Tocco-hardened must be one which passes the usual inspection tests and in addition should be of the fine-grained type. After forging, the crankshaft is allowed to cool slowly, this alone producing the necessary normalizing. Then without further normalizing or heat treating, it is machined, radial oil holes drilled, and the journals rough-ground. The final grinding operation follows the surface hardening.

The Tocco process has already been adopted by a number of outstanding manufacturers.

Deproteinized Rubber

AS a challenge to the valuable properties of synthetic rubber-like materials, methods have been found which materially improve the shortcomings of natural rubber. One of the most important of these is the so-called deproteinized rubber from which small amounts of naturally occurring proteins have been removed in its preparation.

Vulcanized natural rubber has the unfortunate failing of absorbing moisture and thus altering its electric characteristics as an insulating material for cables. By removing the protein from rubber before its fabrication this defect is overcome. In discussing the new type of rubber, Boggs and Blake in a recent issue of *Industrial and Engineering Chemistry* state: "Besides the obvious and primary use of deproteinized rubber in electrical insulation exposed to water, there are other possibilities for its practical application. A definite part of the characteristic odor of rubber goods is due to the raw rubber itself. By removal of protein and by judicious use of compounding agents, entirely odorless articles may be secured. Undoubtedly the public will soon demand odorless rubber toilet goods.

"The physical properties of vulcanized rubber are seriously impaired by absorption of water; tensile strength, tear resistance, and abrasion resistance are decreased materially. For rubber compounds which must maintain these properties under more or less continuous exposure to water (particularly warm or hot water), deproteinized rubber is the only proper ingredient.

"Many surgical rubber goods need to be sterilized repeatedly. Ordinarily the life of such articles is limited. The use of deproteinized rubber will be effective in prolonging their service.

"Ebonite is usually resistant to water absorption, but, when the water is warm, absorption may be a serious consideration. Deproteinized rubber overcomes this objection."—*D. H. K.*

Air Pipe From Window Helps Pneumonia Patient

A SIMPLE, inexpensive substitute for oxygen in treating cases of pneumonia, tuberculosis, or even advanced heart disease has been devised by Dr. J. E. Crewe of Rochester, Minnesota, and reported to the American Medical Association, states *Science Service.* Dr. Crewe's apparatus brings gently moving outdoor air to the patient who, because of problems of transportation or expense, cannot have the benefit of oxygen treatment.

The apparatus consists of a pipe three inches in diameter which extends from near

the patient's face to the window, where it is fitted to a small blower attached to a board that fits beneath the raised window. A hole in the board admits outdoor air which the blower wafts gently to the patient's face. In homes where electricity is not available to operate the blower, an elbow can be fitted to the window end of the pipe to catch the prevailing wind.

In very hot weather Dr. Crewe adds to this simple apparatus an automobile hot water heater with cold water circulating through it, which cools the air. An even simpler variation of this cooling device is to direct the spray from a garden hose past the inlet of the pipe.

"Considerable experience over many years," says Dr. Crewe, "has convinced me that, by the methods described, most patients can be given all the oxygen they require, in nature's own mixture. Recently the apparatus was exhibited at the meeting of the Minnesota State Medical Association and attracted favorable interest, particularly among rural practitioners."

ALCOHOLIC DRINKS FROM CITRUS FRUITS

IN seeking ways to use ripe fruit from the citrus groves of Florida, methods have been developed by the Citrus Products Station of the United States Department of Agriculture for making wines, brandies, and cordials, both of new types and of varieties similar to products of grapes.

In making wines the extracted juice with the addition of sugar (1½ to 1¾ pounds per gallon) is fermented at about 60 to 75 degrees, Fahrenheit. This requires cooling when the fermentation is active to prevent too high a temperature. The product, after filtering, is a dry wine with a more or less musty, harsh flavor which does not improve with aging. It can, however, be made palatable by the addition of enough dextrose or sucrose to give a final sugar content of 3 to 5 percent. Such a wine resembles a sauterne and contains 13 to 14 percent alcohol by volume. To make a wine of sherry-like flavor and color, citrus spirits are added to bring the alcoholic content up to 18 to 22 percent and a larger proportion of sugar is added (7 to 10 percent). This fortified wine, after heating for about 60 days at 125 to 130 degrees, Fahrenheit, in plain oak barrels, has a flavor and color resembling sherry.

For the preparation of spirits and brandy, sugar to the extent of about one pound per gallon is added to the juice before fermentation to yield a wine of about 10 percent alcohol. This wine is separated from the yeast before distillation and the product is aged.

Neither grapefruit nor orange brandy has an aroma or taste suggestive of the fruit or origin, although some tasters were able to detect an orange flavor in orange brandy. Grapefruit and orange brandy may be distinguished from one another; the former possesses a characteristic aroma and taste difficult to describe accurately. By adding sugar and various fruit oils to the distilled spirits, pleasing cordials are made.—*D. H. K.*

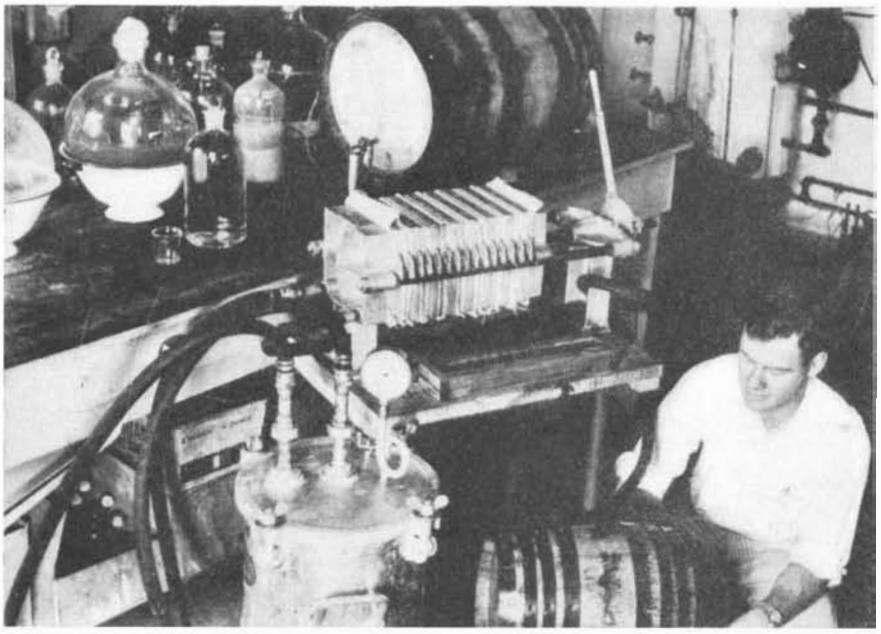
AUTO DEATHS

TWO members of the Chicago Board of Health have pointed out that it is illogical to compute the auto death rates of a city according to the population of that city. They believe—and it seems most sensible—that auto death rates should be based upon auto population of the city in question.

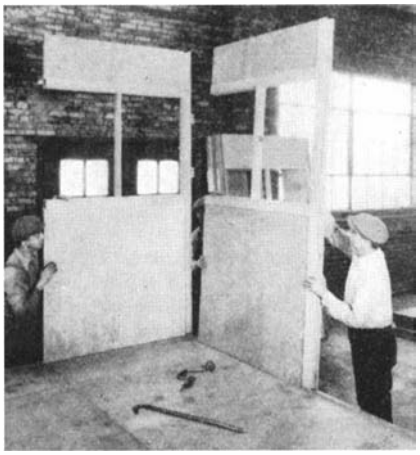
PREFABRICATED AND GLUED

IN the quest for more, better, and cheaper houses for millions of Americans, a distinct need has been felt for a prefabricated type of housing in which much of the material can be put together in standard factory-made parts by mass-production methods, to be followed by speedy and efficient erection on the site.

That wood may be as readily adapted to such a system as other materials has been demonstrated in the system of all-wood prefabricated house construction developed by the U. S. Forest Products Laboratory at



Aluminum press used in the initial filtration of citrus wines



Joining two window units of prefabricated glued wood. *Right:* Drawing of units used in the system

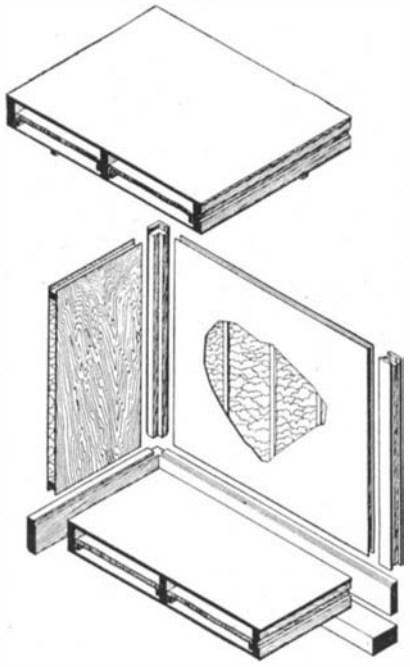
Madison, Wisconsin. Houses constructed experimentally there in connection with the Forest Service wood utilization research program are built up of prefabricated wood unit panels four feet in width and up to 15 feet in length. All panels utilize the "stressed covering" principle, long used in aircraft construction to combine strength, rigidity, and lightness; that is, plywood sheets forming the panel faces are glued with moisture-resisting glue to both sides of the structural framing and thus become a definite part of the load carrying system, instead of being an additional load on the supports as in ordinary construction. In this way the framing members can be materially lightened without any sacrifice of strength or rigidity. Joists, for example, have been reduced in height from the conventional ten inches to six inches.

The outer wall panels, by utilizing effectively the strength of the exterior and interior plywood, are 2¼ inches thick instead of the customary wall thickness of six to eight inches. Secure but easy-fitting joints are provided by upright mullions with double grooves to receive the edges of the inner and outer plywood. All panels are insulated—the wall, roof, and lower floor panels primarily against heat and cold, and the partitions and floor panels between stories against sound. All necessary electrical wiring and outlets for servicing the house can be built into the units. The entire system is being developed with a view to quick and ready assembly on the site.

Alternative to the softwood plywood coverings on the standard panels, hardwood finish surfaces can be applied to both floor and wall panels on the interior and paint can be used on walls or ceilings. Either casement or double-hung windows can be used and a choice may be made between the modern flat roof or the conventional pitched roof.

The fact that the system utilizes standard parts does not mean that any two houses so built must be identical in design and appearance. By interchanging various units, different conditions can be met. The use of standard factory-made parts does not mean "standard" houses identical in every part. Prefabricated houses of widely different designs can be built with the same standard panels, provided a few minor changes are made. Industrialization of all-wood housing would substitute prefabricated wall, floor, and roof panels of wood for the rough materials, timbers, sheathing, siding, rafters, lath, and plaster.

Although houses produced according to the Forest Products Laboratory's system of prefabrication are not in large-scale production at the present time, the principles have been adopted in the rapid erection of



low-cost houses, and it is understood that a number of manufacturers are preparing to launch the production of the essential units and the development of accompanying plan services.

PRODIGY

A POOR American country plant that went abroad and came back to make good in a big way, the tomato has grown from a 13.9-million-bushel crop in 1915, to one that reached over 17.5 million bushels in 1935. Much of the increase was due to the development of disease-resistant tomatoes by our Department of Agriculture.

TIMBER BALANCE

FIGURES often quoted to show that America is using up timber resources several times as fast as they are being regrown, were called in question by John B. Woods of the Society of American Foresters, in an address before his colleagues in Washington, D. C. Changes during recent years, he declared, have gone far toward bringing timber production into balance with timber consumption.

The changes involve both an increase in tree growth and a sharp decline in timber use, he said. The new approach to a balanced state is of post-depression date.

"To compare growth and drain on the basis of 1929 and prior years is to cling to the bad old days," Mr. Woods contended. Consumption declined abruptly from a five-year average of 36 billion feet of lumber to 16.4 billion for the next five-year period.

"Total forest drain for the period 1929-1934 is estimated by Smith in the N.R.A. Report as 9,500,000 cubic feet per year.

The same report carries an estimate of growth for the same period of 8,900,000 cubic feet.

"We recognize that production and loss at the old rate put too great a burden upon our growing capacity. But reduced consumption and increased effectiveness of protective measures have put us practically in a state of balance. The job now is to complete the extension of management to all our lands—both public and private—and build up our productive capacity."

The accelerated re-growth of our timber is a tri-regional affair, Mr. Woods stated. In the still unexhausted Northwest, lumbermen have at last learned the lessons of more conservative cutting, better protection against fire and other natural agencies of destruction, and provision for replacement on cutover lands.

Instead of becoming a barren waste of treeless flats and hills, the South "in two decades has become a potential yellow pine farm, now growing upon half of its pine lands (according to Inman Eldredge) 18,000,000 cords of wood each year. As this great plant swings into production, as the small trees become big ones, the annual yield of sawtimber and pulpwood may exceed in volume the yearly output of old-growth pine in the old days."

The Northeast, Mr. Woods continued, is growing more timber than is being cut. Only in the North Central and Lake States region does growth lag behind depletion.

A brisk building boom, such as is now apparently getting under way, might put Mr. Woods's optimistic calculations to a severe test. On the other hand, more economical use of lumber through recent technological advances could do something toward offsetting an excess demand.

At any rate, it is something of a novelty to hear a note of cheerfulness out of the tall timber, after so long (and justified) a winter of gloomy alarm.—*Science Service.*

FARM PONDS

THAT a water hole for cattle must have considerable depth is indicated by the fact that in the five summer months 200 head of cattle will drink nearly an acre-foot of water—352,850 gallons—at the rate of about 10 gallons of water for each animal daily.

We Chew Far More Than Our Ancestors

THE charming girl who gnaws a ham bone at the dinner party is not being sensibly primitive. Giving the teeth this sort of hearty work-out is not done in primitive society. So the Arctic explorer, Vilhjalmur Stefansson, declared in an address at the annual banquet of the American Dietetic Association, *Science Service* reports.

"Between the dentists and the Fletcherizers, we chew today far more than our primitive ancestors," he stated. Dental reasoning, he said, has gone astray by assuming that the Eskimos, with their fine, healthy teeth, would chew at least as much as we. Then the argument is built up by picturing Eskimos as extraordinary chewers.

"The argument proceeds," said Mr. Stefansson, "that when people ate meat in the way illustrated by the charming girl, they developed and retained excellent teeth through much biting and chewing of tough and coarse food." The point overlooked, he continued, is that primitive people have had tools since Stone Age days, and carnivorous primitives have one single method of handling meat, practically everywhere in the world.

The proper primitive way of eating was then shown by the explorer, who has lived for years among Eskimos, eating their meat diet: "You take a good-sized piece of meat in your left hand and a knife in the right," he explained. "With your front teeth you nip lightly into the edge of the piece, just so you get a good hold, and then you cut in front of your lips. This piece of meat is not likely to be larger than the one you cut with knife and fork when you dine politely on a sirloin."

In actual fact, Eskimos chew their food less than almost any other people, said Mr. Stefansson, and their native meat diet does not massage their gums with coarse food. Yet not one cavity has been found in any tooth of any Eskimo who died before his food was Europeanized. The Eskimos are the only people known, past or present, who have this 100 percent record of no decayed teeth.

The popular belief that Eskimos chew skins a great deal in preparing them for clothing, thus getting dental exercise, was declared "greatly exaggerated." Attributing the Eskimo's good teeth to his exclusively meat diet, which includes many parts of the animal not featured in civilized man's order of meat, Mr. Stefansson said: "All deficiency diseases seem always absent from people living wholly on meat. In view of much discussed theories it is well to specify that certainly there is never a case of scurvy and almost certainly never one of rickets. Tooth decay is absent, pyorrhea is rare or absent. Teeth when ground down, as by sand in dried meat, seem never to wear wholly down to the pulp so as to result in alveolar abscesses."

Cancer has probably never been reported from Eskimos still living on their native food, the explorer commented.

It is a reasonably sure conclusion, he declared, that "you can be healthy, and live at least the Biblical three score and ten, on a vegetarian diet, on a meat diet, or on a combination of the two."

Useful Products from Fungi

MICROSCOPIC fungi of certain varieties produce gums described as stringy, creamy, gelatinous, pasty, doughy, rubbery, leathery, or crusty, which may be important as industrial materials. These products of fungus growth have been used in Germany to make a leather substitute and are suggested as binders, adhesives, coating agents, and oil- or grease-proofing media for the cellulose and rubber industries. "The value of these materials in the manufacture of animal feeds has been repeatedly demonstrated," according to J. R. Sanborn writing in *Industrial and Engineering Chemistry*. "Positive evidence is also accumulating which points to their peculiar adaptability to human nutrition and food preparations. Results obtained suggest unusual applications for the future in the manufacture of flavored or odorous materials and as sources

for valuable chemicals. It is even possible to develop certain specialty articles which may be rendered particularly desirable because of the activities of micro-organisms. Several kinds of low cost raw materials are available for the cultivation of these organisms such as waste sulfite liquor, molasses distillery slop, cereal mashes, slop from starch manufacture, wood residues, and corn syrup." These food uses are quite aside from industrial applications which seem to offer important possibilities.—*D. H. K.*

So That's The Reason!

MOST persons who are nearsighted or have astigmatism get themselves eyeglasses to correct the visual defect and go unhampered about their business. These rather common defects, however, are held responsible for some of the vagaries that puzzle the ordinary viewer of modern art.

How nearsightedness or astigmatism in the artist's eyes can make him draw or paint pictures that look queer (eccentric?) to the rest of us is explained by a Los Angeles eye specialist, Dr. Lloyd Mills, in a report to the scientific journal, *Archives of Ophthalmology*.

What we see, he explains, is a combination of images produced by the central part of our eye-lenses and the peripheral or outer parts of them. In order to draw a picture of things as we see them, the artist must preserve the normal proportions of these two kinds of sight in his drawing. This is particularly so since it is the peripheral sight that is most sensitive to color. When the artist doesn't have normal vision, his pictures may appear "queer."

Dr. Mills first became interested in the effect of eyesight on art when an artist came to him for treatment. This man produced paintings which were remarkable for fine use of color, but the drawings were sometimes distorted. This turned out to be due to astigmatism, but unfortunately, when glasses were supplied that corrected the astigmatism, the artist had trouble in getting the color effects with which he had previously had so much success.

Short-sightedness, a condition found particularly among the educated classes, is especially frequent among artists, and has much effect upon their drawings. In short-sighted individuals, the acuity of vision with the central part of the eye is decreased, and they are forced to use that of the edges of the eye. This, thinks Dr. Mills, accounts for the work of Cezanne, Renoir, Gordon Craig, and George Grosz, the cubist. Pissarro had repeated abscesses of the cornea of the eye, and Van Gogh and Gauguin had mental diseases, which accounts for their drawings' eccentricities.—*Science Service.*

16-Millimeter Color with Sound

A 16-MILLIMETER projection print that measures up in respect to sound, color, and quality of picture to standard 35-millimeter film, and may be produced at a cost as low as that of black and white, has been developed by the engineers of the Motion Picture division of the Cinaudagraph laboratories at Stamford, Connecticut, working in co-operation with Mr. George Lane, inventor, formerly with Audio Productions Inc., a subsidiary of Electrical Research Products, Inc.

The new print is made from standard negatives, taken with standard camera equipment and by existing color methods including Bi-pack. Hence, any 35-millimeter standard negatives in color or black and white can be duplicated and reproduced with the utmost fidelity. No departure from existing methods in the taking of negatives is required. The entire story is in the printing of the 16-millimeter positive.

This new projection print is made on standard raw stock now universally used in making black and white duplicates. Two printers are required, one for the sound track, which is printed full size by contact; the other for the picture, which is reduced in size.

Projection is made by a portable projector through duplicate lens with filters for color; and a single clear lens for black and white. The change from black and white to color takes but a few seconds.

PETROLEUM PERFUME

ALTHOUGH to the average person petroleum means gasoline and lubricating oil, it is a large source also of candles, chewing gum, drugs, perfumes, paint, preservatives, printing ink, cleaners' solvents, waterproofing, alcohols, anesthetics, and so on.

"Not to be Interpreted . . . . . "

IN the cerebral cortex of the orang-utan, of Borneo and Sumatra, are what may be the first rudiments of the brain structure of speech. Such is one of the findings of Dr. Cornelius J. Connolly, professor of physical anthropology of the Catholic University of America, who has just completed an intensive study of the cortical patterns of approximately 50 species of primates from lemur to man represented in the primate brain collection of the Smithsonian Institution, the largest in the world, which has been assembled by Dr. Ales Hrdlicka.

Actual speech, so far as known, is an exclusive accomplishment of human beings. It requires not only the ability to make finely differentiated sounds but the ability to associate them in the memory with objects, ideas, and emotions. This associative process is believed by many neurologists to be centered in a part of the cerebral cortex known as Broca's area. It is found in both the right and left frontal lobes of the brain in regions marked off from the rest of the cortex by well-marked depressions known to anatomists as the "inferior frontal sulci."

Depressions which can be identified with these sulci appear for the first time in the entire primate series, Dr. Connolly finds, in the cortex of the orang. Nature has, in a sense, "staked off" a lot upon which the vast structure of speech eventually will be erected. There is no evidence of such a separation in the gibbons whose brains were studied by Dr. Connolly. It appears, even more notably than in the orang, in the gorilla and chimpanzee.

None of these three higher apes, of course, has the gift of speech, as the term is understood when applied to humans. Nor will they

ever have. Dr. Connolly's finding must not be interpreted to mean that the anthropoids themselves are in the process of evolving into speaking animals.

The orang and the two higher apes apparently have stopped just on the threshold of speech, insofar as the surface pattern of the brain is concerned. They have the cortical material probably necessary for voluntary larynx and tongue movements, but the issuing sounds are not hooked up and systematized with memories.

ROADS

THE total road mileage of the world is 9,268,397, or one mile of road to every 5.3 square miles of the total land area of 49,411,882 square miles in the world. The United States has one mile of road for every square mile; Japan, one for each 0.2 square mile; France, one to each 0.5; United Kingdom, one to 0.5; and Germany, one to 0.8.

Biological Inhibitory Rays

AT the red edge of the invisible in the spectrum there is a narrow band of light waves which have a powerful and hitherto unsuspected biological inhibitory effect. This discovery, announced in a joint paper by Lewis H. Flint, of the Department of Agriculture, and E. D. McAlister, of the Smithsonian Institution, came about as a result of further studies of the germination of dormant lettuce seeds when exposed to radiation.

Previous studies by Dr. Flint had demonstrated that such seeds could be made to germinate by exposure to red, orange, and yellow light, and inhibited from germinating by irradiation with green, blue, and violet light. The inhibitory effect was general for this upper end of the visible light spectrum, but reached its greatest intensity at wavelengths of about 4200 and 4800 angstrom units in the blue-green region. At the same time studies at the Smithsonian Institution had demonstrated that the green-blue-violet region was in part responsible for the curious phenomenon of bending toward the light, called phototropism, by inhibiting the growth of the plant shoot on the side radiated by those wavelengths. Here also the greatest effects were found in the two regions of 4200 and 4800 angstrom units.

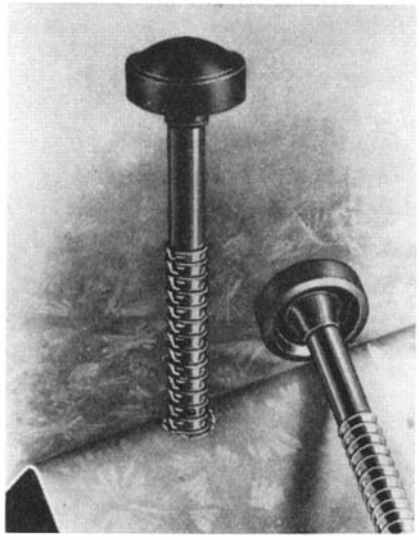
These two regions thus appeared to be of fundamental significance in the complicated relationship pattern between light and biological activity. The discovery of an inhibitory wave band, so far as the germination of lettuce seeds was concerned, more powerful in its effects than the entire green-blue-violet end of the spectrum, came as a complete surprise. This band lies around the critical wavelength of 7600 angstrom units, at just about the point in the red where light ceases to be visible to the human eye.

Ordinarily its effect would be masked by the stimulating effect of the wavelengths surrounding it, especially in sunlight. Perhaps fortunately for vegetation—although the inhibitory influence has been demonstrated only with lettuce seeds—the solar radiation in this neighborhood is greatly reduced, owing, it is believed, to its absorption partly by oxygen in the atmosphere of the sun and partly by water vapor in the atmosphere of the earth. Notwithstanding this absorption, however, the energy of solar radiation at this point is large.

Further studies of the possible effectiveness of this region in respect to the germination of other seeds and in respect to other phases of light sensitivity now are in progress.

Lead Head Nail Doesn't Pull Out

THE new Anchor lead headed nail for galvanized roofing, recently introduced by the W. H. Maze Company, is said not to draw out or work loose, thereby eliminating a common trouble. To gain holding


Lead heads and anchor rings

power, this nail employs the well-known principle of an anchor, the anchors being arranged in rings about the shank as illustrated. The manufacturers point out that this principle, on a lead headed nail, is superior to a screw because it does not twist the head loose and cannot twist out backwards.

200 New Plants Patented Since 1930

DESPITE the fact that over 200 plant patents have been granted by the United States Patent Office since such patents on flowers, fruits, and vegetables became legal in 1930, the field of patented plants is virtually untouched. Material prepared in connection with the Centennial Celebration of the American Patent System shows this fact as a logical conclusion, according to *Science Service*.

Here are some of the future possibilities of the effect of plant patents on everyday life:

1. Forest trees grown as an annual crop the same as oats and potatoes.

2. Oranges and bananas grown outdoors in Maine.

3. Apples and peaches six inches in diameter.

Such apparent fantasies appear remote at the present time, but much less so than the idea of the radio or airplane seemed to the old patent examiners in 1836, when the

present patent system was just beginning.

Queen Elizabeth, it is disclosed, granted what were virtually the first plant patents—except in name—in the famous monopolies given to favored individuals for exclusive rights to flax, hemp, currants, and medicinal and dye plants.

In the early American colonies, monopolies of any form were extremely unpopular. Most of all the dislike was centered on any plant which was considered the gift of nature for all to use as they liked. No one, at that time, foresaw possible research and invention aimed primarily at bringing new and different plant forms, intentionally and for profit. Thus agitation for plant patents continued from 1868 until 1930 before it was finally enacted into law.

Here are a few of the patented fruits, flowers, and vegetables which you can buy today: Apple, apricot, avocado, blackberry, carnation, cherry, chrysanthemum, dahlia, gardenia, gladiolus, grass for golf greens, grape, grapefruit, peach, pecan, plum, rose, strawberry, and waterlily.

One Motor for German Submarines

HECTOR C. BYWATER, the naval correspondent of *The Daily Telegraph*, London, has recently reported development in Germany of a new propulsion unit for German submarines which obviates many of the dangers hitherto present in submarine operation. This new motor operates on the surface on the Diesel compression-ignition principle, but when submerged it is operated by hydrogen and oxygen. The most quickly recognized advantage of this is that the storage batteries, which often constitute one third the tonnage of a submarine, are no longer necessary. Added to this is the fact that the danger of generation of chlorine gas, caused by ocean water seeping into the batteries, is removed.

The motor is driven on the Diesel principle using oil fuel while the craft is on the surface. But these motors also drive dynamos, which, in turn, generate current for working a high-pressure electrolyzer. This apparatus breaks distilled water up into its chemical constituents—two parts of hydrogen to one of oxygen. These gases are stored separately in bottles at high pressure and are used for operating the motor when the craft is submerged.

Pocket Planet Broad Jump Records

LET us consider two approximately spherical bodies, the earth and a ball weighing one pound. So long as the ball is at the earth's surface it will weigh one pound.

Let us next suppose we could take the ball out to the moon. Since the moon attracts bodies at its surface with a force only one sixth as great as does the earth, the ball would weigh one sixth of a pound. If we could throw the ball 100 feet on the earth, we could throw it 600 feet on the moon with the same effort.

The moon's low gravitative power would affect us in a way similar to the effect on the ball. If on the earth we were counted among the first-class broad jumpers who can make a running broad jump of 25 feet, then, assuming equal speed at the take-off, we could jump six times as far, or 150 feet, on the moon.

The case of the high jump is not disposed of so easily. In popular books on astronomy one sometimes reads that if a man could jump over a bar set at six feet on the earth he could clear a bar set at six times that height, or 36 feet, on the moon. This statement is not correct. If we watch a high jumper on the earth we will see that when he is above the bar his body is practically horizontal. This means that his center of gravity is not over seven feet above the ground when clearing a bar set at six feet. When he is leaving the ground the center of gravity of his body is already about three feet above it. In making the jump, therefore, he has raised his total weight only four feet. His jump, *as measured*, is, therefore, about two feet in excess of the height through which he raised the center of gravity of his body. On the moon, therefore, he could clear a bar at 6 times 4 plus 2, or 26 feet, and not the 36 feet which is often given.

Many of the asteroids are probably not over eight miles in diameter, or one one-thousandth the diameter of the earth. If one of these had the same density as the earth the value of its surface gravity would be the same fraction of the earth's surface gravity, or one one-thousandth. If we could be transported to such an asteroid and live we would have most extraordinary experiences. For example, a high jumper who could clear a bar at six feet on the earth (4 plus 2) could rise to a height of 1000 times 4 plus 2, or 4002 feet, on the asteroid. On the earth such a jumper is off the ground about one second, while on the asteroid he would be off the ground 1000 times that long, 1000 seconds or 16.7 minutes. He would practically float upward for half that time and downward during the other half.

A broad jumper who could make a jump of 25 feet on the earth would have a still more thrilling experience. Assuming the same speed at the take-off, the surface gravity of one one-thousandth would enable him to jump 1000 times as far, or 25,000 feet. Since the asteroid is only eight miles in diameter this means about one fifth of the circumference of this body. At the height of the jump he would be about 3000 feet above the ground. For spectators at the take-off, the jumper would disappear over the horizon long before he landed.—*Prof. E. A. Fath, of Carleton College at Northfield, Minnesota, in Leaflet 94 of the Astronomical Society of the Pacific.*

LEGAL HIGH-LIGHTS

Patent, Trademark, 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

A Bill Worth Watching

A WELL known Congressman, who has introduced many bills of far reaching effect, proposes to introduce during the coming session of Congress a bill which, if enacted into law, will revolutionize many phases of our present marketing system. The bill proposes to make it unlawful for a manufacturer or for an affiliate of a manufacturer to transport in interstate commerce any article or material produced by that manufacturer for sale or distribution at retail either by the manufacturer or by an affiliate of the manufacturer. Should this bill be passed by Congress, the various manufacturing and producing organizations which either sell directly or through the medium of a subsidiary or an affiliate corporation to the public will have to change their method of doing business or go out of business altogether. It is understood that the bill is aimed principally at the large chain store organizations. However, it would affect all types of industry.

Be Discriminating When You Discriminate

IN its first attempts to enforce the Robinson-Patman Act, which has been variously referred to as the "anti-chain store" and the "anti-price discrimination" law, the Federal Trade Commission filed two complaints against prominent cheese manufacturers, alleging discrimination in prices between different purchasers, and another complaint against a manufacturer of floor covering material and a prominent mail order house, alleging that the manufacturer had given, and the mail order house had knowingly received, a discrimination in price in certain merchandise sold by the manufacturer to the mail order house.

These proceedings, if carried through to the courts, will test two of the most important sections of the Act, namely, Sections 2-A and 2-F. The first section relates to the giving of price discriminations by a seller and the second section relates to knowingly receiving discrimination in prices by a purchaser. These proceedings are brought under the portion of the Act which empowers the Federal Trade Commission to enforce it. In addition to giving the Federal Trade Commission power to enforce the Act, the Act also contains provisions making certain violations criminal offenses. At the time of writing no proceedings have been brought under the criminal provisions. Should the Federal Trade Commission find any of the complaints justified, it is empowered to issue an order against the guilty party to cease and desist the practices complained of. The order of the Commission is then subject to review by the Federal Circuit Court of Appeals which can either enforce the order by granting an injunction or can modify or set the order aside.

Codes—by Another Name

SINCE the NRA was declared unconstitutional by the Supreme Court, and especially during the last few months, there have been an increasing number of applications made to the Federal Trade Commission by various Trade Associations for permission to draw up fair trade practice rules to govern the particular industry which the Trade Association represents. The trade practice rules resemble somewhat the Code set up under the NRA with the exception that they do not include any labor provisions but deal solely with trade practices, as the name indicates. The rules are drawn up by representatives of the industry and are then submitted to the Federal Trade Commission for approval. The rules are usually divided into two groups, the first group dealing with practices which in the opinion of the Commission constitute violations of the law, and if any member of the industry violates any of the rules in the first group, the Commission will take steps to enforce it. The practices covered by the second group are not recognized by the Commission as violations of the law but merely as expressions of the industry on the question of ethical trade practices.

Some of the rules already approved by the Commission contain interesting provisions which might prove of importance in the stabilization of an industry, such as prohibitions against selling below the cost of production or selling below price lists which the seller has circulated. Most of the approved rules also contain provisions relating to price discrimination, interfering with the customers or employees of a competitor, and the imitation of labels and the like.

The Federal Trade Commission has been ready to approve such rules for many years but it has only been within the last few months that any appreciable number of applications have been made to the Commission. It appears as though this may be a development which will have a far reaching effect upon American industry.

Watch That Disclosure

INVENTORS and manufacturers frequently inquire as to the liability of a manufacturer for using, prior to the granting of a patent, an invention which the inventor disclosed to the manufacturer. This question came before two separate United States Circuit Courts of Appeal within the last few years and both of them decided that where an inventor before applying for or receiving a patent discloses his invention in confidence to a manufacturer and the manufacturer makes use of the invention without the consent of the inventor, the inventor is entitled to compensation or damages for the use of his invention even prior to the date of his patent should a patent be granted. In both of the cases referred to above, the inventor ultimately secured a patent for his invention on one of which the patent was declared invalid, but the interesting feature of the two cases resides in the fact that the inventor was allowed damages for the period during which the invention was used prior to the granting of the patent, not on the theory of patent infringement, but on the theory of breach of confidence.

In one of the cases the Court held that it was not necessary that the invention be expressly submitted to the manufacturer in confidence but the mere fact that the manufacturer requested that the inventor disclose the invention to him was sufficient to constitute confidential relationship. Inventors seeking to protect themselves under the doctrines laid down in these two cases should take such precautions as to enable them to prove that their inventions were submitted under circumstances which would give rise to a confidential relationship. Manufacturers seeking to protect themselves from unjustified claims of breach of confidence should preserve careful records of all inventions conceived and developed in their organization and of all disclosures of inventions made by outside parties.

These cases serve to emphasize the importance of making and preserving complete records of all inventions in the manner outlined in the article entitled "A Weapon for Inventors," which appeared in the August 1936 number of Scientific American.

Utility in a Game of Chance?

IN an interesting case of rather recent vintage, a Federal District Court has revealed the hereditary American moral position on the question of gambling by declaring that a patent on a mechanism of the class sometimes referred to as "slot machines" was invalid and lacking in utility. The owner of the patent contended that the patent related to a vending machine. The device in question consisted of a cabinet with glass walls having a number of articles of merchandise on display therein and in which was located a beam and scoop. By manipulation of the handle, the customer could adjust the position of the scoop and in this manner attempt to grasp some particular article therein. The Court took the position that the device could not be manipulated by the customer so as to deliver with certainty the merchandise he may desire and for that reason the patent was held to be lacking in utility and therefore invalid. The Court stated: "I do not believe the progress of science or the useful arts will be aided by this invention."

CURRENT BULLETIN BRIEFS

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

SAFE MOTORING ON AMERICAN HIGHWAYS is a typescript of a broadcast interview between William O'Neil, President of General Tire and Rubber Company, and John B. Kennedy, noted news commentator. It gives Mr. O'Neil's opinions as to highway safety. *Write for Bulletin 137A to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

HOW TO USE THE NATIONAL BETTER BUSINESS BUREAU, while definitely an appeal for financial support of this Bureau, tells in concise question-and-answer form of the activities of the Bureau and how it can be of assistance to business and industry. *National Better Business Bureau, Inc., Chrysler Building, New York City.—Gratis.*

THE REPUBLIC OF ECUADOR AND HER PRINCIPAL AGRICULTURAL PRODUCTS is a 20-page pamphlet, illustrated with photographs, telling some of the pertinent facts regarding this relatively little known country. *Dr. Francisco Banda C., Director General of Commerce, Department of Foreign Affairs, Quito, Ecuador, S. A.—Gratis.*

INDUSTRIAL USES OF MICARTA describes and illustrates the many uses for a plastic material which is available in a number of grades and shapes. Many specific applications are shown in photographs; mechanical and electrical properties as well as standard forms available are listed. *Write for Bulletin 137B to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

130 PHOTO-FAULTS, by Wolf H. Doring, deals with the many mistakes that the photographer can make from the instant of exposure up to the production of the final print in either contact or enlarged form. *American Photographic Publishing Co., 428 Newbury Street, Boston, Massachusetts.—40 cents.*

DC VOLTAGE DISTRIBUTION IN RADIO RECEIVERS is prepared specifically for the radio service man who desires to keep up to the minute with his work. It provides a background of knowledge that cannot be found elsewhere in such compact form. *John F. Rider, Publisher, 1440 Broadway, New York City.—60 cents.*

GRINDING AND FINISHING WITH PORTABLE EQUIPMENT tells of the growing field of use for portable grinders in many diversified industries. It also lists the various types of abrasive wheels and points that are available for accomplishing specific work. *Write for Bulletin 137C to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

CALIFORNIA, Volume I, No. 1 of the Magazine of Pacific Business, is prepared with a fine format including numerous illustrations in color as well as black and white. It deals specifically with industries in California. *California, Magazine of Pacific Business, Ferry Building, San Francisco, California.—25c a copy, $2.00 a year by subscription.*

AIR CONDITIONING—REFRIGERATION—SPACE HEATING illustrates and describes complete equipment for industry, business, and the home. The wide variety of available units and central plants is indicated by the tables giving capacities and ratings. *Write for Bulletin 137D to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

CELESTIAL NAVIGATION, by Albert W. Ames, offers to those who may wish to know, without a serious study of the subject, the relation between navigation and the sun, moon, and stars. It is complete enough for practical use and shows how astronomy has been simplified in its practical application to the latest method of navigation. *The Candler Company, 1810 34th Avenue, Seattle, Washington.—50 cents.*

THE MAKING AND SHAPING OF ALLOY CONSTRUCTURAL STEELS, by E. C. Smith, gives first a definition of an alloy steel and leads up to modern methods with a brief summary of the early days in steel manufacturing. Most of the booklet is devoted to modern practice. Well illustrated with a series of photographs. *Write for Bulletin 137E to Scientific American, 24 West 40th Street, New York City.—3-cent stamp.*

LORD KELVIN—MASTER OF HEAT AND COLD gives a brief summary of the life and work of William Thomson, born June 26th, 1824, and raised to the peerage as Lord Kelvin of Largs in 1892. This is a valuable addition to the human-interest side of physics. *The Temperature Research Foundation of Kelvinator Corporation, 420 Lexington Avenue, New York City.—Gratis.*

THE MAHOGANY BOOK describes and illustrates in 80 pages the various uses for mahogany in the decorative arts and also shows definitely the distinctive characteristics which make mahogany such a beautiful and enduring wood. The covers are printed in simulated mahogany. *Mahogany Association, Inc., 75 E. Wacker Drive, Chicago, Illinois.—Gratis.*

TOURISM IN THE NETHERLANDS INDIES is a beautifully prepared booklet describing the scenic wonders of Malang, one of the high-altitude residential cities of Java. A map of Malang and environs is included. *The Travellers Official Information Bureau of The Netherlands Indies, Rijswijk 15—Batavia-C., Java.—Gratis.*

BLONDIN'S AIRCRAFT CHART is a compilation of 94 pictures, on one large sheet, arranged in numerical order and illustrating the evolution of every type of aircraft. Each one is briefly yet comprehensively described. *Blondin Chart Co., P. O. Box 34, Los Angeles, California.—$1.00.*

Books SELECTED BY THE EDITORS

THE STORY OF HUMAN ERROR

By Joseph Jastrow and 15 other scientists

READERS with a special interest in odd and abnormal things will enjoy this book. For each branch of science a specialist relates the errors into which past scientists have fallen. For example: error in astronomy (Stetson), in geology (Mather), in geography (Leighly), in physics (Swann) . . . and so on for chemistry, zoology, physiology, neurophysiology, anthropology, psychology, sociology, medicine, psychiatry. Science in the past has run up some odd and often amusing blind alleys. No doubt some of its choicest present-day tenets will be recited in another book on error, about A. D. 2036.—$3.70 postpaid.—*A. G. I.*

RADIO FIELD SERVICE DATA

By Alfred A. Ghirardi, E.E.

SUPPLEMENTING the 1300-page text book, "Modern Radio Servicing," this second edition brings the radio service man strictly up to date for work in his field. The loose leaf form has been adopted in order to make it possible to keep the book up to the minute at all times by regular periodic supplement sheet service. This latest edition covers modern radio receivers from the standpoint of trouble shooting, gives information on automobile radio receivers and their troubles, and lists the characteristics of all modern vacuum tubes. A complete series of tables gives valuable data on wire sizes, common metals and alloys, transformer design, and so on.—$2.70 postpaid.—*A. P. P.*

SKYWAYS TO A JUNGLE LABORATORY

By Grace Crile

THE wife of a famous physician gives a diary account, very readable, of an expedition to Africa in an airplane, in order to study specimens of wild animals.—$2.90 postpaid.—*A. G. I.*

COLLECTING STAMPS FOR FUN AND PROFIT

By A. Frederick Collins

PROGRESSIVE educators have come to the realization that the philatelic hobby is excellent as an outlet for the natural tendency of children to collect things. It imparts in painless doses a broad knowledge of art, geography, exploration, transportation, natural history, architecture, and so on—all of which are covered more or less thoroughly on stamps of all nations. Mr. Collins' book is essentially for the embryo collector, but it should prove of equal interest to those who know how to wield a perforation gage. It outlines how a stamp collection should be started and how to nurse its growth. Historical data that every philatelist should know are given, as well as a general idea of the printing of stamps. The latter portion of the book deals with the finer points of philately with which this reviewer would not be surprised if some of his brother philatelists were as unfamiliar as he.—$2.15 postpaid.—*G. C. B. R.*

MODERN ALCHEMY

By Dorothy M. Fisk

THIS is a lively and graphic account of science's latest significant game, the transmutation of elements, by a lady who is as entertaining as she is well-versed in physics. Its best chapters deal with the history of alchemy up to its present ultra-modern form, including, as they must, the developments in allied fields of physics and chemistry. The treatment is non-mathematical, the result extremely readable, and, with a few minor exceptions, accurate.—$1.90 postpaid.—*J. H.*

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ANYONE who knows welding and welding operations should be familiar with this volume now in its fourth edition, revised and greatly enlarged. It brings up to date every detail of welding operations from the design of structures through to the advanced production, including methods, technique, procedures, and metallurgy of the many metals and alloys which may be welded today.—$1.50 postpaid in U.S.A., $2.00 postpaid elsewhere.—*F. D. M.*

SO YOU'RE GOING TO A PSYCHIATRIST

By Elizabeth I. Adamson, M.D.

PSYCHIATRY, often confused with psychology, is a cat of another color—in fact, almost a different animal. Psychologists are generally students of the human mind. Psychiatrists seek to take the kinks out of minds. Psychologists are usually professors at universities, psychiatrists are physicians usually connected with hospitals. This book is on the psychiatric side and has to do with the kinks in the more or less abnormal mind and how they are straightened out. It is written in simple, straightforward language. The reader will learn a great deal about the motives and mechanisms of the mind—including his own if only he is frank with himself.—$2.65 postpaid.—*A. G. I.*

MONSTERS & MADONNAS

By William Mortensen

IF the amateur photographer can stand an intensely satirical commentary on his hobby—particularly if he be one who thinks that possession of a good camera necessarily makes him a good photographer—he will thoroughly enjoy the preface to this book which treats particularly of the methods of the artistic photographer. If not, he should skip the introduction and plunge directly into the outstanding full-page illustrations and accompanying text which tells definitely how certain desirable results were achieved. Essentially a book of methods, this paper-covered volume with spiral binding presents a number of beautiful photographs ranging from portraits through nudes to the grotesque. No photographer who has the least bit of artistic talent can fail to profit by the thoughts presented here.—$4.15 postpaid.—*A. P. P.*

KENT'S MECHANICAL ENGINEERS' HANDBOOK—POWER

By Robert Thurston Kent, M.E., Editor-in-Chief, with the Collaboration of a Staff of Specialists

THERE is perhaps no engineer in the country who is not familiar with Kent's. A traditional authority, this volume has long since outgrown the pocketbook size and in this newer volume reaches the dimensions 8½ by 5¾ by 1¾ inches. As to its content, an engineer need only know that it has been brought up to date in every respect. It is 1226 pages long and should be on every engineer's library shelf.—$5.20 postpaid.—*F. D. M.*

WORLD POPULATION

By A. M. Carr-Saunders

AN elementary but quite detailed study of population, with a discussion of the causes and consequences of the immense expansion in population which

has taken place in the past 300 years and a statement of the problems which arise from the world population position as it is now. The emphasis is on the former—the statement of conditions—rather than on detailed or lengthy debate on what to do about it; in other words, this is not an argumentative book but, in the main, a book of facts, and its reader would carry away a good solid understanding of the subject of population as a take-off for further study. Its author is English.—$4.70, postpaid.—*A. G. I.*

TWO HUNDRED METERS AND DOWN

The Story of Amateur Radio

By Clinton B. De Soto

IN probably no other scientific development in history have laymen played as great a part as in the growth of radio telegraphy. From the very earliest days of wireless communication these laymen—"amateurs" in the vernacular of the art—have contributed largely of their time and skill in searching for the solutions to the multitude of problems that constantly beset their paths. The history of amateur radio is inspiring, due largely to the fact that they have been constantly on a frontier, exploring sections of the radio spectrum which have been cast aside as worthless. As a result of these explorations has come about the development of short wave radio as we know it today. In the present book the author has traced this work from its beginning to the present, and has concluded with a glimpse into the future. Every amateur will want this book. Anyone interested in radio must read it to round out his knowledge of the subject. 184 pages, limp composition cover.—$1.10 postpaid.—*A. P. P.*

HANDBOOK FOR THE CURIOUS

By Paul Griswold Howes, Curator Bruce Museum, Greenwich, Conn.

VARIOUS animals from sponges and jellyfish, to worms, starfish, crustaceans, spiders, molluscs, fish, amphibians, and reptiles, such as anyone is likely to see while on a walk, are described and identified by photographs in this book. The treatment is popular and chatty.—$3.90 postpaid.—*A. G. I.*

DIESEL APPLICATION PLAN BOOK

Edited by John W. Anderson

DONE in a sort of loose-leaf form with the new celluloid ring binding, this volume contains numerous plans for the installation of Diesels in all types of plants and vehicles. These complete plans are reproduced as blueprints and the diagrams are very clear because of the size of this book—9 by 12 inches. The Diesel engineer, the plant operator, or, in fact, anyone planning installation of motive power for any purpose will get many valuable suggestions from this very readable volume. It contains 239 pages of text and a large advertising section of Diesel engines and auxiliary equipment.—$5.20 postpaid.—*F. D. M.*

NEW WAYS IN PHOTOGRAPHY

By Jacob Deschin

HOW to obtain the best possible results with his camera, particularly when he does all of his own finishing, is the aim of the serious minded amateur photographer. The Editor of "Camera Angles" in Scientific American has prepared this latest addition to the literature of photography with just this fact in mind. The book is eminently practical from every point of view. It contains nothing of theory and nothing that the advanced amateur will not find valuable in one way or another in the course of his work. It covers the whole range of amateur photography—sometimes even bordering on the ways of the professional. It discusses varied phases of trick photography, commercial photography, photomurals and transparencies, retouching, infra-red photography—in fact, it runs the whole gamut of the art, leaving nothing untouched. Ideas for photography will be found in plenty here; the average amateur will revel in the details given and particularly in the excellent accompanying photographs.—$2.90 postpaid.—*A. P. P.*

LIVE LONG AND BE HAPPY

By Llewellys F. Barker, Prof. Emer. Medicine, Johns Hopkins Univ.

"HOW to Prolong Your Life and Enjoy It" is the sub-title of this book which discusses the desire to live long, heredity and longevity, environment and longevity, personal habits and longevity, and the prolongation of life through the prevention and adequate treatment of all the main diseases that afflict us poor mortals. Most of the book is then devoted to a description of these diseases, which would fill in the reader's background of information about divers diseases (if it did not make him think he had them all), with data on the methods usually employed in treating them—not, however, specific data on home treatment, for this is no old-fashioned "doctor book."—$2.15 postpaid.—*A. G. I.*

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PROJECTION CONTROL

By William Mortensen

THERE is usually a vast difference between the ordinary contact print produced without any concern for improving quality and an enlargement from the same negative that has been handled by one skilled in the art of projection. The author of the present book strives to make clear those steps and tricks in projection which mean the difference between an ordinary enlargement and a strikingly beautiful artistic composition. He covers such phases as framing, local printing, distortion, montage, and texture. The book is beautifully illustrated with photographs that definitely annotate the text.—$1.90 postpaid.—*A. P. P.*

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By T. E. LAWRENCE

Colonel T. E. Lawrence in Arabian Costume

THE SEVEN PILLARS OF WISDOM will be, as it was meant to be, Lawrence's monument to posterity. It has an exciting story of its own, and for years has partaken of the sensational and legendary which surrounded everything that Lawrence did. Lawrence finished it during six months of writing at the Peace Conference in Paris. Close to 250,000 words had been written. Then one day while he was changing trains at Reading Station near London, he left this manuscript unguarded and it disappeared. It has never been recovered.

Within a few months he rewrote a second draft in 400,000 words; but his style was careless and hurried, and realizing he would never be satisfied with it, a year later characteristically he burned the entire manuscript. The third text was begun at once and was composed with great care. It is the present one. It was privately printed in London and fabulous sums were said to have been paid for the few copies sold in England. Twenty copies were printed for America, to retain copyright here, and the price of these was set at $20,000 apiece. The money realized from the sale of his book was donated by Lawrence to charities. Upon his death, last year, the unexpurgated text was given to the world.

"Compiled from a notebook which must often have contained hurried items set down in exhaustion and anguish, expanded into a book in the bitterness of disillusion, the SEVEN PILLARS OF WISDOM is neither all narrative, all reflection, all memoir, but a blending of every kind of writing except formal poetry in complete self-expression. . . . Nor is it a clear and simple account of the Arab revolt which helped to win the war in the Near East. For the truth is that Lawrence was not writing a history in this book. . . . The stream of explanation and narrative is made up of many elements. There are studies of Arab history and Arab character, the latter brilliant in the extreme, and pen portraits of Arabs, Turks, French and British leaders of extraordinary wit, shrewdness and power, and these and much else are floated on a narrative of adventures that are terrible, humorous, exciting to a degree unequalled in our time, enriched by descriptions of the desert, of Arab life, of the backgrounds of critical action, many of which are beautiful in a high degree, real masterpieces of English prose. . . .

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