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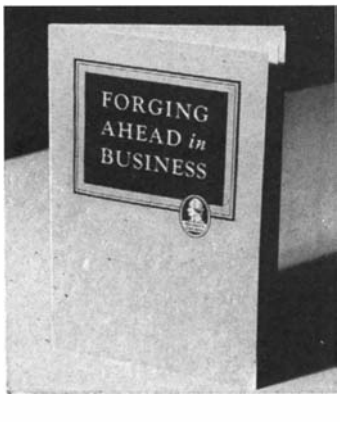

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The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

CONTENTS • MAY • 1940

INDUSTRIAL progress frequently revolves around a strict attention to small details. An example is the valve-stem testing machine illustrated on our front cover. This machine, used in testing the valves in Pontiac motors, presses a precision ground, cone-shaped diamond into the end of the stem. If the diamond digs deeper than the permitted tolerance, the stem is rejected. Hand-operated machines work at a rate of 200 stems an hour; this new electrical tester checks 600 stems an hour.

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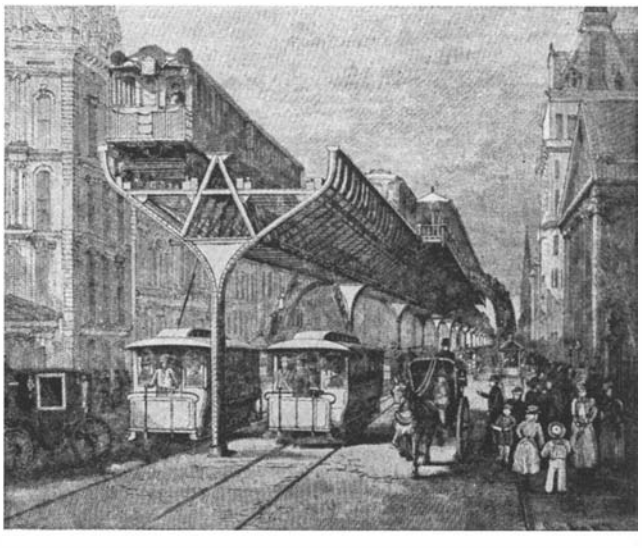
50 Years Ago in . . .

Scientific American

(*Condensed From Issues of May, 1890*)

NEW DEAL?—"When the government buys what every one produces, and pensions every individual in the nation with the taxes collected from every one . . . the government will, of course, then dictate what shall be produced and who shall produce it."

ELEVATED—"In all city streets where there are two surface railway tracks there is a space between them of little use except for direct crossing. To utilize this space is the object of the elevated railway illustrated. . . It carries two tracks, supported upon a single line of columns. Taken in combination with street tracks



below, it practically solves the question of rapid transit. The upper cars move at high speed, make few stops, and carry people quickly to long distances. The lower cars move more slowly, stop often, and take local travel chiefly. Long distance passengers can ride on the surface cars to the nearest elevated station and then take an express train."

BALLOONETS—"Mr. Andre Mahoudeau describes, in *Les Inventions Nouvelles*, a new kind of balloon devised by him, and divided into several compartments. . . One of the advantages of this system is that a rent in the balloon does not imperil the life of the aeronaut. Each compartment is provided with a pipe that descends through a central funnel. In this way, it is possible to inflate the compartments independently of one another, and with gases of different natures."

INVENTORS—"If there is any man to whom the term 'self-made' will most truly apply, it is the inventor. He must possess three general characteristics peculiar to all men who achieve success in life, but in more full development than most others; to wit, ingenuity, enthusiasm, and perseverance. Like the true poet, his soul is in his work; but his is the poetry of substantial achievement, which gives wealth, as well as happiness, to mankind."

STEEL PIPES—"Steel pipes as a substitute for cast iron now form an important item for the engineer's consideration in the conveyance of water. Such pipes are being adopted for several reasons. As their weight is only about one-quarter the weight of cast iron pipes for the same service, the matter of transportation forms an important consideration. They are also much less liable to fracture than cast iron."

HEAVY GUN—"The first high-power, breech loading 8-inch rifle made entirely of American steel lately passed a successful test at the Naval Ordnance Proving Ground at Annapolis. The gun is one of four intended for the cruiser *Baltimore*. Its forgings are from Bethlehem, and the machining and assembling were done at the Washington Navy Yard. With a sample of brown prismatic powder furnished by Messrs. Du Pont, of Wilmington, Del., a muzzle velocity of 2,129 feet per second was obtained with a 110-pound charge and 155 tons pressure. The projectile weighed 250 pounds and its velocity was the highest ever attained by an 8-inch shell in this country."

LABOR SAVING—"One of the latest inventions is a machine for buttering bread. It is used in connection with a patent bread cutter, and is intended for use in prisons, workhouses, and other reformatory institutions. There is a cylindrical shaped brush which is fed with butter, and lays a thin layer on the bread as it comes from the cutter. The machine can be worked by hand, steam, or electricity, and has a capacity of cutting and buttering 750 loaves of bread an hour. The saving of butter and of bread and the decrease in the quantity of crumbs is said to be very large."

AND IRON MEN—"The largest wooden vessel afloat is the *Rappahannock*. . . She was built at Bath, Maine, and cost $125,000. The vessel is 287 feet long, 48¾ feet beam, and her total tonnage is 3,053 net. In the construction of the ship 700 tons of Virginian oak and 1,200,000 feet of Virginian pine timber were used. . . The ship has a steel bowsprit, which is an innovation. . . Her spread of canvas will be 15,000 yards."

SURGERY—"At the Surgical Congress at Berlin, Professor Gluck, of Berlin, gave . . . an exhibition showing a most valuable advance in surgery, namely, the successful substitution of catgut, ivory, and bone freed from chalk, for defects in bones, muscles, and nerve sinews. . . He presented the cases of patients in whom there had been an insertion of from six to ten centimeters of catgut to supply defects in the leaders of the hands, to which complete mobility had been restored . . . In the case of another patient Professor Gluck removed a tumor from the thigh, causing a considerable defect in the bone. He inserted ivory, and no shortening ensued."

POWER—"A scheme has been organized and work begun to generate electricity, by the aid of Niagara, sufficient to drive all the machinery in the mills and factories, propel every horse car, light up every street, avenue, and road in and around the village of Niagara Falls, the city of Buffalo, and the neighboring towns and villages. The present plans contemplate the production of 120,000 horsepower, but there is no limit to the amount of power which may be produced."

AND NOW FOR THE FUTURE

¶ What sort of inventions will help to win modern wars? By Major William H. Wenstrom.

¶ Long-range weather forecasting based on findings in a bog. By W. F. McCulloch.

¶ Commercial possibilities of tantalum, a new-old metal. By Philip H. Smith.

¶ Marvels of the aurora borealis, with illustrations by William Crowder.

¶ Artificial lightning, a big gun of science. By C. W. Sheppard.

Personalities in Science

ERNEST O. LAWRENCE

CHINA in the early 1920's presented a picture of chaos. Warring factions ravaged the country. Nevertheless, by extremely roundabout method, the conflict in China contributed heavily to a chain of events that has led to astounding new knowledge of the world in which we live, a promise of future benefits to mankind, and, incidentally, to the award of the 1939 Nobel Prize for physics to Dr. Ernest O. Lawrence, developer of the atom-smashing cyclotron and professor of physics at the University of California.

Following the close of the World War the Federal Wireless Company had planned to establish a large station in China. An 85-ton magnet had been constructed for use in this establishment. The turmoil in China forced reconsideration of these plans; consequently the company was left with a huge magnet which it was anxious to dispose of.

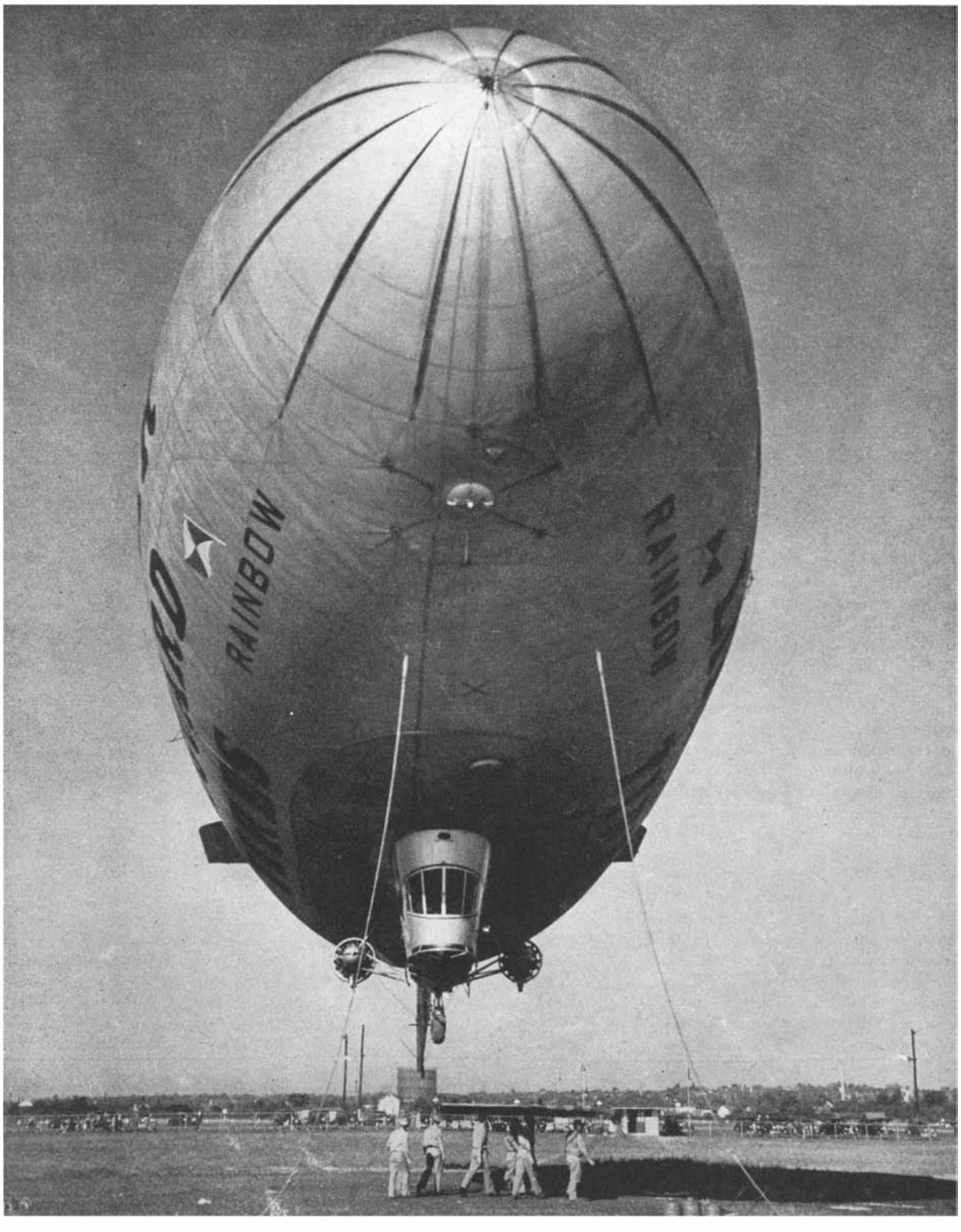
The magnet was purchased by the University of California, to be used as the heart of a new machine called the cyclotron. This machine was to be used by Dr. Lawrence, then newly-arrived from Yale, to explore the interior of the atom. A much smaller cyclotron had already been constructed and had proved its worth in the laboratory, but this was mere child's play in comparison with the work which Dr. Lawrence desired to perform. He wanted to break up the closely knit structure of the atom to see what it was really composed of, and to find out what results might be obtained when the tiny citadel in the nucleus of the atom had been destroyed. To do this he needed a cyclotron many times larger and more powerful than his laboratory model. The first requisite was to purchase a large magnet cheap. The one owned by the Federal Wireless Company answered these qualifications.

The new cyclotron, with its 85-ton magnet, was installed in the Radiation Laboratory at the University. Once it was put into operation exciting news began appearing in scientific journals. Lawrence had smashed the atom more easily than it had ever been done before. He had created strange new substances, never before seen on earth. They were simply sodium, phosphorous, or iron, when they were first put under the blast of the cyclotron, but after being subjected to bombardment they became radioactive. For the first time the world came into possession of radioactive materials that could be manufactured at will, were many times less expensive than radium, and had advantages over radium through the ease with which they can be handled. A new type of radiation, the neutron ray, was discovered. And, while all of these discoveries were of fundamental importance to the science of physics, they also have proved to have tremendous significance in the field of medicine.

During the past year the new W. H. Crocker Radiation Laboratory has been constructed on the University of California campus. It contains, beside a new giant cyclotron with a 225-ton magnet, facilities for laboratory experimentation with the new radioactive materials and for treatment of cancer with the neutron ray. Now Dr. Lawrence is planning the construction of another and even larger cyclotron — one weighing 3000 tons — with which he hopes to unleash the energy locked within the atomic structure, if he can get the money.

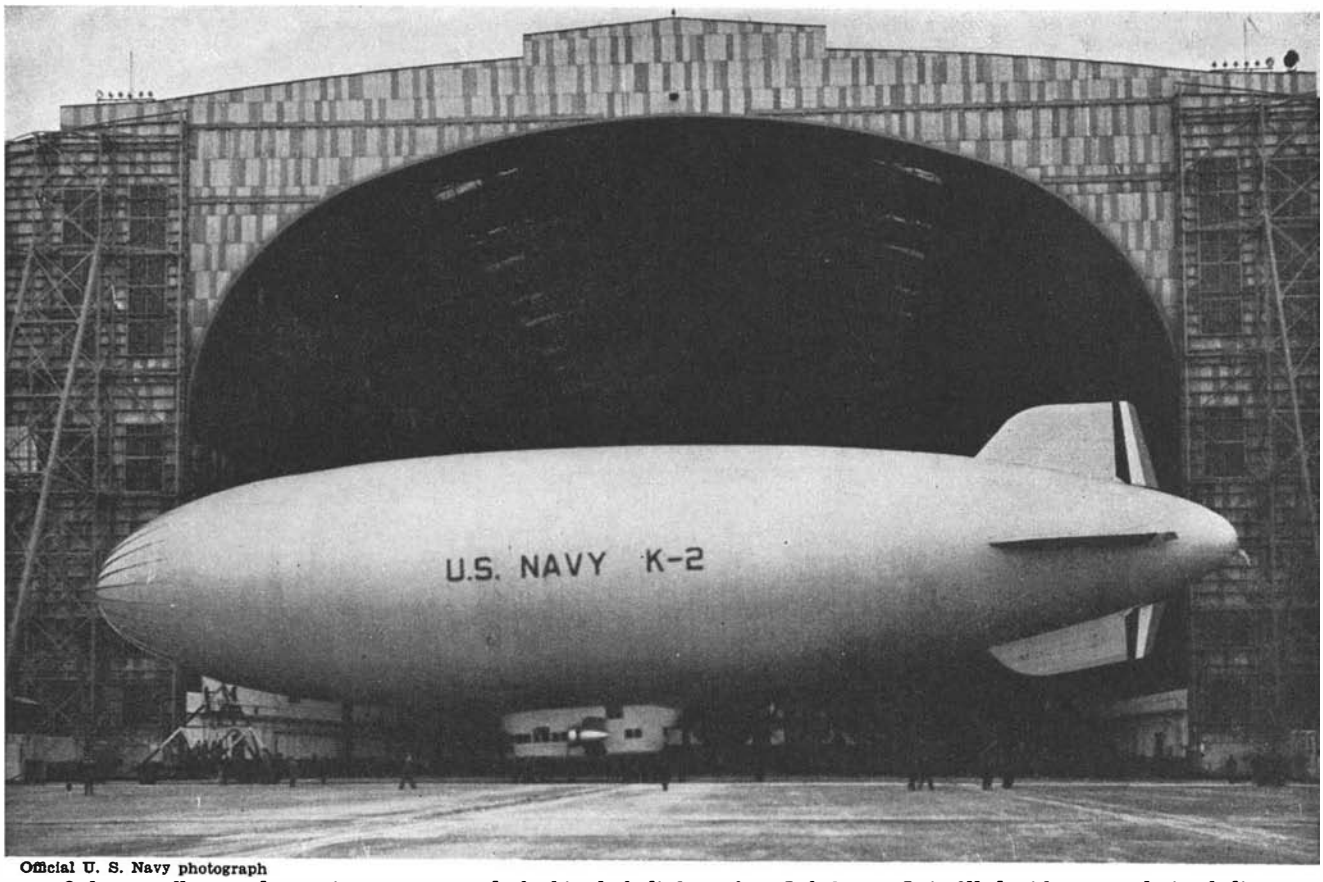
The University of California physicist is one of the youngest men ever to be awarded a Nobel Prize. With his youth he combines imagination, resourcefulness, enthusiasm and, above all a keen, analytical mind. He has surrounded himself with a particularly able staff and insists that they share every honor with him. Under the impetus of Dr. Lawrence's executive ability and far-sightedness, the Radiation Laboratory has become a research institute of the highest rank.

Dr. Lawrence was born in Canton, South Dakota, in 1901. He is a graduate of St. Olaf College, Northfield, Minnesota, and the University of South Dakota. He holds M.A. degrees from the University of Minnesota and the University of Chicago, and a Ph.D. from Yale University. Before coming to the University of California, he was a member of the faculty at Yale. For recreation he likes ice skating, boating, and tennis.



FLAGSHIP OF A RECORD-BREAKING FLEET

OVER the bumpy air of New York City, five blimps, of which the *Rainbow* shown above is the flagship, have flown almost continually for many months. Filled with helium, paying little attention to the vagaries of weather, these ships have proved the air-worthiness of this type which is discussed in the article on the opposite page. Up to April 1, 1940, these five Goodyear airships had flown 3,646,000 miles in a total of 134,771 flights and 81,631 hours of flying time, carrying a total of 362,231 passengers without accident. Such a record makes understandable the Navy's desire for such ships.



Official U. S. Navy photograph

Only a small ground crew is necessary to dock this sleek little craft at Lakehurst. It is filled with non-explosive helium

BLIMPS AND MODERN WARFARE

Neglected Type Used Successfully in World War . . . Potentialities for Scouting, Patrol, Convoy Work . . . New Bill Calls for Several Dozen

By BROCKHOLST LIVINGSTON

IN an effort to round out our naval defenses, Congressman Vinson, Chairman of the House Naval Affairs Committee, early this year introduced a bill to provide for further expansion. Included in the proposed authorizations is one which permits the President to acquire lighter-than-air craft so that a total of not more than 36 useful ships of this type may be maintained. This is the largest such program ever proposed for the United States in time of peace.

None can deny the advances made with the airplane, but this form of flying has not out-moded the airship for wartime uses. Both have limitations but the one can supplement the other. What many have forgotten is that there are two major branches to the science of aviation.

Lighter-than-air comprises various types, just as we have the larger patrol planes and the tiny fighters in heavier-than-air. The Navy, charged with the development of the rigid airship in this country, is still hopeful that further development of this type will be permitted but, meanwhile, believes in the efficacy of the non-rigid, or blimp, for training, patrol, observation, and other duties.

When the first World War broke out, the nations knew little of the capabilities of blimps. It was not long, however, before most were utilizing these ships for all manner of purposes. Even when filled with hydrogen, that demon of the airship, belligerents' blimps made many thousands of successful flights. As the only available lifting gas, hydrogen had to be used even though it increased the vulnerability of the ships. At present, we alone of the nations of the world possess a supply of helium, a non-flammable lifting gas, but we have given little attention recently to airships as an arm of national defense.

WHEN we entered the war in 1917, we hurried as best we could to make up our deficiencies but our earlier neglect necessitated the importation of instructors from the Allied air services. Eventually we constructed a large number of blimps which saw service along our own coasts and from bases constructed in Europe. In a future emergency, we might not be fortunate enough to have allies to hold off the enemy for us while we build up our defenses. That is probably why airships have been included in the expansion bill.

In the last 18 months of the first World War, the British maintained an average of 56 blimps in service and in that period undertook 9059 patrols and 2210 escorts. Blimps located 134 mines and destroyed 73 of them. They sighted 49 submarines and attacked 27 with either gunfire or bombs. Anti-submarine work by blimps was accomplished at far less cost than were similar tasks performed by surface vessels although, for best results, the two types should,

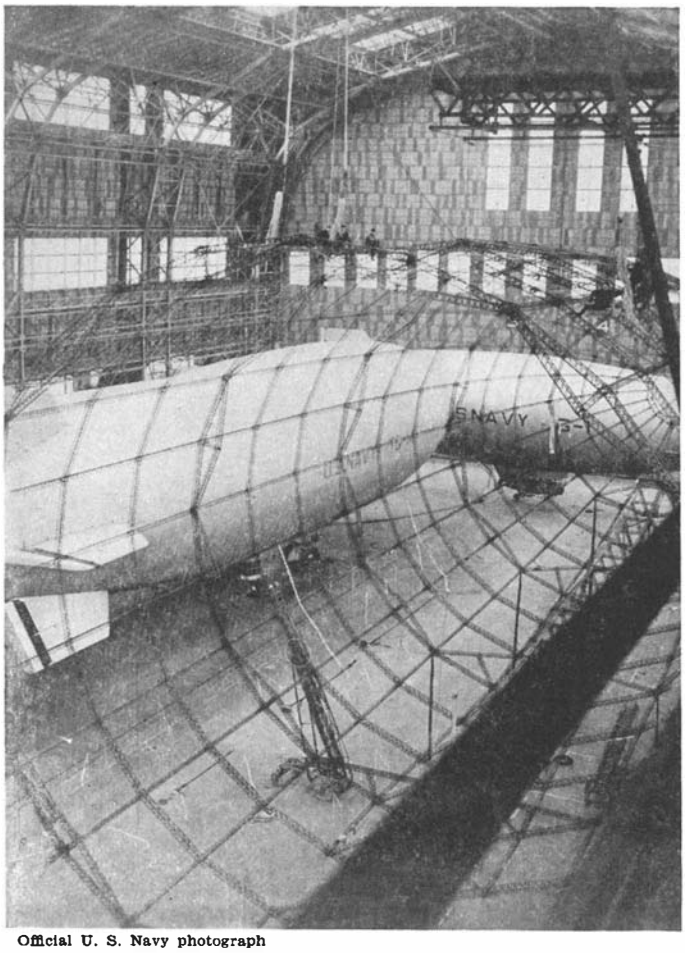
and did, co-operate fully with each other.

Most authorities claim that no ship under convoy by blimps was sunk by submarine; some say only two. Even accepting the latter figure as correct, the efficacy of the blimp, considering the many thousands of ships escorted, is almost phenomenal. It is worthy of note that while the British began the present war without blimps, they have instituted balloon patrols for spotting mine-laying operations.

In 1915, blimps flew only 339 hours, but in 1918 their operations and the number in service had so increased that 53,554 hours were flown. For every blimp fatality, 42,548 miles were covered. In the final eleven months of the last war, there were only nine days in which airships were grounded because of bad weather. This latter fact is of particular interest in view of the criticism directed at airships because of their supposed vulnerability to weather.

IN this connection, some interesting statistics were prepared by the Navy Department shortly after the Armistice in 1918. These showed that a large non-rigid in France had an average percentage time spent in operations of 27 and flew 5270 miles in the last month of the war as against averages of 45.7 for destroyers which covered 4582 miles, and 47.4 for coastal patrol vessels which sailed 2540.9 miles. The airship's flying time was 200.5 hours producing an average speed of 26.3 miles per hour which compares favorably as a convoy speed. The airship's operation record includes only time actually under way, while that for the other ships covers time spent at anchor during darkness as well. The comparison is very favorable to airships. To refute claims of the airship's dependence on favorable weather, it may be added that in the above case it was "worse than average" for the month.

Despite the favorable results obtained from blimp operations in the last war, the end of hostilities saw the beginning of a long period of neglect for this type. Interest in the development of rigid airships and the phenomenal advances made with the airplane retarded progress with a type which had proved its worth in war. Only a small fraction of what has been spent on experimentation with airplanes has been devoted to airships. Even with the limited funds available, however, great strides have been made by the airship branch of our naval aviation. No longer is the airship a crude, ill-shapen thing. Its "streamlining" and other modern developments match those of the airplane. Handling and operational advances have been made to the limit of available means.



Official U. S. Navy photograph

Two small blimps, *TC-14* and *G-1*, seen through the partly dismantled, German-built *Los Angeles* in a Lakehurst hangar

As lessons have been learned, the possibilities for extending the functions of the airship have increased. Besides the war-time duties of convoy and anti-submarine patrol which the blimp performed so well, the small airship has extended its usefulness to such duties as acting as aerial listening post offshore, carriage of infra-red optical range locating apparatus, photographing of the fall of shot in target practice, chasing practice torpedoes, and a long list of other important tasks. Blimps have carried planes in hook-on experiments although this is more within the province of the large rigid ships. Sea rescue work has been facilitated by the development of new devices recently tried out with success by ships from the Naval Air Station at Lakehurst (particularly anchoring devices to hold a blimp stationary within rope-ladder distance from the water — see page 161, March, 1940 Scientific American). Many of these tasks cannot be undertaken by heavier-than-air craft due to their higher speed, their inability to hover, and their relatively lower useful load capacity.

In a test conducted last spring by the Navy's *K-2* it was demonstrated conclusively that blimps may be used on expeditionary work. The objects of the flight were to test the feasibility of mooring a large non-rigid to an expeditionary mooring mast and of transporting mast and equipment by plane; to study the operating characteristics of *K-2* and generally to extend the range of usefulness of this type for coastal patrol operations. Each of these was successfully fulfilled. It was determined that the portable mast is adequate for mooring in reasonably severe weather and, on the flight in question, winds averaging 22 knots with peak gusts of 36½ knots were encountered. It was found the mast could be readily transported by plane and quickly erected at the chosen location. Only a moderate sized landing field and a ground crew of 50 men are needed for operations of this type.

IT was recommended, following the completion of the flight, that the potentialities of the non-rigid airship be further investigated by means of similar operations and that the *K-2* be used for the purpose of familiarizing naval personnel with the possibilities of the blimp in support of local coastal defense measures. Nothing further along these lines was done, however, because the *K-2* was damaged shortly afterward and no other suitable blimp was available. This is a sad commentary on our American reputation for progress.

Nothing useful can be proved by attempts to show the relative merits of the various types which make up a naval force. Many proponents of the airship claim that one of this type is equal to so many cruisers or destroyers. Every known type has a distinct place in the scheme of defense and no one should be developed at the expense of another. However, we do know that, under given conditions, an airship can patrol a greater area than can any surface craft. Blimps are less expensive to construct and to operate than long-range patrol

planes and cost but a fraction of surface vessels capable of comparable performance. The blimp, however, is not a combatant type and may be used to greater advantage for strategic than for tactical scouting.

Our present situation with regard to blimps is not reassuring. We have only eight Navy blimps available and some of these are not in operating condition. Only one, the *K-2*, was built specifically for the intended functions of a naval blimp. The others, including two taken over from the Army when lighter-than-air activities were abandoned by them, range in age from two to ten years and are either adaptations of commercial types or fail to embody recent developments. The *K-2* and the two ex-Army ships are the only ones at all suitable for extended patrol duties. Endurance is dependent on volume; that is, roughly 10 hours at cruising speed for each 100,000 cubic feet of volume. An airship must, therefore, have a volume which will permit it to maintain reasonably extended patrol. A volume of 400,000 to 500,000 cubic feet is considered satisfactory.

Included in our available ships is the *ZMC-2*, a completely metal-clad, as opposed to fabric-covered ship. This craft, built ten years ago as an experiment, is considered to have proved the practicability of metal hulls but we have failed to follow up its possibilities by constructing a ship of larger dimensions.

Official U. S. Navy photograph

During wartime, blimps can scout the vicinity of merchant ships or convoys. In this view the airship *J-4* is making contact with a merchant vessel

OUR ground facilities are equally limited. The air station at Lakehurst is the only one entirely suitable for lighter-than-air activities. The station at Sunnyvale, California, is now under Army jurisdiction but may be returned to the Navy when required. At Cape May, Coco Solo, and San Diego, there are small sheds capable of housing from one to four blimps each. None is now in an operative status and ships suitable for assignment to them are not available. Privately owned blimp sheds in nine different locations could be taken over by the Navy but several are so situated that they would be of little value as patrol bases. The U. S. S. *Wright* which started her career as a balloon tender is now employed with seaplanes, while the *Patoka*, recently recommissioned as an aircraft tender, can handle rigids but has no mast suitable for blimps.

Our personnel situation is not more reassuring. In 16 years we trained only 75 officers as naval airship pilots and many of these are no longer available to the Navy. There are few Naval Reservists qualified for such service, and enlisted personnel trained for lighter-than-air has been widely scattered due to the lack of ships upon which they could continue their interest in this type. All in all, the picture is not a bright one and yet situations are developing abroad which blimps helped to meet in the last war and could in this were they available. Whether we shall enter the war or not does not detract from the necessity of our being prepared in every respect and with every arm modern warfare can utilize in its pursuit. The loss of the *Courageous* might have been avoided if blimp patrols had flown over her operational area to determine the presence or absence of enemy submarines. The *Royal Oak* might still be an active vessel of the British Navy if blimps had been on constant patrol duty outside the entrance to Scapa Flow. Because of its higher speed, the airplane cannot perform these functions as well as the airship. Flying over the sea at 150 miles an hour, one is more likely to miss objects below than if he is flying at only 50 miles an hour.

No one claims that the blimp is the answer to all our air problems but we had fairly conclusive evidence of its efficiency in 1914-18. If small, inexpensive non-rigids can save even one ship which might otherwise become the victim of attack, the effort and expense involved in providing them have been worth while. For the neutrality patrol which now occupies the attention of our naval forces, there is no more ideal type than the blimp. Patrols of this nature do not require heavily armed vessels but the ability to cover the tremendous areas around our shore-line is vital.

There are disadvantages to the airship and these are fully recognized by their advocates. But, the same is true of every known type of naval vessel. We do not pit a cruiser against a battleship if we can help it and, similarly, we should not match the airship against stronger craft. The mission of the airship is to carry out its duty with least risk, and evasion is one of its strongest defenses.

Blimps *have* a place in our naval establishment. The provision of the number of airships referred to in Mr. Vinson's bill would permit the granting of educational orders in line with our industrial preparedness program. This will make it possible to maintain at least the nucleus of an airship industry in this country. The ships to be provided will also permit the first large-scale operations both with the fleet and on local defense duties. It should be possible by these means to determine more accurately the full extent of the capabilities of blimps as adjuncts of the national defense and to continue the training of personnel which we shall need in an emergency. Further development of experimental types such as the metal-clad airship may also be undertaken. Our extensive coast-line makes the airship particularly valuable to us and our possession of the world's helium supply decreases the vulnerability of the type.

War rages abroad. No man can foresee when or how we may be drawn into its flames. We have neglected the blimp for far too long. It is time we got started on making up for our neglect. The program which has been proposed is evidence of a growing recognition of this.

WHO WAS SHAKESPEARE?

Reader Response to X-ray Revelations of Identity of Shakespeare, Published in January Number . . . Presenting Further Evidence from Other X-rays

RARELY has a magazine article aroused such widespread interest as the one by Charles Wisner Barrell entitled "Identifying 'Shakespeare' " which appeared in our January number.

Hailed by many readers as one of the most remarkable true detective stories of the time, the article was based on an investigation that its writer and his technical associates carried out with X-rays and infra-red photography on a series of ancient paintings long known to Shakespearean authorities as traditional portraits of the Bard of Avon.

Through exigencies of space, Mr. Barrell was obliged to confine his discussion to one of these paintings, the famous Ashbourne canvas, owned by the Folger Shakespeare Library, of Washington, D. C.

With the scientific media employed, he demonstrated graphically that the man who originally sat for this portrait must have been the mysterious Elizabethan Court poet and dramatist, Edward de Vere 17th Earl of Oxford.

In his own day, Lord Oxford was known as the writer foremost "in the rare devices of poetrie" but, at the same time, one whose "doings" could not "be found out and made public with the rest."

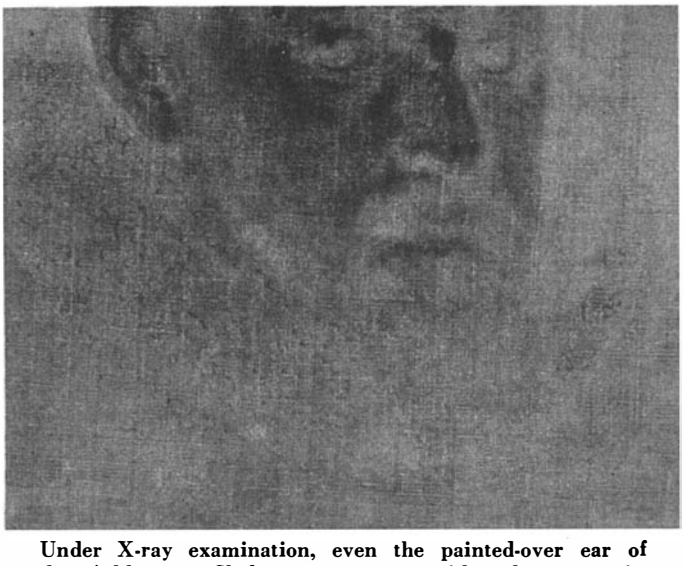
Of late years, his name has frequently been associated with the long-disputed authorship of the Shakespearean plays and poems, beginning with the publication in 1920 of J. Thomas Looney's scholarly volume, " 'Shakespeare' Identified in Edward de Vere 17th Earl of Oxford."

Mr. Looney's work won the endorsement of such scholars, historians and students of the Elizabethan period, as Dr. Gilbert Slater of Oxford University; Dr. Gerald H. Rendall, former Headmaster of the Charterhouse School; Alan Gordon Smith, author of "William Cecil, the Power Behind Elizabeth;" Sir Geoffrey Callender, historian of the Tudor Navy and knighted for his writings on the Elizabethan Age; Dr. Sigmund Freud, the psycho-analyst, whose studies of the Shakespearean plays had a profound influence upon his professional theories; and John Galsworthy, the novelist, who helped distribute the book by Looney.

Since Lord Oxford's long-hidden career as poet and dramatist was first brought to light in 1920, more than 30 additional volumes of research and commentary relating to his life have been published.

These facts are mentioned to make clear the point that, while Scientific American is not a literary or historical magazine, Mr. Barrell has substantial corroborative backing for the conclusions that he drew from his X-ray and infra-red dissections and discussions of the ancient Shakespeare portraits.

A close-up view of the ear from the X-ray photograph shown below



Under X-ray examination, even the painted-over ear of the Ashbourne Shakespeare agrees with other portraits

Moreover, while Mr. Barrell submitted for our consideration some 75 X-ray, infra-red and panchromatic photographs, together with voluminous documentation covering his studies of the Hampton Court, the "Janssen" and the Ashbourne paintings of the Bard, it was a manifest impossibility to publish anything more than a digest of his material in one issue of the magazine. It also seemed necessary to concentrate on a single set of the dissective photographs. Those relating to the Ashbourne portrait were chosen. But equally interesting and telling evidence could have been used from the Hampton Court or "Janssen" paintings, which also indicate that they are disguised originals of the poet-Earl whose "doings" in the literary world of his own day were so difficult "to find out."

The Associated Press and other news syndicates treated "Identifying 'Shakespeare' With X-Ray and Infra-Red Photography" as a special wire feature. As a result, versions of the story were printed in some 2000 newspapers, news reviews and magazines throughout the United States and Canada. Many of these items were given front page space. In addition, many columnists, such as Walter Winchell, Benjamin de Casseras, Joseph Henry Jackson of *The San Francisco Chronicle*, Ada Hanifin of *The San Francisco Examiner*, Harlow R. Hoyt of *The Cleveland Plain Dealer*, and so on, gave the Scientific American article much space. From Maine to California and from Winnipeg to San Antonio, millions of newspaper readers had their attention called to the first discoveries of their kind ever announced in the field of Shakespearean research. Nearly a hundred prominent journals devoted editorials to the ensuing controversy. During one week, *The New York Times*, *The New York Post* and *The New York Sun* commented at length. On January

(*Please turn to page* 299)

OUR POINT OF VIEW

Proportion

IN his thought-provoking article on "Man's Earthly Future," concluded elsewhere in the present number, Professor Mather points out that, even though man now seems to have learned to control the environmental factors that invariably have exterminated other higher mammal species within 3,000,000 years, and thus may survive indefinitely, he may lose this ability and thus may end in the same oblivion as the rest.

Judging by comments heard here and there in conversation, many prefer to believe only the best. They do not like to think of this old Earth which they call "ours" rolling on and on through space without the presence of man to adorn it and, as they put it, take care of it. This earth with none to work the soil and fisheries and mines; none even to run away with Kentucky hordes of gold or bother to look at them; everywhere peace . . . revolting thought.

But if this old Earth had a consciousness and voice it might chuckle and say, "Oh, don't worry. I hardly knew he was here. I'll get along fine. I always did."

There is, however, sound scientific basis for the cheerful statement that if man became extinct men would evolve again from some of our cousins the apes. If not, then from our more distant cousins the monkeys. And if all the primates became extinct, more would evolve. If all the higher animals became extinct, in time the same animals would evolve, provided the environment were the same. All this might take a billion years or so but what's a billion years in the course of cosmic time?

So man, modern man, civilized man, may be taking himself just a bit too seriously. What he most needs here is a sense of proportion.—*A. G. I.*

No Block to Progress

RECENT controversy between the Federal Communications Commission and Radio Corporation of America brings once more to attention an important phase in the development of television. Shall television transmission be commercialized — thus, as some hold, freezing television standards to the detriment of technical development — or shall commercial television programs be withheld and the art continue on an experimental basis?

Analysis of this problem requires some reiteration of what has gone before. Detail in a received television image depends on the number of lines into which the original has been broken for transmission. The receiver, of course, must operate on the same line standard in order to reassemble the image so that it can be seen. A receiver designed for operation on a 441-line signal, for example, cannot receive the images from a transmitter that is operating on a 605-line standard. Then, too, televison transmitters are costly to construct, expensive to operate. Television companies cannot continue experimental work indefinitely unless permitted to acquire some financial return on their investment. And the only logical way to receive such return is to sell advertising time on the air, just as is done by sound broadcasters.

Opposite as these two factors of standardization and finance may appear, they are inseparably linked. A line standard must be set before a satisfactory system of commercial television can be established. And the 441-line standard that is being used by Radio Corporation of America is under fire as possibly not being the last word. Some commentators feel that an attempt to establish commercial television on this standard would result in the freezing mentioned before.

Let's look at it this way: In this writer's opinion, 441-line television is good. Sometimes it is excellent. There is plenty of work for engineers to do, for some time to come, in improving the consistency of excellent reception, decreasing the times of poor reception. And this work can best be done if a standard basis has been set up. There will be one less variable for them to consider, one more fixed point from which to operate.

If this fact can be coupled with an opportunity for the television companies to realize a return on their investment, the picture will look brighter. With money coming in, they will be able to improve their service, produce better programs, make technical advances that would be impossible otherwise. Without such financial support, television may languish in the laboratory for years to come. It all boils down to this: Good television is available now. Let's make use of it, study it under wide-spread operating conditions, improve it as much as possible. Setting a 441-line standard will not result in freezing progress. Rather, it should result in tremendous acceleration.

—*A. P. P.*

An Unwanted Investigation

IF we are to believe the politicians, the Federal Bureau of Investigation is rapidly becoming an American Gestapo and the Bureau's Director, J. Edgar Hoover, a ruthless dictator with insidious power. The politicians want to investigate the Bureau, having already made up their minds that private citizens can no longer look for justice at the hands of the Bureau.

Of course, it may all have been a dream, but we seem to remember the wave of jungle law that swept over the country a few years ago. Public enemies took their toll of human lives—including little babies who were kidnapped and murdered after ransom was paid. Local peace officers were powerless, when into the fight stepped an organization that had long functioned efficiently but had never had spectacular chores to give it publicity before. That organization cleaned up the "public enemies" down to the last unimportant individual.

The Federal Bureau of Investigation, under the leadership of its greatest Director, J. Edgar Hoover, indeed performed a spectacular task in a way designed to impress criminals of its power against them. For the new sense of security which the Bureau gave to the country, that country is grateful. Naturally, the Bureau gained a high and glorious esteem in the hearts of all Americans. Consequently it has been given the chance to expand and become more efficient. In most respects, it is now the finest, most scientific, and consistently successful body of its kind in the world. Its record is spotless, for neither J. Edgar Hoover nor any member of the Bureau can be bought or intimidated—never could be and never will be!

There are no political appointees in the Bureau, yet an investigation of it would put the Bureau into politics simply because Congressmen will necessarily take sides in the ensuing argument. This may be the intent of the politicians—in order to grab some of the Bureau's glory for their own party or to open up within the Bureau new patronage for party members. No matter what the reasons behind the proposed investigation, it would play into the hands of organized crime, for criminals would like nothing better than to see the Bureau's powers limited. In any case, the whole idea is ridiculous, and if the investigation does go through, it is our firm belief that, not the Bureau, but the politicians will be adjudged guilty of Gestapo practices—by a public that is grateful for the work of its Federal Bureau of Investigation and J. Edgar Hoover.—*O.D.M.*

TREASURE IN EAST ANGLIA

A Buried Anglo-Saxon Ship . . . Riches in Refined Gold and Silver Work . . . A Surprise to Archaeologists and Historians . . . Unearthed in England

By J. REID MOIR, F.R.S.
President of the Ipswich Museum, Ipswich, England

A DISCOVERY, unique in the history of western Europe, has been made in eastern England. The county of Suffolk is already renowned for its wealth of archeological remains, but the discovery of a royal ship burial beneath a tumulus or sepulchral mound at Sutton Hoo, near Woodbridge, is an event overshadowing in romantic interest all other discoveries in that part of England.

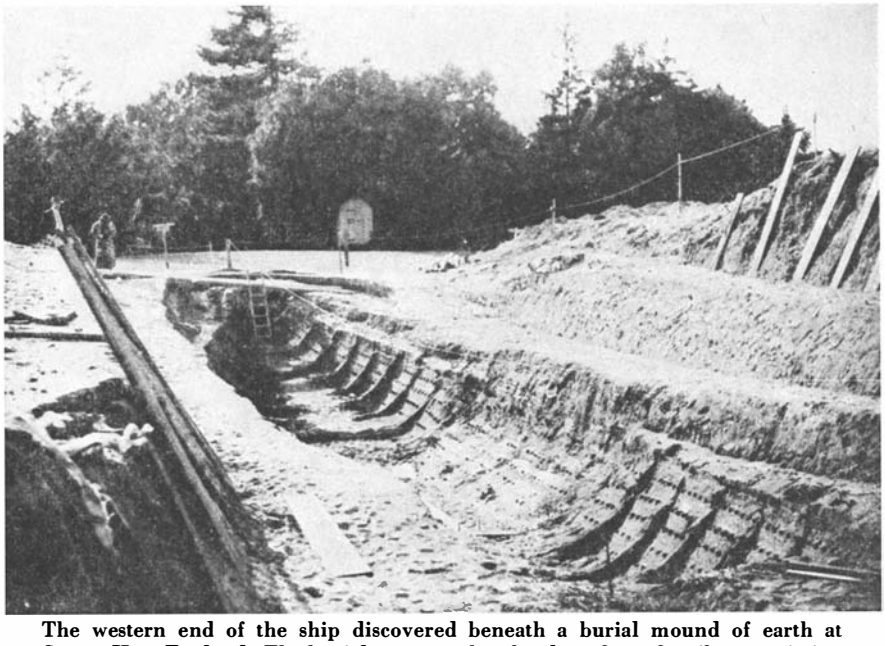
When the Roman power, which for over 400 years had governed Britain, began at last to wane, enemy raiders, coming across the North Sea, started to invade that country. The earliest of these were the Anglo-Saxons, who were followed in later times by the Vikings, who burned and raped and pillaged to their hearts' content up and down the whole length of Britain's eastern seaboard. All these people were sea-rovers, and when their great men died they were buried in the ships which had carried them on their voyages in this world and would be used for a similar exciting existence in the next.

Clearly, the idea of an all-pervading peace had not then entered men's minds. After the departure of the Romans from Britain, a period about which very little is known began, and without much doubt was characterized by increasing lawlessness, fighting, and disorganization. But it is known that, toward the close of the 6th Century, A.D., Redwald, the third ruler of the East Anglian tribes, held sway in eastern England. He died about 617 A.D., and there are weighty reasons for believing that the treasure ship found at Sutton Hoo represents the grave of this warrior King.

REDWALD'S history is of considerable interest. Under the influence of King Ethelbert of Kent he adopted Christianity, but, on arriving back in Suffolk, is supposed, under the influence of his wife, to have reverted to paganism. It is believed, however, that from then on he kept, as it were, a foot in each theological camp, and in his temple at Rendlesham, some few miles from Sutton Hoo, he caused to be erected two altars, one to the Christian God, and the other to the pagan deities. If this is true, the nature of the burial found at Sutton Hoo becomes of much interest. It was, in fact, aggressively pagan in character, and may represent Redwald's pagan interment, while his Christian burial may be elsewhere at a site not yet discovered. In any case, no traces of human bones were found at Sutton Hoo, and, while this is possibly to be accounted for by the non-preserving nature of the soil there, it is equally possible that no body was ever interred in the tumulus, which represents a token burial to the high gods of paganism.

The site at Sutton Hoo is on the north bank of the River Deben and is situated about 100 feet above the water. There are a number of tumuli at this spot, and, on the request of Mrs. E. Pretty, the owner of the estate, who generously financed the work, Ipswich Museum had excavated, during 1938, certain of the smaller mounds. The archeological results of these diggings were interesting, though not spectacular, as definite signs of boat-burials had been found, accompanied by cremated bones and certain funerary objects. These at the time were thought to be of Viking age but it was clear that the mounds examined had in all probability been dug into before, and it was not possible to decide with certainty the age of the burials from the scanty objects recovered.

© British Museum
A six-inch gold buckle, of horse's head design, from the Sutton Hoo burial chamber in the ship below



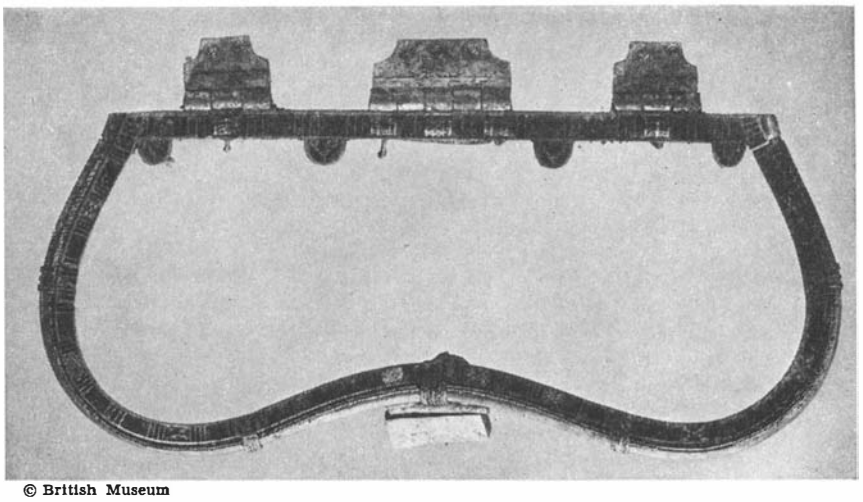
The western end of the ship discovered beneath a burial mound of earth at Sutton Hoo, England. The burial treasure chamber lay where the ribs are missing

In 1939, work was begun on the largest of the burial mounds at Sutton Hoo, and it was not long before Mr. Basil Brown, in charge of the excavation, came upon evidence pointing to the

presence of a large ship underneath the tumulus. Though very little of the actual woodwork remained, the original shape of the vessel was clearly to be distinguished by the rows of large iron rivets still in place in the sand, and the evident signs of the position of the ribs of the ship.

She was 82 feet long, with a beam of 16 feet, and represented a more or less flat-bottomed rowing galley with 16 or 18 oars on either side. To the west lies the Deben Estuary, ready to bear the ship away on her ghostly voyage to the far distant spirit land.

It is possible to conjure up the scene when the burial of King Redwald took place. Evidently it was a somewhat lengthy process. First, the preparation of the trench for the ship, and later hauling it, by means of teams of horses and rollers, up the steep slopes of the valley side. These things no doubt took time and were followed, in all probability, by funerary feasts and ceremonies of an elaborate kind.



© British Museum

Gold frame of the King's purse, with sliding catch and hinged strap fastenings

© British Museum

Two of the nested silver drinking bowls found with their nine drinking horns

© British Museum

A silver dish, 15 inches in diameter, bearing a female head in répoussé

All these matters are intensely interesting, but when we turn to the contents of the wooden tomb chamber in the center of the ship, these feelings change to amazement. The richness and completeness of the funerary objects in a measure compel comparison with those found in Tutenkhamon's burial chamber in Egypt. Never before has such an array of beautiful gold and silver objects been discovered in a tomb in western Europe, and no one had any idea that the East Anglian Kings of 1300 years ago possessed treasures of the kind unearthed. Clearly, the grave was that of a man, and the richness of the funerary objects indicated that he was of the highest rank. There were present his spears, axe, and sword, the golden pommel of which, and the massive boss from the center of the shield, were beautifully decorated with interlacing ornament and enriched with enamel.

The excavator of Anglo-Saxon graves is usually more than content if his labors are rewarded occasionally with a brooch crudely set with garnets, or one or two imperfect spearheads. At Sutton Hoo, however, was a massive gold buckle, possibly from a magnificently decorated sword belt and nothing less than a masterpiece of Anglo-Saxon interlacing design. Also two pairs of splendid clasp-plates, possibly used as armlets, with rich decoration of sliced garnets and millefiori glass inlaid and mounted in solid gold.

The great purse, of which the gold frame lay by the side of the presumed site of the body must, when entire, have been a magnificent object. The sliding catch of the gold frame is in perfect condition, and the workmanship and design of this and other objects is a revelation of the supremacy of Anglo-Saxon and Frankish art at this period.

One of the most remarkable finds is a great whetstone, or honing instrument, four-sided, with bearded faces cut in relief at either end, which also carried bronze cup mountings. But, in addition to these war-like furnishings, the grave contained many silver objects for use in the celestial feasts. A great Byzantine dish, made in Constantinople in the time of the Emperor Anastasius, lay to the east of the place where the body was presumed to have lain. Beneath this dish, which bears inside its base the name and portrait of the Emperor, lay a silver dish 15 inches in diameter, bearing a répoussé female head in the center.

In association with these were nine nested silver bowls, with the same number of drinking horns mounted in silver. Thus, the dead King was to be enabled to entertain in the world of the shadows, and to pay his way with the 40 gold coins and two small ingots of gold which were found close by his magnificent purse.

It is impossible to describe all the funerary relics at Sutton Hoo: the silver spoons, the numerous objects of iron, some for culinary purposes, and the much decayed wooden specimens, one of which may represent a musical instrument. All the relics are being treated and examined at the British Museum, under whose auspices the final stages of the excavation were carried out, and to which, by the generosity of Mrs. Pretty, all the finds have been presented.

●

Archeologists are referring today to the Sutton Hoo discovery as the finest ever made in Great Britain, perhaps in Europe.—Editor.

Don't Worry—It Can't Happen

By JEAN HARRINGTON

JUST about a year ago, two German physicists who had been gunning at the metal uranium with neutron bullets, just to see what would happen, suddenly found that they had caused the biggest explosion in atomic history. It wasn't a big explosion in an everyday sense; no Berlin window panes rattled at the blast, and no one heard the noise. But it seemed big and loud to other physicists all over the world. They had never before known of an atomic blast of such tremendous energy, and presently they began to worry about it.

Scientific American, for October, 1939, contained an article, "Two Atoms for One," which described the German discovery and the flurry of research and excitement which followed. The new phenomenon was called "nuclear fission," because Hahn and Strassmann, the two Germans, had found that their neutron bullets split the heavy cores of uranium (and a few other heavy elements) into halves.

Previous experiments had succeeded only in knocking chips off atomic nuclei, and these operations released only a tiny fraction of the boundless energy locked up in atoms. But, when uranium cracked in two, 200,000,000 volts of energy burst forth in the form of radiation, heat, and speed.

Scientists have long wanted to convert matter into usable energy, and this was the biggest step they had ever taken in that direction. No matter that there was still an almost astronomical number of steps to be taken. Feverishly they began to attack uranium in their laboratories.

IT was soon apparent that quite a number of strange and wonderful things happened when the uranium nucleus blew up, as the accompanying diagram shows. Besides the two main fragments, a few spare neutrons (two or three per fission) were thrown off from the original nucleus. In addition, the two new atoms were unstable, erupting neutrons and other particles in a whole series or chain of reactions until they finally subsided. The result was a great hodgepodge of new atoms and extra neutrons.

Early last summer, in the midst of all this research, a chilly sensation began tingling up and down the spines of the experimenters. These extra neutrons that were being erupted — could they not in turn become involuntary bullets, flying from one exploding uranium nucleus into the heart of another, causing another fission which would itself cause still others? Wasn't there a dangerous possibility that the uranium would at last become explosive? That the samples being bombarded in the laboratories at Columbia University, for example, might blow up the whole of New York City? To make matters more ominous, news of fission research from Germany, plentiful in the early part of 1939, mysteriously and abruptly stopped for some months. Had government censorship been placed on what might be a secret of military importance?

The press and populace, getting wind of these possibly lethal goings-on, raised a hue and cry. Nothing daunted, however, the physicists worked on to find out whether or not they would be blown up, and the rest of us along with them.

Now, a year after the original discovery, word comes from Paris that we don't have to worry — at least, probably not. Frederic Joliot, son-in-law of Mme. Curie, and three co-workers, von Halban, Kowarski, and Perrin, finally traced to its end the tumultuous course of the uranium-fission chain reaction. They found that, instead of building up to a grand climax, it runs down and stops like an unwound clock.

Their method was to measure the total number of neutrons emitted in one of these chain reactions. The original fission liberates two or three. They found that the remainder of the chain produced five or six more, an average of eight for each split nucleus. If the process were cumulative, there should be far more than that.

With typical French — and scientific — caution, they added that this was perhaps true only for the particular conditions of their own experiment, which was carried out on a large mass of uranium under water. But most scientists agreed that it was very likely true in general.

The key to the problem is probably the speed of the neutrons. In the original experiments it was soon found that relatively slow neutron bullets were the most effective in producing fissions. As the chain reaction proceeds, and more and more energy is released, the uranium target becomes heated. The extra neutrons are perhaps so speeded up by the heat that they cease to be efficient atom-busters. Thus the reaction poohs out as the temperature rises.

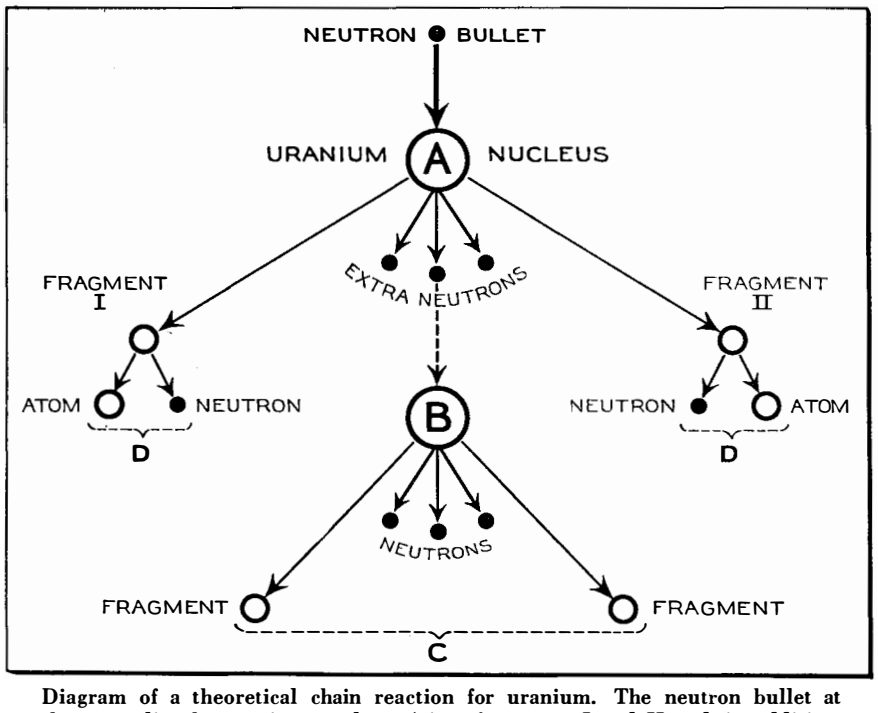


Diagram of a theoretical chain reaction for uranium. The neutron bullet at the top splits the uranium nucleus *A* into fragments I and II and, in addition, erupts three extra neutrons. One of the latter may hit another uranium nucleus *B*, and split it into similar fragments and neutrons *C*. Each of the first two fragments may break down into another atom plus a neutron, as at *D*. The total number of neutrons is eight. Readers made insomnious by "newspaper talk" of terrific atomic war weapons held in reserve by dictators may now get sleep

PACKAGED BY SCIENCE

THE package in which a product is sold becomes more and more important. Designers have tackled this problem with a vast amount of research in the effort to provide more attractive packages, packages that are more easily opened, and others that provide combinations of advantages not hitherto available. On this page are shown a few of the 60 prize-winning packages chosen from more than 30,000 entered in the 1939 All-America Package Competition, sponsored by *Modern Packaging* magazine. Some of them are startling innovations. Offhand, one might imagine all these developments simply the result of certain ingenuity displayed by the sales force, but their ingenuity goes deep into the processes of scientific research. None of them would be possible were it not that research departments have developed, for example, new films resistant to pickle vinegar, newer alloys resistant to fluids used in medical dressings, and new processes for handling and improving upon the uses of these and many other products.

First wet, pre-medicated dressing, Tu-Ba-Gauze, in a sterile tube. Compact, for the first-aid kit, it holds a square yard of gauze wet with three ounces of medication. A thumb nail cut opens it easily

Made of a heavier quality of the material Pliofilm, of which some women's raincoats are made, a new pickle pack—pickles and juice—is a limp bag inside the window box. More convenient for shipping, store-shelf stacking, and general handling, the bag is opened by cutting with a knife

Eye-catching beauty of ruffling in these transparent counter display containers is overshadowed by the protection against soiling and rumpling they provide. The transparent material is Vuepack. Clerks touch only yardage sold; inventory means counting remaining rows in containers

Lower Right: **Shoe polish in a collapsible tube which screws into base of a brush. Squeezing the Shubador tube pushes shoe cream into the center of the brush. The cream stays fresh as it is not exposed; and the fingers do not touch the cream**

A special award was given for the process made possible by this valve-headed can. Corn is cooked in can in 30 seconds at high temperatures under vacuum. It is claimed to give a degree of flavor preservation never before attained in cans

Protection against contamination and loss of flavor is given to cheese by the transparent, inner bag. While still hot and molten, the cheese is poured into a bag of Pliofilm which is then heat-sealed. Other foods—coffee and the pickles shown above—are also hermetically sealed in this same material which is rubbery, slightly elastic

RAILROADBED HIGHWAY

Super-Highway Across Pennsylvania Follows Old Railroad . . . Original Tunnels Utilized . . . No Sharp Curves . . . No Steep Grades . . . Speed With Safety

By F. E. WOOD

IN the forest fastness of Pennsylvania's mountains, one of this country's last remaining frontiers is falling a victim of engineering achievement, as a small army of 10,000 workmen cuts through a "dream highway" that is expected to be the first link in a network of super high-speed motor roads from coast to coast.

This four-lane divided highway, being built at a cost of $60,000,000, is called the Pennsylvania Turnpike. Completed, the Turnpike will run 160 miles over an old wilderness trail that was cut through before the turn of the century by a railroad syndicate but never completed, and will use seven of the old tunnels. Next summer, the Turnpike will be thrown open to the nation's 27,000,000 motorists, busses, and trucks as a speedy passageway through the Appalachian Mountains between Harrisburg and Pittsburgh.

This highway is, however, more than just a super motor road. It has military significance of prime importance. The Turnpike will link Pittsburgh, seat of the nation's vast steel industry, with the eastern seaboard, permitting rapid transport of vital materials in time of war. And although this factor is not stressed by the Pennsylvania Turnpike Commission, it is understood to be one of the major reasons that the Public Works Administration agreed to underwrite $26,000,000 of the road's total cost.

At the instigation of the War Department, the Bureau of Public Roads even now is making a detailed survey of this country's 3,000,000 miles of highway system from a military point of view, ever mindful of the need for rapid transport of troops, guns, and supplies to safeguard our shores from enemy attack and protect inland strategic points.

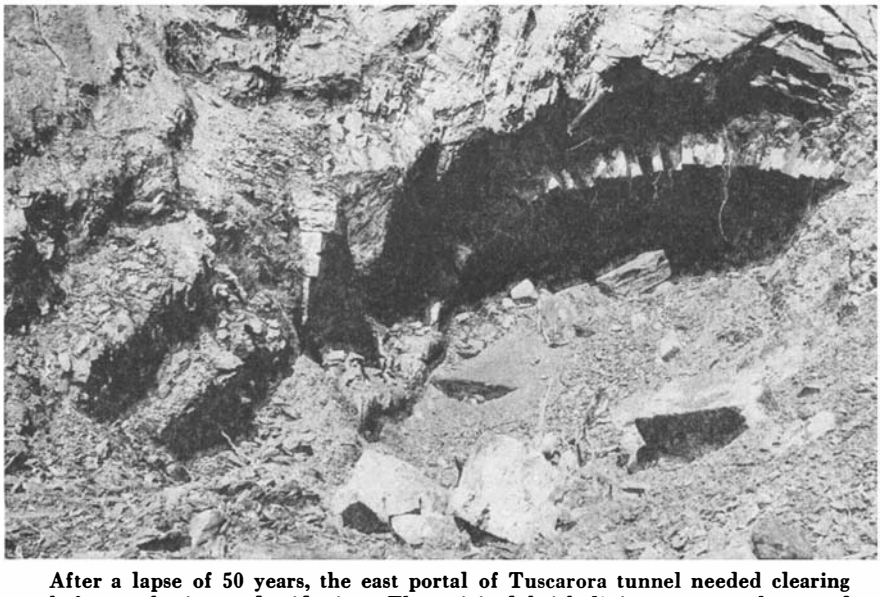
Although Congress has often been told that the country's present roadway system is adequate for the transport of troops, highway engineers point out that many improvements are necessary for movement of heavy artillery and other bulky military equipment. Most of the high-speed roads constructed within the last five years have taken this into account, but, the engineers contend, little has been done to construct roads thoroughly geared to military emergency demands.

The Harrisburg - Pittsburgh highway is, primarily, a commercial road, but its military aspects have been considered should the need arise for the rapid movement of troops between the two cities. To augment this, engineers who designed the Turnpike planned for an extension of this new superhighway to Philadelphia.

The Turnpike was routed so that it could utilize to the best advantage seven of the tunnels and most of the roadbed of the Old South Penn railroad that was started 60 years ago by William H. Vanderbilt and Andrew Carnegie, who sunk $10,000,000 into their enterprise before abandoning it.

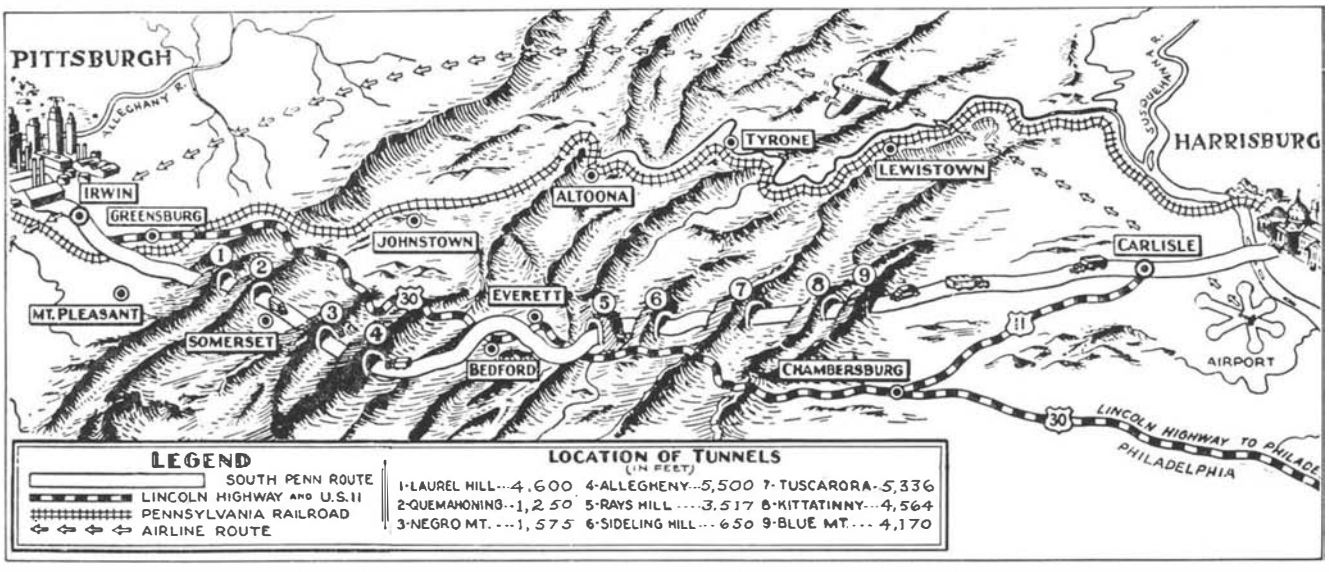
Divided by a 10-foot parkway, the Turnpike is the most scientifically designed thoroughfare ever planned, its engineers claim. By using seven of the abandoned railroad-project tunnels, the longest of which is a little more than a mile, steep grades are eliminated. The maximum ascending grade will be no more than 3 percent, and curves will be long and sweeping, with a minimum radius of 1000 feet. This design makes for a degree of sustained speed such as never before has been possible on other highways. Maximum safety at maximum speed is allowed because at no point will a curve loom at the end of a long straight stretch or near the crest of a grade. A minimum of 1000 yards vision is assured at all times.

One of the many rubber-shod pieces of construction equipment used

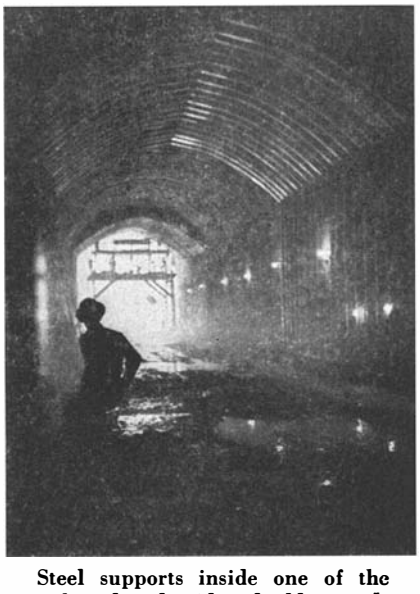


After a lapse of 50 years, the east portal of Tuscarora tunnel needed clearing before re-boring and widening. The original brick lining seems rather good

With a total length of 162 miles, the highway will pass through many cuts and over fills that make necessary the excavation of 26,000,000 tons of earth and rock. Along the route, the seven tunnels to be utilized—named for the mountains which they cut through—are Blue Mountain, Kittatinny, Tuscarora, Sideling Hill, Rays Hill, Allegheny, and Laurel Hill. Sideling Hill, the longest,



The Pennsylvania Turnpike will have great strategic importance—linking our greatest steel center with the eastern seaboard



Steel supports inside one of the re-bored and widened old tunnels

runs 6650 feet. The others average slightly more than one mile in length.

The old railroad tunnels, most of which were only about half finished, are being bored to extra width and height to make way for the wider roadway. They will be buttressed with steel beams, concrete, and structural glass. The Turnpike, running over a 200-foot right-of-way, is graded 78 feet wide in the open, and narrows to 28 feet at the entrance to the tunnels. On fills are 10-foot shoulders. In the tunnels, cars will travel on two 11½-foot lanes. Of 176 horizontal curves, only 10 are of more than 4 degrees.

Construction on the project is a race against time. In order to qualify under the terms of the federal grant, the express highway must be "substantially completed" by June 29, 1940. And the engineers directing the gigantic task say it will be ready for the public by the Fourth of July. If the road comes through on time—and with the pace already set, this seems assured—it will set a record for high-speed construction of high-speed highways.

Because of the necessity for speed in building, the 27 contractors engaged on operations have moved onto the right-of-way with the most modern excavating, grading, and road-building equipment. Gone are most of the old-fashioned steel-wheel earth movers. In their stead are some 300 to 400 fast-moving, rubber-shod machines. Some of the earth-mover tires, designed especially for this type of big-load operations, measure eight feet in height, weigh nearly 1000 pounds, and give increased traction to the large excavators, some of which haul 30 cubic yards of earth and rock per trip.

CONTRACTORS on the job report that rubber-shod equipment reduces operating costs as much as one-third and speeds up operations so greatly that the highway will be completed in one-third the time it ordinarily would require with less modern rolling stock. W. H. Elliott, technical director of design for bus, truck, and earth-mover tires for the B. F. Goodrich Company, estimated that more than four-fifths of the machinery used by contractors on the 160-mile highway project is rubber-shod, bringing the total number of units to 1000.

Never before have highway builders undertaken to tunnel a roadway through such a mountainous region. The mountains range from 2000 to 3000 feet in altitude in some of the most picturesque country in North America. Pennsylvania's other two major highways, the Lincoln and the William Penn, have solved part of the transportation problem in the state, but the rapid increase in traffic left these two roads inadequate to handle the greater volume. The Lincoln Highway crosses the mountainous region with steep grades and sharp curves, and the William Penn follows the winding Juniata River and crosses one range, the Allegheny escarpment.

Scientific protection is given workers on this giant tunneling project. Although Pennsylvania has no complete dust-control law, the Turnpike Commission is following New York's statute closely with mandatory wet drilling when the dust content of the tunnels exceeds the allowable limit.

Altogether, 114 bridges will be built along the highway, and several viaducts will be necessary to elevate the high-speed Turnpike. The 600-foot New Stanton Viaduct in Westmorland County is the largest of these, spanning a 1400-foot-deep valley. It will carry the Turnpike over two highways, a railroad, and a creek. A trip over either the William Penn or the Lincoln Highways involves a cumulative total ascent of 13,000 feet, while the total climb on the Turnpike will be less than 4000. In eliminating 10,000 feet of climbing, the Turnpike lessens the dangers of skidding on ice-coated inclines.

Because of the elimination of steep grades and a shortening of the route over the mountains to the eastern seaboard, the Turnpike will save up to $27 for heavy trailer-trucks, the engineers estimate, and a proportionate amount for light passenger cars. Toll charges will range from $1.25 for motorcars to $10 for the heaviest trucks.

Traffic engineers estimated, when the Turnpike was designed, that 1,300,000 vehicles of all types will use the high-speed highway during its first year, and that traffic will increase to more than 2,000,000 by 1945. This "yardstick" of future super-highways involves every known principle of engineering skill, and the many ideas tested in its construction will be valuable to undertakings on an even larger scale. It gives America a send-off to a national network of super-highways to aid commercial, pleasure, and military needs of the nation.

EVEN THE EARTH ERRS

Man's Most Accurate Clock is the Rotating Earth but the Earth Goes Fast and Slow . . . Science Must Keep Eternal Watch on its Subtle Changes

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

THE important error in a time-piece is its error of rate; it keeps on getting more and more wrong from day to day. Yet, though we demand relatively high precision of time measurements, both in practical matters and in scientific work, it is harder to get a good standard unit of time than of length or of mass. Experts can construct a standard meter or standard kilogram with the utmost care, and of the least perishable materials, compare it as accurately as possible with the international primary standard, and keep it in a vault at the Bureau of Standards, whence it is taken only rarely to test other subsidiary standards. But we cannot keep a standard second, or day or year, in a vault at the Naval Observatory to be taken out when we want it. We must catch time on the wing, and can measure it only by the motion of some body, which is moving as nearly as possible under undisturbed and uniform conditions. Our best clocks are kept in air-tight cases, in a partial vacuum, and in deep underground vaults, thermostatically maintained at a constant temperature; yet, despite the ingenuity of their design, their readings will not agree for more than a few weeks at a time. It does no harm if one clock runs a little fast compared with the other, so long as it does so at a uniform rate. This can be very easily allowed for; but, although such adjustment has been made, the readings of the best clocks begin, after a few weeks, to disagree by much more than the error of recording them.

Better things may be hoped from the "crystal clocks" which depend upon the very rapid but very uniform vibrations of a suitably-shaped piece of quartz, under electrical stimulus. Such a crystal reminds one of the advertisement that was sometimes seen in the days of primitive mechanical refrigeration: "A cake of ice never gets out of order."

But we have a more easily available moving body, which gives us a scale for time-measurement which surpasses in uniformity that of any device of human construction — namely, the rotating Earth on which we live.

The Earth is very big and very heavy, and is rotating freely as it moves in empty space. The attraction of the Sun, which holds it in its orbit, has no influence at all on its rotation, neither has that of the Moon or the planets — with one reservation. The differences of attraction of the Moon or Sun upon different portions of the Earth, which are known as tidal forces, cause the waters of the ocean to move over its surface; and these motions, when they produce currents in shallow water, are attended by friction. This friction produces heat, at the expense of the Earth's energy of rotation, and therefore tends to slow the rotation down. It can be calculated, however, that a continuous frictional loss at the rate of a billion horsepower would cause a lengthening of the day by about a thousandth part of a second at the end of a century. No humanly constructed clock can even remotely approach this degree of accuracy in running. Our only chance of detecting so small a change in the Earth's rotation is to compare it with some other motion which is still less liable to disturbance— and this may be found in the orbital motions of the Earth around the Sun, and the Moon around the Earth. These are affected, in a very complicated manner, by the mutual attractions of the three, and of the planets. But these effects can be, and have been, calculated, and precise allowance for them can be made.

The story has long ago been told in these columns how Fotheringham, by a careful study of the records of eclipses observed in classical antiquity, proved beyond a doubt that such a change has actually occurred, and that the Earth, considered as a clock, is very gradually running slower and slower.

SINCE the era of telescopic observation began, other moving bodies, such as the inner planets and the satellites of Jupiter, have also become available as checks upon the Earth's rotation. The Moon, which moves fastest in the sky, gives the best check.

Now it has been known for a century or so that the Moon's observed motion did not agree exactly with the best calculations; but these calculations are so intricate that it was only the classic work of the late Professor E. W. Brown which settled conclusively that the effects of the gravitation of all known bodies had been accurately calculated. But the Moon, compared with Brown's theory, still shows serious and very puzzling deviations, which are not steadily progressive with the time but fluctuate irregularly. Compared with the Moon's motion as a standard, the "clock" based on the Earth's rotation is sometimes fast and sometimes slow. From the most recent discussion, by the Astronomer Royal, Dr. H. Spencer Jones, it appears that, after allowance has been made for the slow progressive change revealed by the ancient eclipses, the Moon was 13″ (of arc) behind its calculated position in 1681, 15″ ahead in 1785, even with it in 1863, 16″ behind in 1898, 10″ behind in 1920, and 16″ again in 1935. Since the Moon takes 1.8 seconds of time to move a second of arc, this means that our Earth-clock was 23 seconds fast in 1681, 27 seconds slow in 1785, 29 seconds fast in 1898, 18 seconds fast in 1920, and 29 seconds fast in 1935. During the last part of the 19th Century, it ran fast at the rate of four fifths of a second a year; then it changed and ran half a second a year slow; 20 years later it began to run fast at about the same rate as before. The observations suffice to show that these changes took place within two or three years; they can not be made accurately enough to follow the alterations from month to month.

Such changes as this can not be explained at all by tidal friction (which can only *slow* the clock) unless we assume that the friction is usually heavy, and is "let off" at times when the Earth appears to run fast. But any such assumption plays havoc with the ancient eclipse records, and demands that we believe that gigantic changes in the ocean tides and currents took place about 1898 and 1920, when mariners observed nothing unusual.

There is but one solution to the puzzle — found by Brown — namely, that the *size* of the Earth is subject to change. If the Earth should shrink uniformly by one part in a million its rotation would become more rapid, and the day would shorten by two parts in a million — as follows from elementary

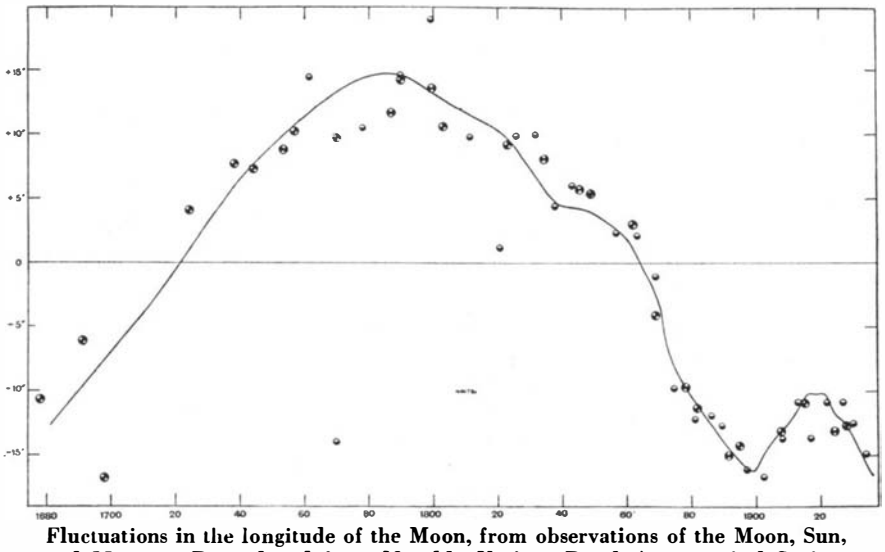
principles of mechanics. The changes in the speed of rotation in 1898 and 1920 amounted to 1.3 seconds per year, or one part in 24,000,000, so that they could be explained if our planet at the former date (or within a couple of years of it) expanded by one part in 48,000,000 of its diameter — that is, by ten inches — and shrank back to nearly its former size 20 years later. These changes must have affected the main body of the Earth, and been fairly uniform, for otherwise sea-level would have been altered along the coasts. No one has any idea what processes in the deep interior of our planet caused them; but the assumption that they happened accounts for the observed facts, and nothing else that has so far been suggested does so at all. One check upon the hypothesis is possible. If the "fluctuations" of the Moon's motion really arise from changes in the Earth's rotation, and hence in our ordinary time-standard, they should reappear in the case of every moving astronomical body which can be observed with sufficient accuracy. These should all run ahead of calculation, or fall behind it, in the same years, and by amounts proportional to their own apparent rates of motion.

This test has been applied by Jones in his recent paper. The other astronomical motions available for a test are those of the Earth about the Sun (or of the Sun in the heavens), of Mercury around the Sun, as shown by the times of his observed transits, and of Venus about the Sun.

The discussion of material of this sort demands a thorough knowledge of the details of the observations which are considered. For example, the apparent motion of the Sun may be studied either in an east-and-west direction (right ascension) or north-and-south (declination). The former gives the larger observable effect, but it depends upon observations of the times of transit of the Sun's limb across the wires of a meridian instrument (its brightness being of course greatly diminished by suitable screening devices).

The personal equation, or individual peculiarity of the observer in noting the moment when the edge of the great round disk just crosses the spider-thread, may be very different from that which holds good for the same man in watching a star — a mere point of light — transiting the same system. A great many different observers were at work during the 170 years for which observations were observable, and their unknown personal peculiarities render the observations less trustworthy. The declination observations, though not ideally accurate, are less troubled in this way. Again, the observations of Mercury's transits are of greater weight than those of Venus, in the daylight sky.

The net result of Dr. Jones' analysis



Fluctuations in the longitude of the Moon, from observations of the Moon, Sun, and Mercury. Reproduced from *Monthly Notices*, Royal Astronomical Society

— made with his characteristic thoroughness and accuracy — is that the condition spoken of above is satisfied. The other celestial motions show "fluctuations" in the same direction and at the same time as the Moon's motion, and these are of just the amount which would result if the Earth, as a clock, was wrong to the extent indicated by the Moon's motion. To be more precise, the observed and calculated effects agree within 2½ percent, with a probable error of 3½ percent. The evidence that the fault is really with our Earth-clock is therefore entirely conclusive.

These conclusions are remarkable enough, and may some day be of great importance to geophysicists, in studies of the deep interior of our planet. To the astronomers of the present and future, they assign something more than a "life-sentence" of hard labor. We must keep on observing the Moon's position in the sky, as often and as accurately as we can "without end, repose or rest." Only by doing so can we keep account of the unpredictable changes of the Earth's size, and of its behavior as a clock, and only thus can we provide ourselves with a reliable time-scale. It is to be like poverty — something we always have with us.

THESE observations of the Moon were formerly made mainly with the meridian circle. The difficulties of observing a large disk, already mentioned, are not quite as bad as for the Sun, but are still present; but the average deviation for a whole year gives a reliable value. As a check upon these, photographic observations were initiated some 20 years ago. A snap-shot of the Moon, in the middle of a time-exposure on the surrounding stars, was obtained by a very ingenious method devised by Professor E. C. Pickering. These plates gave accurate determinations; but the necessary calculations were long and costly — when hundreds of observations were desired — and the method has been abandoned in favor of a simpler one. This is the old scheme of observing the occultations of stars by the Moon. From the tabular values of the position and motion of the Moon the exact time at which she will hide a star of known position, from an observer at a given spot on Earth, can be calculated, and the discordances between these predictions and the observed times afford the desired evidence how far the Moon is ahead of prediction, or behind.

There are plenty of stars whose disappearance behind the dark side of the Moon can easily be observed with a telescope of moderate size, and amateurs, as well as professional astronomers, can make valuable observations in this way. It is necessary, of course, to know the Greenwich time — or other standard time — at which the star vanishes, with an error of a second at the worst. Before the days of radio this was not easy for the amateur to do; but nowadays enough accurate time-signals are available to enable anyone to check his clock or watch daily or oftener. By collecting and working up observations of occultations, Professor Brown and Dr. Comrie of London succeeded, in a very few years, and at small expense, in doubling the accuracy in which the position of the Moon was known (that is, the average amount of its deviation from the tables, for a given year). The calculations involved are simple enough, but rather tedious — but Brown and Comrie found that there were amateur computers as well as amateur observers, who *liked* to work with logarithms, and, when provided with suitable instructions and blank forms, did the calculations for pleasure.

Amateur and professional astronomers, in co-operation, are thus adding yearly to our knowledge of things whose very existence was hardly suspected 20 years ago. — *Mount Wilson Observatory, February 28, 1940.*

MAN'S EARTHLY FUTURE

The Earth's Natural Resources Should Suffice for Another Thousand Years of Civilization . . . The Outlook for Man is Far From Pessimistic

By KIRTLEY F. MATHER
Professor of Geology at Harvard University

RÉSUMÉ: *In the first part of the present article the author pointed out that the Earth is safe and will remain suitable for life for many more millions of years; that its present climate is not its typical climate, which has been and will again be more genial all over its surface; that man is an animal and that few species of animals have lasted more than two or three million years, the average being more like half a million years; and that our species,* Homo sapiens, *therefore should last that long. He also stated that most species of animals have gone down because of their inability to adapt themselves to altered environments, but that* Homo sapiens, *uniquely, has learned to control his environment through the clever use of material things. He has enough of some things for his use indefinitely but at present is using up others, such as petroleum, at a prodigal rate.*

(In Two Parts—Part Two)

ALTHOUGH petroleum affords an excellent illustration of the relation of non-renewable resources to the activities of man, it is by no means typical of the items comprising nature's accumulated capital. For nearly all of the important non-renewable resources, the known world stores are thousands of times as great as the annual world consumption instead of less than a hundred times. But, for the few which, like petroleum, are not known to be available in such vast quantities, the story is much the same. Substitutes are already known, or potential sources of alternative supply are already at hand, in quantities adequate to meet our current needs for at least two or three thousand years. There is, therefore, no prospect of the imminent exhaustion of any of the essential raw materials, so far as the world as a whole is concerned, provided our demands for them are not multiplied rapidly in the future.

That, of course, raises another question. Will the demand for non-renewable resources increase materially in the future and thus hasten their exhaustion? Recalling the fact that the human population of the Earth has increased almost five-fold in number in the last 300 years, we might well be fearful on that score. The study of current population trends, however, makes it readily apparent that the next few hundred years will by no means duplicate that record of the past. If present trends continue, the all-time maximum population of the United States will be attained about the year 1970 and will total little more than 150,000,000 souls.[4] Thereafter, except for possible influx of immigrants from other countries, no further increase in numbers is to be expected.

Accurate figures are available for only a few other countries, such as England, France, and Germany, but there is a strong probability that the all-time maximum for the "white" races will be reached during the last third of the 20th Century and for the entire population of the Earth before the end of the 21st Century. Although the human family has doubled its numbers since 1860, it is extremely unlikely that it will ever reach twice its present number of approximately 2,000,000,000. The pressure of demand for non-renewable resources will not, therefore, become acute because of the increase in population in the near future. Mother Earth is a very wealthy benefactress, and our heritage of physical resources is far greater than ordinarily supposed.

THERE is, however, another reason why current consumption of non-renewable resources cannot be taken as the basis for computing the "life" of such stores of basic materials. The demand for automobiles, telephones, radios, airplanes, zippers, is today very unevenly distributed. Only a small fraction of the human population uses such things in any large amount. Other peoples are beginning to demand them and will do so increasingly as they become acquainted with the "benefits of civilization." In a few decades, unless we return to savagery, the world demand for many non-renewable resources will be twice or thrice that of today.

Taking all these things into consideration, it would appear that world stores of needed natural resources are adequate to supply a basis for the comfortable existence of every human being who is likely to dwell anywhere on the face of the Earth for something like a thousand years to come.

Even so, there may be found here an excuse for the policy of "grabbing while the grabbing is good," which motivates many individuals and nations at the present time. That excuse might, of course, be offset by the suggestion that there is no need to take thought for a morrow a thousand years hence, if we have any respect for the ingenuity of our remote offspring. There is, however, another phase of current trends in human history that should not be overlooked in this connection.

One hundred years ago, something like 80 percent of all the things man used had their source on farms; most of the energy used to do the work of the world came from the muscles of living beings and from falling water. Today only about 30 percent of the things man uses come from things that grow; most of the energy with which work is done comes from petroleum and coal. For a century or more, the policy has been to use relatively less of the annual income and more and more of the stored capital.

Now comes the change. Automobile steering wheels are made from soy beans, piano keys from cottage cheese; innumerable articles fashioned of plastics are produced in part from corncobs and alfalfa; multitudinous metal and rubber substitutes are synthesized from various farm crops. Energy is transmitted at high voltages for hundreds of miles from hydro-electric turbines. A considerable portion of the annual budget for research is being devoted to progress in the direction of using more of the renewable resources—man's annual income, and less of the non-renewable resources—nature's stored capital.

What this new policy will mean is readily apparent. With progress along such lines, the pressure for political control of metalliferous ore deposits, coal fields, and oil pools is lessened. Much of the physical basis for international jealousy is liquidated. At last the intelligence of science may make it truly practical to beat our "swords into

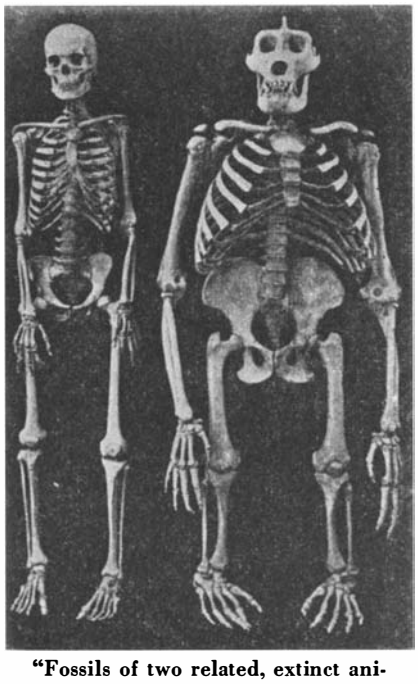
From the Eighteenth Sigma Xi Lecture, delivered at the Columbus, Ohio, convention of the American Association for the Advancement of Science.

[4] Thompson and Whelpton, "National Resources Committee, Population Statistics," Vol. 1, "National Data," p. 9, 1937.

ploughshares, our spears into pruning hooks."

Again comes the insistent question from the pessimistic critic. Is there land enough? Is there sufficient fertile soil to provide adequate food and in addition the plant materials for the ever-expanding chemical industries? And again we hear the same reply. Yes, there is enough and to spare. J. D. Bernal computes from apparently valid data that the cultivation of 2,000,000,000 acres of land by the methods now in vogue in Great Britain would provide an optimum food supply for the entire population of the Earth. "Two billion acres is less than half the present cultivated area of four billion, two hundred million acres, itself hardly 12 percent of the land surface of the Earth."[5] And in this calculation no account is taken of the increased yields that may confidently be expected from the continuing research of agronomists, plant breeders, and experts in animal husbandry, not to mention recent developments in the new science of the soil-less growth of plants. Evidently, the predictions of Malthus notwithstanding, mankind need have no fear that increasing populations will place an impossible burden upon the available sources of food. Human ingenuity, intelligent use of renewable resources, wise adjustment of structures and habits to environmental conditions, seem competent to dispel that dread shadow.

BUT these optimistic conclusions concerning the relation of man to the non-renewable and renewable resources essential for comfortable existence are based upon world statistics. Obviously they do not apply with equal force to the economy of individual nations. No nation, not even the Soviet Union, Brazil, or the United States of America, embraces within its political frontiers a sufficient variety of geologic structures to give it adequate supplies of all the various metalliferous ores necessary as raw materials for modern industrial operations. The United States, for example, must import nickel, tin, antimony, chromium, and platinum, if American manufacturers are to use those metals in the fabrication of articles essential to what we are pleased to call the civilized way of life.[6] Likewise, no nation enjoys a sufficient variety of climatic conditions to permit all kinds of food-stuffs to be grown on its farms and fields or gathered from its forests, and to allow the growth of all the various plants contributing raw materials to industry. The United States, again the most significant example for us, is forced to import all the bananas, coffee, tea, camphor, coconuts, flax, jute, quinine, rubber and shellac, consumed in this country, either from foreign countries or its own over-seas possessions.[7] It is entirely possible that, within a few decades, substitutes of domestic origin may be available to take the place of many, or even all of such commodities or that plant breeders and agronomists may find a practical way of extending the geographical limits of some of the plants whose products are considered essential so that any nation occupying a large fraction of any continent may actually be self-sufficient. But for the present and probably for a long time to come it is evident that every nation is dependent upon many other nations for the raw materials that it needs for its own industrial prosperity.



"Fossils of two related, extinct animals of the Quaternary Period, 24,500,000 years ago. The odd one at the left was for a time civilized, in a way of speaking." From an intelligence dated 25,000,000 A.D.

Perhaps the most important fact concerning the life of man today is this fact of interdependence. No nation, community or individual can gain any lasting measure of security without taking that fact into consideration. The resources that man must utilize, if he wishes to escape the fate of his less intelligent relatives now known only by their fossil remains, are unevenly distributed and locally concentrated. The techniques of discovering and utilizing them are now fairly well known, but satisfactory procedures for making them and their products available to all members of the human family are not close at hand.

The very solution of the physical problems which man encounters in his attempt to maintain his foothold upon the Earth brings him all the more forcefully into bruising contact with psychical and spiritual problems that must also be solved if he is to continue his existence on this planet. The critical question for the 20th Century is: how can two or three billion human beings be satisfactorily organized for the wise use and equitable distribution of resources which are abundant enough for all but are unevenly scattered over the face of the Earth? Clearly, the future of man depends upon finding and applying the correct answer to that specific but far-reaching question.

Man is not only a specialist in the art of coördinated activity, but the trend toward organization is recognizable in the entire development of cosmic administration. Electrons, neutrons, and protons are organized into atoms, atoms into molecules, molecules into compounds; some of the compounds prove to be cells, and these are organized to form individual plants and animals. Latest of all in the history of creative evolution certain individuals have been organized into societies. Transcending all that has gone before is the development of human society, obviously the most difficult, but at the same time potentially the most glorious organization yet attempted.

TWO antagonistic alternatives present themselves as possible bases for this organization. The issue between the two has never before been so clearly drawn as it is today. The social group, whether it be the family, the industrial or commercial company or the political unit, may be organized on the principle of regimentation, or it may be developed according to democratic principles. Both methods are being tried under a variety of conditions, and each has something to be said in its favor. But both cannot be equally conducive to the continuing existence of mankind. One or the other must be selected as the basis for the future security of man.

If regimentation be the choice, then the great mass of humankind must be trained for obedience — blind, unquestioning, but superbly skilful obedience. The educator becomes the intellectual and spiritual counterpart of the drill-sergeant in the army. This is no menial task, nor is its objective a mean one. Skill is a commodity of which there is never likely to be an over-supply. On the other hand, if democracy be the choice, the great mass of humankind must be trained for wise, self-determined co-operation. Precisely those qualities of mind and heart which have long been extolled in Christian doctrine must be developed to the fullest possible extent. Not only skilfulness but also the ability to govern oneself, the eternal prerequisite for freedom, must be de-

[5] J. D. Bernal, "The Social Function of Science," New York, 1939, p. 347.

[6] Brooks Emeny, "The Strategy of Raw Materials," New York, 1937, p. 26 and chart facing p. 29.

[7] Ibid., pp. 26-37.

veloped in each member of the group.

In so far as physical existence is concerned, there would seem to be little or no choice between these alternatives. Perhaps, human nature being what it is today, the regimentation of society may temporarily be the more efficient method. But the full circle of organic law embraces more than mere existence. From the continuity of the evolutionary process, there has emerged a creature who is aware of vivid values in life that may be found beyond the goods necessary for comfortable existence. Ideas and ideals are powerful determining factors in the world today, and among them the ideal of freedom for the individual in the midst of social restraint is the most vital and compelling of all. Though it baffle our scientific tools for measurement, it is none the less a reality.

IT is in the yearning for freedom, the love of beauty, the search for truth, the recognition of moral law and in the awareness of spiritual forces that human nature is distinguished from all other sorts of nature. Man shares with other animals the need for satisfactory economics, for adequate food and shelter, for the goods essential to existence, but his needs transcend these physical factors because his nature differs from theirs.

Regimentation may be good for man as an animal; through that type of social organization his need for goods may be efficiently supplied. But regimentation is certainly not good for human nature as thus distinguished. Experience verifies what wisdom foresees; regimentation stultifies the spirit, destroys personality, standardizes thought and action. Worst of all, regimentation means stagnation of the creative process and, as we have seen, stagnation among the more complexly organized vertebrates has led inevitably to extinction. If man attempts to live by bread alone, mankind commits collective suicide. Apparently the best and perhaps the only chance for mankind to succeed in the quest for security is through progress in the art of living on a high spiritual plane rather than through exclusive attention to the science of existence on a purely physical level.

To put this same thought in more specific terms, it means that coördinated activity directed toward efficient organization of individuals must become co-operative activity directed toward the enrichment of personality within an efficiently organized society. This requires both intelligence and good will.

Fortunately, these characteristics are uniquely developed in the species of placental mammal with which we are preëminently concerned. Man is a specialist in the use of both. The trend of the past 5000 years may well continue, despite numerous temporary setbacks, throughout the next few centuries at least.

It is sometimes suggested that because man has specialized in brains, brains may cause his downfall, just as presumably the overspecialization in external armament contributed to the downfall of certain herbivorous dinosaurs. That argument by analogy is, however, heavily punctuated with fallacies. There is as yet no evidence that mankind is weighted down with a superabundance of intelligence. On the contrary, it is failure to act intelligently that endangers individuals and groups in the midst of competition. To see in advance the remote consequences of contemplated action is an ability which ought to be increasingly cultivated rather than scouted as a menace.

There seems to be no good reason why a sound mind should not be accompanied by a sound body. If the number of psychopathic individuals is increasing in this high-speed, technologic age, it is a challenge to be met not by bemoaning the imminent collapse of civilization but by intelligent adjustment of habits and activities to the new demand of the new times.

The roots of self-centered individualism may be traced backward for at least 600,000,000 years in the record of geologic life development, whereas our heritage of social consciousness dates from a time only about 60,000,000 years ago when gregarious instincts became clearly evident among placental mammals. That trend is, however, especially apparent in the group from which mankind has stemmed.

Man is still in the stage of specific youth. His "golden age," if any, is in the future rather than in the past.

In thus seeking a satisfactory coördination of intelligence and good will, it becomes necessary for research scientists to give more thought than has been customary in the past to the social consequences of their work. They share with statesmen, politicians, educators and all molders of public opinion the responsibility for determining the uses to which the new tools provided by scientific research are put. As scientists they should continue to seek truth regardless of its consequences and to increase human efficiency in every possible way, but as members of society, as individual representatives of a species seeking future security as inhabitants of the Earth, they must also do their utmost to ensure wise use of knowledge and constructive application of energy.

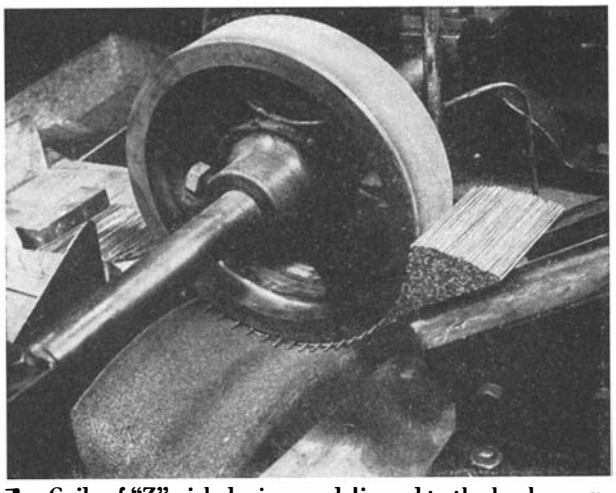
THERE is a real difference between the so-called "social sciences" and the "natural and physical sciences" that has an important bearing here. It is not that there is anything "unnatural" about the social sciences. Man is a part of nature, and the study of human society is just as truly "natural science" in the real sense of the term as any other study. The difference arises from the peculiar factors and particular functions pertaining to the co-operative way of life. Whereas the scientific use of things may be achieved through the efforts of a very small minority of the citizens, provided with adequate facilities for research, the scientific organization of society in a democracy can be achieved only when the majority of its citizens have the scientific attitude toward social problems and act in accordance with that attitude of mind. In other words, only a few physicists, chemists, and technologists are required for the mastery of our physical environment, but for victory in the struggle with ourselves every man must be his own sociologist.

Although this places upon the forces of education a Herculean task, it is not nearly so impossible an assignment as at first glance it might appear to be. In the first place, the responsibility upon the individual citizen is rarely that of designing a new social structure or charting a new program for society. Almost invariably it is his duty merely to select from many plans, programs or proposals the one that seems to him most likely to produce the most desirable results for all concerned. In the second place, scientific habits of mind have already been developed to a greater extent than is ordinarily recognized. The garage mechanic attacks the problem of a balky automobile in a truly scientific manner. The salesman uses psychology in planning his approach to a difficult prospect. The housewife thinks scientifically when about to concoct a new dessert or redecorate the living room. In most cases, it is only necessary to apply in the area of social relationships the same habits of mind that have been followed in the area of individual behavior.

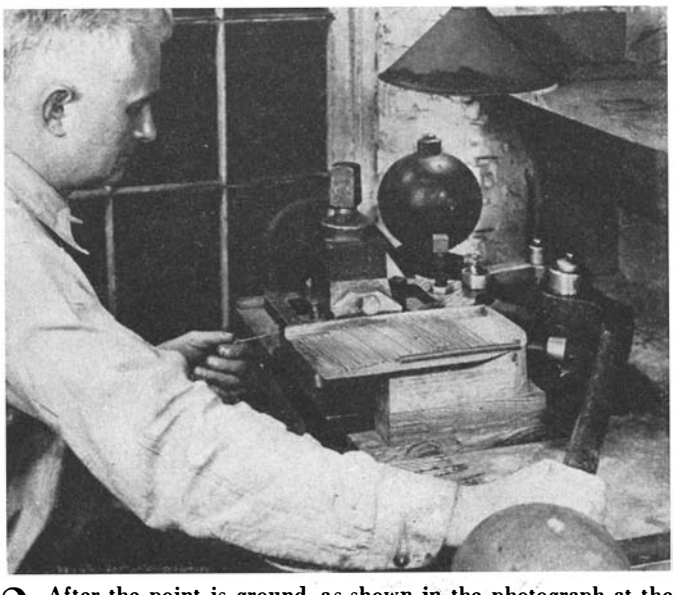
In conclusion, the outlook for the future of man as an inhabitant of the Earth is far from pessimistic. If certain tendencies already developing are encouraged and certain resources already available are capitalized to the full, there is good reason to expect that mankind will maintain existence and even live happily for an indefinitely long period of time. The opportunity is his to demonstrate the intrinsic worth of biologic phenomena and thus to justify the vast expenditure of time and energy involved in organic evolution. With greater emphasis upon the development of intelligence and good will, he may achieve that which the temporarily triumphant dynasties of the past have failed to achieve. Thus the geologist may turn from the long perspective of geologic history to the enticing vista of the geologic future of Earth and man with high hope and even with confident assurance.

Fish Hooks of New Alloy

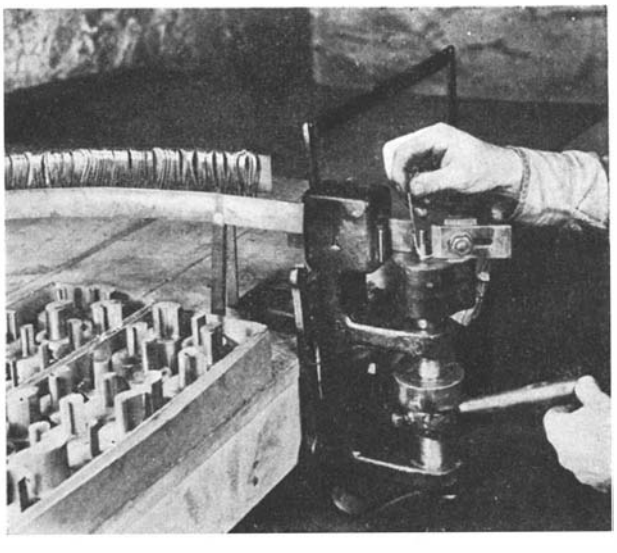
RUST proof and high in strength are fish hooks now being made, in a wide range of sizes, of "Z" nickel, a heat-treatable alloy that is approximately 98 percent nickel. The alloy gives through-and-through corrosion resistance.



1 Coils of "Z" nickel wire are delivered to the hook manufacturer. The wire is first straightened and then cut into correct lengths for the hooks to be made. Then the short blanks are fed automatically over the surface of a grinding wheel (*above*) where the point is fashioned. One wheel carries the blanks along; grinding wheel is at right angles

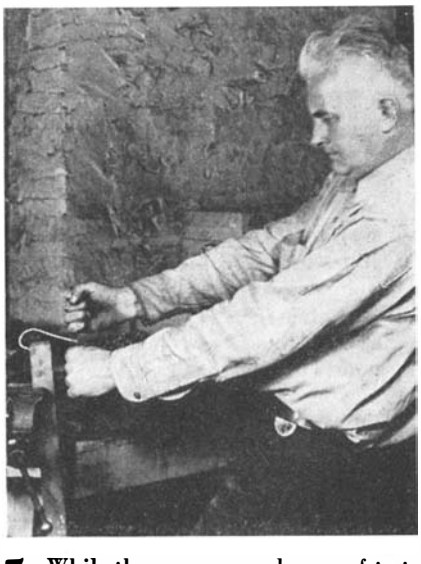


2 After the point is ground, as shown in the photograph at the upper right, a special hand-operated cutter is employed to form the barb. The alloy of which these hooks are made is the first available material that combines the quality of being rust proof with the physical properties required in manufacturing satisfactory fish hooks



3 *Right, above:* The pointed and barbed blank is now bent around a die to provide the proper hook shape. Separate dies, shown in the left foreground of this picture, are employed for the different hook sizes and designs to be produced. At the time of writing, these new alloy hooks are being made in five different sizes, from tiny flounder hooks to the large sizes used in tuna fishing, in the O'Shaughnessy style

4 *Left:* After the wire blank has been pointed, barbed, and bent to shape, another special machine turns the eye. Fish hooks, small in themselves, constitute a million-dollar-a-year industry. About one third of the hooks used in the United States were imported last year, and most of these were of the higher qualities. The new nickel hooks are expected to capture a large part of this market formerly served by importation from abroad



5 While there are several ways of testing hooks, many craftsmen producing high-quality hooks prefer to make their tests by hand. Experience has taught them to gage accurately the force that each size of fish hook should be able to withstand

Employee Health Pays Dividends

Dusts, Fumes, Chemicals, Cause Worker Illness . . . Concerted Drive Against Such Hazards . . . Preventive Measures Also Against All Sickness

By JOHN F. McMAHON
Executive Assistant, Air Hygiene Foundation

ILLNESS is industry's biggest bill! In the heavy industries, employing some 15 million persons, the average male worker loses about eight days a year because of sickness. The average woman worker loses some 12 days. There is approximately 15 times as much lost time from illness and home injuries as from industrial accidents such as cuts and broken bones.

For every day lost by a skilled worker, it has been estimated that the employer loses one and one-half, or maybe twice, the amount of the worker's daily wage.

If we take eight days as the average amount lost yearly per worker and multiply this by the 15,000,000 workers in the heavy industries, we get the staggering total of 120 million lost work days. And if we consider $5.00 as the average daily wage, and one and one-half times this, or $7.50, as the employer's loss, then we get the dizzy sum of 900 million dollars as industry's annual bill for sick absenteeism. This covers only heavy industry, about *a quarter* of our total work-a-day population. Nor does this figure include the losses suffered by the workman, the cost of health work sponsored by management, the compensation costs, and the like. Dr. C. O. Sappington, in his "Industrial Health — Asset or Liability," estimates the total cost of sickness in American industry at 10 billion dollars annually.

AIR Hygiene Foundation, an organization of industrial concerns for the advancement of employee health, has launched a sweeping study of sick absenteeism among its 200 member companies. In a preliminary survey Dr. A. J. Lanza, Chairman of the Foundation's Medical Committee, points out that respiratory diseases, notably the common cold, accounted for 44 percent of the male and 47 percent of the female disabilities among employees of a number of companies studied by the U. S. Public Health Service. Another source finds that colds alone account for about three lost days per worker. Encouraged by the dramatic success of the Safety Movement in reducing accidental injuries, the Foundation believes that by organized effort, corresponding progress can be made in reducing sick absenteeism.

In fact, on an individual basis, numerous alert companies have worked wonders in reducing sick absenteeism by attention to preventive measures and by keeping accurate records of lost time.

R. H. Macy and Company inaugurated a new program of preventive medicine in 1926, and has since expanded it. The National Industrial Conference Board reports that Macy's total absence rate from all causes declined 46 percent between 1928 and 1937. The medical department points out that if the company experience for the past 12 years had been relatively the same as in 1926, there would have been: 156 more deaths; $21,938 more paid in death benefits; $347,445 more paid in sick benefits; 8369 more resignations because of poor health; and 631,769 more work days lost.

After installing adequate medical supervision, another company reduced lost time by 8000 working days in the second year—an estimated saving of

Courtesy Mine Safety Appliance Company

Sand blasting of industrial products is a highly dusty operation. Workers so engaged are protected by hoods while they breathe clean air through a small hose

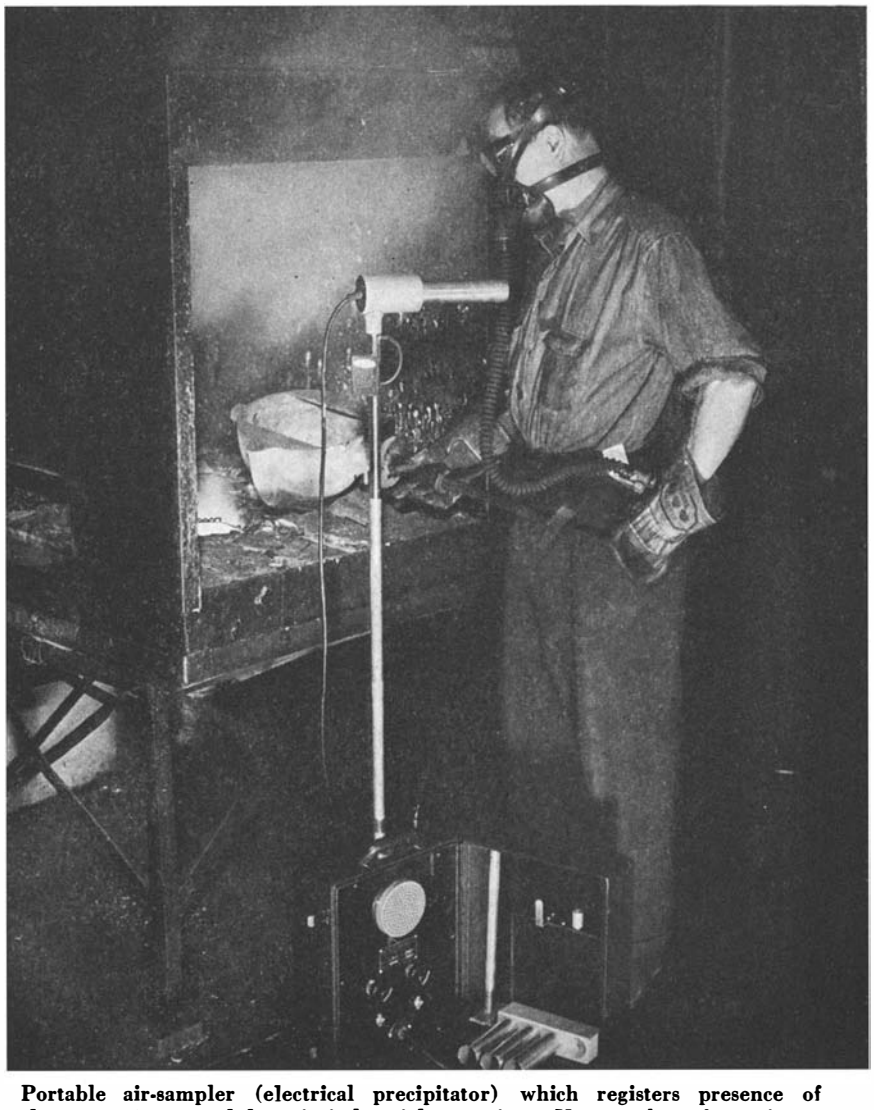
$29,094—and by 16,000 days in the third year.

The whole problem of health in industry is as old as industry itself, yet it failed to stir the American mind until the silicosis furore of four years ago. Hippocrates, "the father of medicine," was one of the first parents of industrial hygiene. He wrote about the diseases of tradesmen in the 5th Century B.C., describing metal workers as pale and subject to respiratory ills.

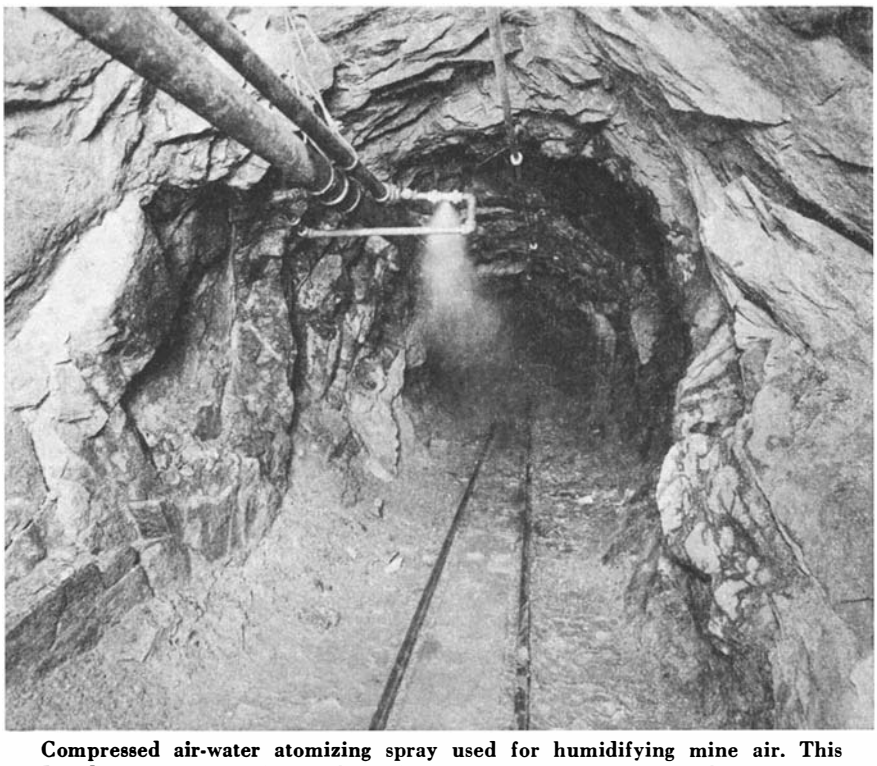
Cleaners and dyers of antiquity used stale urine for cleaning purposes. (Because of the foul odors they were forced to work outside the walls of Rome.) These tradesmen suffered certain infections which Hippocrates described. Rome also recognized mining as a highly hazardous occupation. Instead of sending "public enemies" to concentration camps, the offenders were sentenced to work in the pits. This usually amounted to the death penalty.

LONG before the discovery of America, "chimney sweep's cancer" flourished in the cities of old Europe where boys and frail adults earned their living by removing soot from clogged flues. In so doing they encountered chemicals in the soot which caused cancerous growths.

Occupational ills are created and then eliminated by the forward march of man. Chemicals which were "laboratory curiosities" a few years ago are now sold in carload lots for use in industry. Dr. Carey P. McCord says some 2000 different chemicals or work conditions may endanger health unless controlled. Whizzing power drills replace the time-honored pick and shovel. Spray guns supersede the paint brush. These innovations cause air impurities, harmful dust, fumes, gases, and vapors, chiefly responsible for illness in industry.



Portable air-sampler (electrical precipitator) which registers presence of dangerous fumes and dusts in industrial operations. Note workman's respirator



Compressed air-water atomizing spray used for humidifying mine air. This Laird type spray is also used to eliminate dust and gases caused by blasting

The Foundation's Preventive Engineering Committee, headed by Prof. Philip Drinker of Harvard, has issued a series of brief engineering "cook books," giving ways and means for combating many toxic substances encountered in industrial atmospheres, such as benzene, carbon dioxide, chromic acid, lead, sulfur dioxide, and others. Silicosis, which can now be controlled, is caused by breathing the powdery, flour-like, silica dust arising from many manufacturing processes.

Silicosis gets the publicity—they're even writing poems about it now—but tuberculosis is of greater concern to industrial management. J. S. Whitney, studying tuberculosis death rates among men gainfully employed, has found:

Occupational Group	*Death Rates per 100,000*
Professional men	26.2
Proprietors, Managers, Officials	43.2
Clerks and kindred workers	65.8

Agricultural workers	46.5
Skilled workers, Foremen	72.1
Semi-skilled workers	98.2
Unskilled workers	182.0

Home and community conditions are heavy contributors to this disease. Hence some companies extend their medical services beyond the factory gates in the form of community clinics, care of school children, and similar services. Under the able leadership of Dr. C. D. Selby, General Motors has been doing fine co-operative work with local health departments to halt tuberculosis.

Lead is another health hazard encountered in many trades. "Painter's colic" is one familiar manifestation. Andrew Fletcher, Vice President, St. Joseph Lead Company, and Vice Chairman of Air Hygiene Foundation, tells how his company overcame the lead hazard:

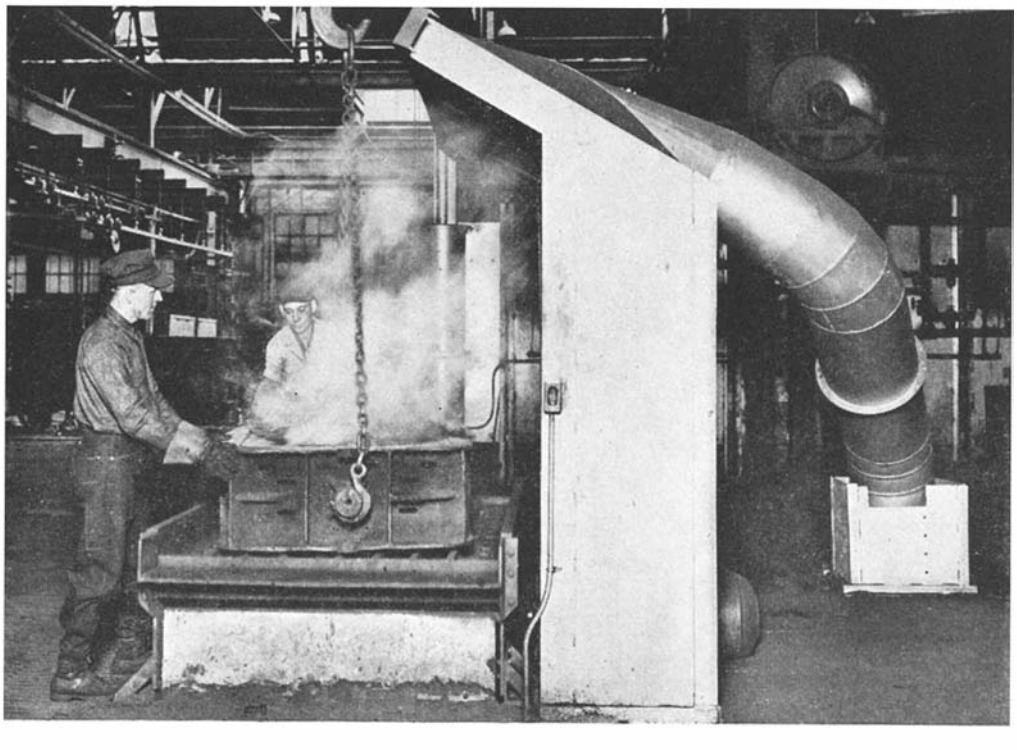
"At our smelter there were 64 lead poisoning cases in 1920 in an organization of 400 employees. A study was made on the hazard, and as a result semi-annual general physical examinations and weekly physical inspections were instituted, a modern change room and a cafeteria were provided. Arrangements were made for employees to wear work clothing supplied and laundered by the company, and all employees were advised as to the importance of personal cleanliness in combating the lead hazard. A resident doctor not only examined the men, but also made periodic plant inspections to check conditions that might adversely affect health. As the result of careful supervision, lead poisoning is no longer a problem. As a matter of fact we have not had a case of lead poisoning for the last 10 years."

In 1918, this company had a labor turnover of 250 percent; that means it had to hire 250 new men each year to keep 100 on the job. By intelligent attention to employee health, working environment, and community conditions, St. Joseph Lead reduced the turnover to 3.6 percent in 1938. To illustrate the economic saving alone, the management figures that it cost approximately $100 to replace one workman.

IN the sintering operating at a Pennsylvania smelter, a dust prevention and recovery plant was installed at a cost of approximately $26,000. Disregarding the greatly improved working conditions and employee satisfaction, the minimum saving per year is over $5000; and, therefore, the installation will pay for itself in less than six years. But the same plant furnished a more striking example of making money when it spent some $13,000 in improving working conditions in the furnace basement. As a result, it is estimated that the recovery in the furnaces has been improved by over 1 percent. This saving may seem very small, but it is one which will more than pay for the operating cost of the installations, refund the entire $13,000 investment in one year, and show a profit of about $13,000 each year thereafter.

Bunker Hill and Sullivan Mining and Concentrating Company, a member of Air Hygiene Foundation, installed two solariums at its Kellogg, Idaho, operations. "Sun treatments" are available for underground workers and townspeople. Stanley A. Easton, President, describes the work this way:

"Repeatedly I have been asked to report what good has been accomplished in the 10 years of our experience. Such results, while undoubtedly good, are difficult to express statistically, especially in the case of adults. School children are brought to the solarium in the school bus in large numbers. Superintendent of Schools John Booth has caused to be kept a record of time lost by the school children on account of illness. He reports that the children who have used the solarium regularly show far less loss of time than those who take it irregularly or not at all. The School Nurse reports the same thing, and that the solarium is almost a specific in the case of eczema and other skin ailments, in improving anemic children and those who lack appetite and natural vigor. We give about 7000 treatments a month from October until May. Adults who take the solarium regularly report in most instances entire freedom from colds and, almost universally, much lighter colds when they are afflicted. A matron has charge of the solarium for two hours each morning for the use of the women and girls from whom we have similar reports. Pneumonia during the late winter months is often prevalent, and in some years fatalities are high; records show that during 10 years there has been only one death from pneumonia by a regular user of the solarium, the victim being an old man in poor physical condition generally. Some users of the solarium have had pneumonia but in a slight form. The solarium is so well regarded by our people that we were petitioned to put one in at the smelter for the greater convenience of the employees at that plant which is somewhat remote from the mine. This installation was recently completed and is already being used by a large number of our employees at the smelter and their



Considerable dust arises from the "shake-out" of castings in foundries. In this foundry, all the dust is drawn into the wide hood before the shake-out table and exhausted through the large pipe

Photograph courtesy Claude B. Schneible Company

families. I might add that my own experience largely confirms the foregoing; I take the solarium treatment regularly and am practically free from colds, or any other ailment for that matter."

Weary workmen are easy marks for illness and accidental injuries. Some companies noticed that accident rates soared in late morning and afternoon. Westinghouse Electric and other firms harkened back to school days for the solution, reviving the recess idea. Now they have "snack periods" when lunch carts wheel through the plants and workmen can get a bite. The "pick me ups" have stepped up production, reduced accidents and illness. One Pennsylvania manufacturer instituted two 15-minute rest periods, one in the morning and one in the afternoon. Although this shortened the work day by half an hour, production jumped 20 percent. A Toledo manufacturer who tried the plan reports a 12 percent increase in production despite a 6.66 percent decrease in working time.

IT is well known that salt tablets have helped banish heat prostrations where workmen are exposed to high temperatures. Glucose, a source of energy, combats fatigue. Some plants make gum drops available, but one Pittsburgh steel mill had this experience: workmen "hoarded" the drops. Instead of eating the candy they took it home to their youngsters.

Space forbids listing the many companies that are active in conserving the health of their employees. The U. S. Public Health Service and U. S. Bureau of Mines also are doing valiant work in this same field. Both agencies are represented on the Foundation's Board by Dr. R. R. Sayers and Dan Harrington, respectively. Government is increasingly active in industrial health. Theodore C. Waters of Baltimore, noted authority on occupational disease legislation and member of the Foundation's Legal Committee, advises that 24 states and the District of Columbia have now passed laws granting compensation for occupational diseases. Arkansas, Idaho, and Maryland enacted such laws during the past year. Meanwhile, commissions have been named in New Hampshire, Oregon, Tennessee, Texas, and Utah to study such legislation and report to their Legislatures this year. Some 30 states as well as several cities, including Baltimore, Detroit, and St. Louis have established industrial hygiene bureaus. The courts hold, and properly, that the employer is responsible for the health of his employees.

It was the growing difficulty of meeting this obligation that led to the formation of Air Hygiene Foundation. A year before the silicosis sensations of 1935-36, organization details were being worked out by energetic A. W. Sherwood, Toledo glass executive; Dr. E. R. Weidlein, Director, and Dr. W. A. Hamor, Assistant Director of Mellon Institute; Dr. H. B. Meller, international authority on air pollution; and a committee of industrialists headed by Roger A. Hitchins of Philadelphia. The Foundation is a kind of partnership of industry and science. Some 200 companies, employing about one million workers, subscribe to the work. About half the funds go in the form of research grants to Harvard, The Saranac Laboratory, and University of Pennsylvania.

Fumes from molten lead can be a cumulative, slow poison. The workman shown here is safeguarded by the powerful ventilator at rear which draws off fumes

This research gets down to fundamentals. The work at Harvard, under Prof. Drinker, deals with engineering measures — exhaust systems, for example — for combating health hazards through control of potentially dangerous dusts and fumes.

The research at Saranac and Penn deals with intricate medical investigations, such as "protector" dusts that clump with silica and drop it from the air or render it innocuous; the effects of dusts and fumes on lung tissue; and the improvement of X-ray methods for mass medical examinations of employee groups. Dr. Leroy U. Gardner, noted authority on silicosis, directs the Saranac studies, while the work at Pennsylvania is under personable Dr. Eugene P. Pendergrass, one of America's foremost X-ray specialists.

From its headquarters at Mellon Institute, Pittsburgh, Air Hygiene Foundation makes plant health surveys for member companies, issues a monthly "news service" digesting latest industrial health literature, distributes medical, engineering and legal information and carries on numerous short time studies and membership services.

Safety would never have scored its triumph on the basis of individual companies all working independently, however fine their unrelated efforts. It was the Safety Movement that did the trick. Similar unified effort by employers is a prerequisite of progress in industrial hygiene. Prof. Drinker, designer of the iron lung, says industrial illness of all kinds is caused by a combination of environment and ignorance. Employers are steadily improving the working environment. Air Hygiene Foundation, through its studies and services, is helping dispel the ignorance by advancing knowledge on an industry-wide front.

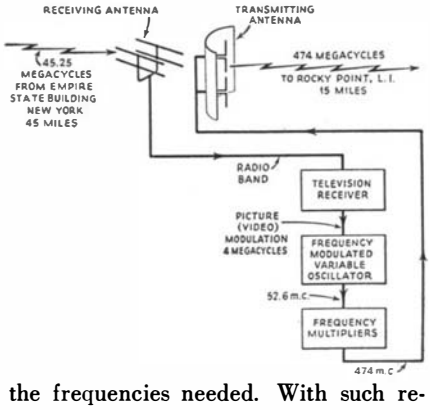
TELEVISION RELAYED

Makes Possible Network Systems . . . Test Operation Shows Feasibility . . . Uses Directional Transmission of High Frequencies . . . New Tubes

By A. P. PECK

TELEVISION signals, confined as they are to the ultra-short waves, have an inherently short range. Regardless of the power of the transmitter, the characteristics of the waves used limit the practical service range to the optical horizon. This brief statement sums up one of the greatest problems which engineers have faced in the development of television for general public use. It is impracticable to establish television networks using telephone land lines, as is done in sound broadcasting. The high frequencies and the broad frequency bands demanded by high-quality television transmission cannot be carried satisfactorily on wire lines of the usual design.

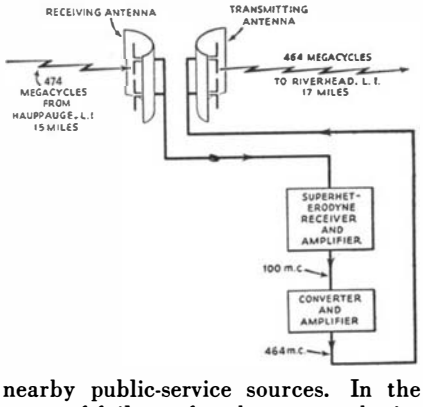
Thus the engineers have turned their attention to the possibility of radio relay stations which would give satisfactory and consistent service and would handle



the frequencies needed. With such relays properly spaced, it would become possible to establish television networks whenever and wherever the public demand became sufficient.

An experimental radio relay system has been in test operation for nearly a year between the National Broadcasting Company's Empire State Building transmitter and Riverhead, Long Island. Each relay station contains both receiving and transmitting devices, mounted on a tower. The antennas are of the parabolic type necessary for the highly directional, or beam-like, transmission which the system uses. The distance between each relay point, in practical operation, would vary according to the terrain. The average distance would probably work out at approximately 30 miles.

Radio relay stations used in the test are located at Happauge and Rocky Point, Long Island, making available at the Riverhead terminal programs sent from the television transmitter on the Empire State Building in New York City. Power for the stations, which operate unattended, is supplied from the

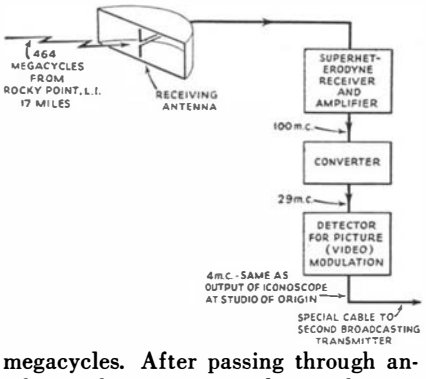


nearby public-service sources. In the event of failure of such sources, the individual station will automatically switch to use of its own emergency power supply, and change back to the first source again automatically when power service is restored. Operation of the relay stations may be started and stopped by radio signals sent over the circuit.

Development of a new, "inductive" type of radio tube has made possible the reliable transmission of very high frequencies with a radiated power of less than five watts, between relay points separated by 25 to 50 miles. In this tube, energy is derived from a stream of electrons without their coming in actual contact with active parts of the circuit, which gives the device the ability to handle with unprecedented efficiency very wide band widths at extremely high frequencies.

The first relay point of the new system is at Happauge, Long Island. Here the television signals radiated from the NBC television transmitter in the Empire State Building, New York, at a frequency of 45.25 megacycles, are received and "detected," to provide the video (television) component, the band width of which is four megacycles. This is used to control a transmitter with multi-stages of frequency tripling, embodying recent developments in frequency modulation. At its first stage of conversion into centimeter waves, the video component is employed to frequency modulate an oscillator producing 52.6 megacycles; at the second stage, the frequency becomes 158 megacycles; and in the final stage it is 474 megacycles.

At the second relay station, the signal is received at 474 megacycles and converted to 100 megacycles, after which it is passed through a multi-stage amplifier which increases its energy to about one watt. This energy is fed to an inductive tube operating as a converter, and the frequency is increased to 464



megacycles. After passing through another inductive type tube used as a straight amplifier in the final stage, the 464 megacycle wave is sent out.

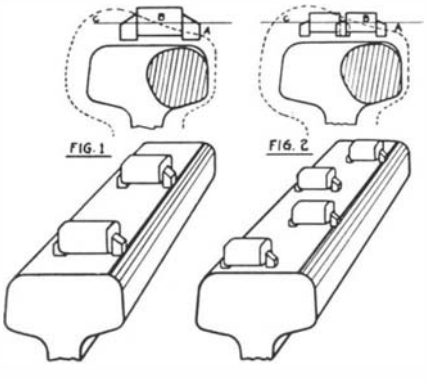
At the final station in the relay link, the signal is received at 464 megacycles and converted to 100 megacycles, as in the previous station. After being amplified it is passed on to a second converter, where the frequency is further reduced to 29 megacycles, to provide a more favorable ratio between the frequency and its video component, for purposes of detection. In the process of detection, the signal is changed from its characteristic of frequency modulation to one of amplitude modulation. After further amplification at the video frequency, it is then ready to pass along to a second television broadcasting station, where it may be employed to modulate that station's transmitter, operating on one of the channels, between 44 to 108 megacycles, allocated to television broadcasting service.

The outstanding characteristics of the new relay development are the very high frequencies employed, and the new tubes used to produce such frequencies.

Rail Fissures Give Up Secrets

ONE of the greatest railroad track hazards known today is the internal transverse fissure which occurs in rails. If rails containing such fissures are not found and replaced by good ones, these faults are capable of causing rupture of rails while in service and possibly disastrous results. True, there are relatively few railroad accidents which might be attributed to such faulty rails but those that have occurred have been serious.

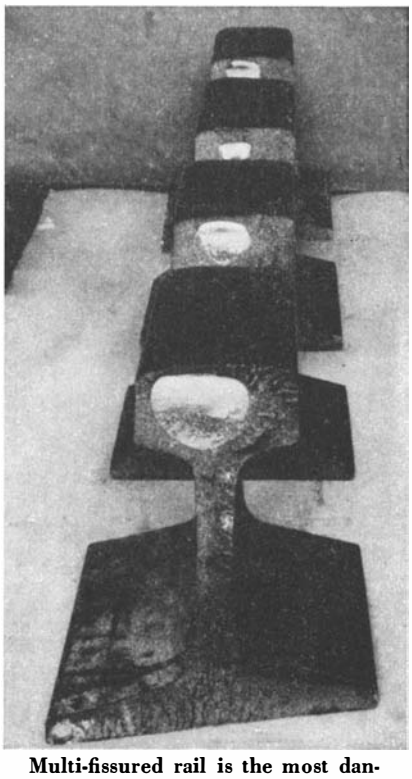
Some years ago the Sperry Detector Car was developed by Dr. Elmer A. Sperry in co-operation with the American Railway Engineering Association. This car was first used in 1928. Its equipment consisted of a generator which introduced current into the rails over which the car travels, via two sets of copper brushes — one on each side of the car. Each of these brush clusters carried a searching unit consisting of a pair of electrically opposed coils mounted midway between the current brushes and directly above the rail head.



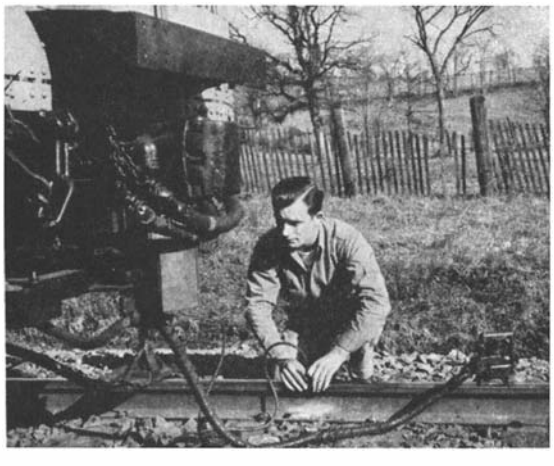
Current flow was unimpeded through sound rail, but when a fissure was encountered the consequent change in magnetic flux caused a "paint gun" to squirt white paint on the rail at the location of the fissure. Later hand testing of that particular rail found the exact point of the break, and the rail could then be removed.

While the idea is not new, such improvements have been made on the detector cars and they have been used so much more widely that remarkable progress has been made in the important business of locating dangerously defective rails in railroad tracks. For example, in 1934, 22,818 defective rails were found in 41,151 track miles—an average of nearly one bad rail in every two miles of track. In 1935, 25,437 such rails were found in 61,860 track miles, and a steady increase was made through the years to 1939, for which year the figures were, respectively, 47,966 and 82,250. During the 11 years from November, 1928, through December, 1939, the Sperry Railway Service has tested over 549,000 track miles and have found over 279,000 defective rails. This is indeed a startling record.

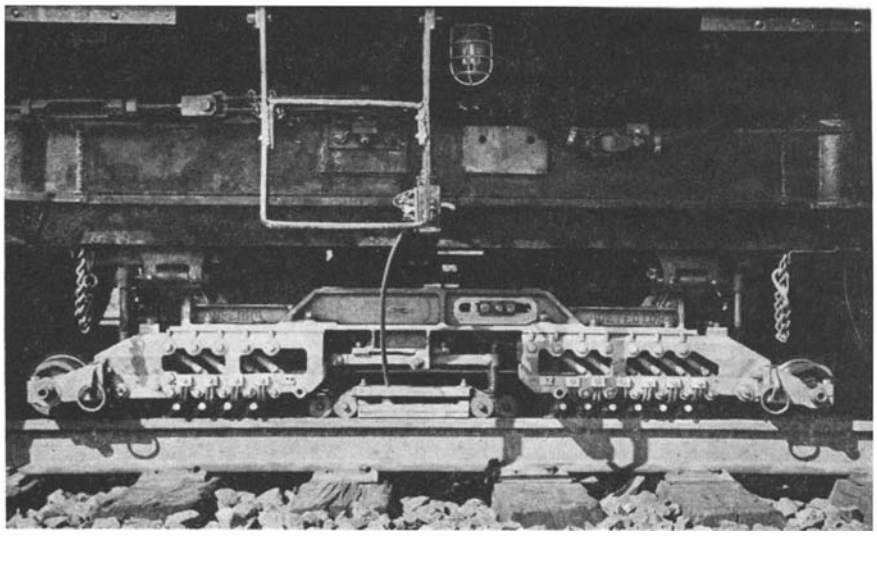
How important is this testing for rails which might cause wrecks is shown by the fact that trains have been speeded up tremendously in recent years, the rails must carry heavier axle loads and are subject to the wear of greater traffic density. And too many rails have been in service too long, the average annual replacement of rails, 1929 to 1939, being 897,000 long tons as against an average of 2,137,000 long tons per year from 1926 to 1928 inclusive.



Multi-fissured rail is the most dangerous of track defects. Nearly 12 percent of fissured rails found are multi-fissured. Four transverse fissures were in this two-foot piece



Left: **The early Sperry searching unit had two pairs of coils—in line (Figure 1). It often missed fissures to one side. Modern type (Figure 2) has multi-tandem, staggered coils.** ***Below:*** **Main brush carriage of detector car. Between two sets of current brushes is searching unit.** ***Right:*** **At the paint spot, a hand searching unit, two rail contact points, and a meter mounted on rear of car, determine size of internal fissure. Each rail flaw, indicated by a paint spot, will be examined in this manner**



Making Tissues Ageless

Experiments on Tissue Cultures and on Portions of Plants . . . Suggest Promise of Artificial, Earthly Immortality . . . Direct Bearing on Medicine

By BARCLAY MOON NEWMAN

ONCE it was thought that aging is a universal characteristic of life — and that, in order to live, it is necessary to age. Now, to every one's satisfaction, it has been established that at least small portions of the body may be kept alive endlessly, agelessly. Man has discovered the secret of immortality — for bits of tissue, at least. A fresh nutrient medium keeps tissue fresh, youthful, growing. Every passing second does not necessarily leave an indelible imprint on living flesh.

For more than a half-century, it has been possible to maintain life, for varying numbers of days, as strips sliced from bodies dying but not yet dead throughout. Human flesh, still living even if cut from a body legally dead, will more or less lengthily stay quick in dilute salt solution very similar to seawater, hence very similar to the salt solution which floods our veins. Or such bits immersed in plasma — blood minus corpuscles — will likewise cling amazingly to vitality. More than 40 years ago, human skin was held alive in tissue fluid, for weeks, and then successfully transplanted. Then, within the next few years, cancer tissue was being cultured in dog blood, also for weeks.

IN 1907, Ross G. Harrison reported a simple but revolutionary technique whereby bits of tissue can be made to live for several weeks outside the organism. He took lymph from a young animal and touched drops of the fluid to the under-surface of small, extremely thin, glass plates. The lymph drops clung and clotted. Into the clots he introduced fragments of embryonic tissue. He protected each culture by suspending the hanging drop over a small depression in a glass slide. And, as the days passed, he saw nerves grow out through the clots — grow from embryonic nervous cells. In a drop whose minute bulge looks down into a glass hollow, many a mystery of life is discoverable. Thus, at the very outset, Harrison taught men that a nerve cell can develop its own conducting thread, or axon.

Thus also he gave a hint to the genius of Alexis Carrel. It has been the genius of Carrel to extend indefinitely the life activities that can go on in a hanging drop. And Carrel has invented flasks and fluids at last achieving the perfect result — artificial immortality of minute groups of cells.

In either hanging drop or flask, a coagulum is prepared from blood plasma. A liquid nutritive mixture must also be provided. If extraordinary precautions are taken against infection with microörganisms, and if the bit being cultured is transferred every two or three days to a fresh, sterile medium, ageless life is gained. Growing tissue must be chopped in half at the time of transfer; otherwise the mass of cells becomes too bulky to permit inflow of nutrient and outflow of waste. A living mass merely in the state of survival, rather than in some phase of growth, needs no slicing.

In 1912, Carrel cut a tiny piece from the embryonic heart of a chick and immersed the fragment in warm, nutrient bed; plasma being the source of nutrient as well as coagulum-support. Then commenced a regular series of transfers to regularly prepared, fresh medium. But the bit of connective tissue, though maintaining its life, slowly dwindled and promised eventually to perish, after several months in the series of flasks. The seeker after terrestrial immortality thereupon thought to test the influence of fluid extracted from chick embryo — embryonic tissue extract. Success! The long-living fragment began to wax as its cells multiplied healthily. Consequently, this discovery, plus an almost infinite capacity for taking pains, means potential immortality for numerous sub-cultures of the original piece of connective tissue from the chick's embryonic heart. As Carrel tells us:

"The cell colonies remain indefinitely in the same state of activity. They do not record time qualitatively. In fact, they are immortal." [1]

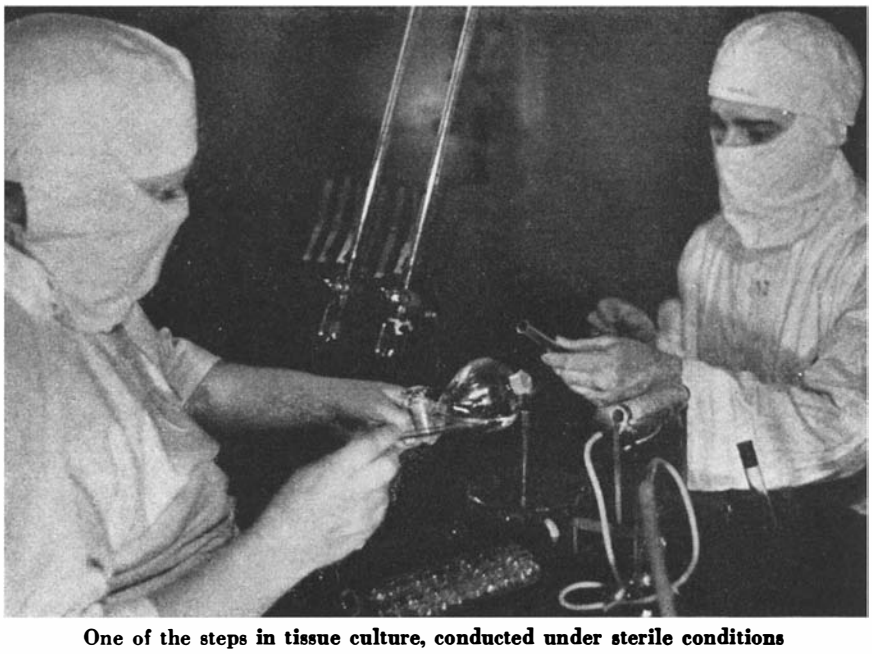
Ageless they will remain, as long as laboratory assistants care for them.

Recently, new methods have been introduced for the cultivation of larger masses of tissue, including human tissues of practically every kind, especially tumor cells. In 1936, G. O. Gey and M. K. Gey reported their invention, the roller-tube system, for the maintenance of human normal cells and tumor cells in continuous culture. Thin-walled test tubes are used, their walls being coated with plasma to which the living colonies adhere. Nutrient fluid within the test tube bathes the filmy layers of cells

[1] Carrel, A.: Physiological time, *Science* 1929:618, December 18, 1931.

Photographs courtesy United States Public Health Service

An operation for removal of a tumor. After removal the tumor can be cultured in a special medium (see text) or transferred for culture to a living animal



One of the steps in tissue culture, conducted under sterile conditions

— streams over them as a motor revolves the test tube rack six times an hour. Fresh fluid is provided after four days. Transfer to a fresh tube, with new coagulum, is effected after a week or a month, depending upon the nature of the culture. Other techniques, devised by Carrel and Raymond C. Parker, at the Rockefeller Institute for Medical Research, New York, by W. H. Lewis and several other pioneers, permit a wide choice of procedures by which a large variety of animal, including human, cells may be given deathlessness far beyond — indefinitely beyond — the present average span of life of the whole creature. Terrestrial immortality for almost any part of the human anatomy is nowadays only a question of money to cover the cost, which is high.

THE methods are sure and, moreover, are steadily being improved, as the vast and growing list of valuable discoveries bears witness. At the Strangeways Research Laboratory at Cambridge, England, from embryonic dental tissue whole rat- or rabbit-teeth are grown, without the jaw being present. If human tooth-germ cells were available, from these microscopic specks entire human teeth could be synthesized in the test tube — the main factor being merely the appropriate nutrient mixture. Factors controlling the production of blood corpuscles, controlling growth itself, controlling the rate of wound healing, regulating cartilage development, factors regulating success in grafting — an apparently endless list of factors — are being measured and evaluated. All medicine benefits.

The relation between blood pressure and the thickness of the arterial wall is being elucidated, to the benefit of the considerers of arteriosclerosis, great tragedy of older man. "In grafting experiments with tissues derived from races of different size, genetic rather than immediate factors have been shown to be the more influential," the editors of the *British Medical Journal* (December 31, 1938) relate. They continue:

"The Strangeways Laboratory is now even better equipped than before for studying the effects of radiation, and work has been done on the degree of susceptibility to X-rays of different processes in cell metabolism. The factors controlling the effects of irradiation have been studied in tadpoles, and the results appear in several ways to confirm the long-held belief that metabolic activity, and in particular the imminence of cell division, determine the susceptibility of the cell to irradiation. All the work has evidently a fascination in that it deals with living material which is yet under complete control."

The editors could add that these determinations have direct bearing on medicine of today and tomorrow: extending the practical limits of grafting, learning the main secrets of success in treating cancer by irradiation, finding the means of molding tissue cultures to the plan of man rather than of a wild Nature. And in the background is the stupendous basic discovery; tissue in glassware can by man be cultivated limitlessly. Further, as we shall see, protoplasm's plasticity can be in glassware more astonishing than anywhere else.

By a method distinctly different from tissue culture, it is now possible to give agelessness to life, for very long if not endless periods. Animation may be suspended indefinitely by careful freezing and subsequent maintenance of a constant very low temperature — minus 70 degrees centigrade. Whole organs or whole animals cannot so be preserved alive — at least as yet. But practically any type of cellular mass, if not too large, may be frozen and after long periods revived successfully. At Cornell University, C. Breedis and J. Furth have been keeping all sorts of cancer tissue frozen for as long as a year without any diminution of virulence after the thaw.

Cells lining the windpipe have beating, hairlike cilia. Breedis and Furth froze chicken's ciliated cells. After 327 days, warmth made many cilia beat again, as though in the animal's windpipe.

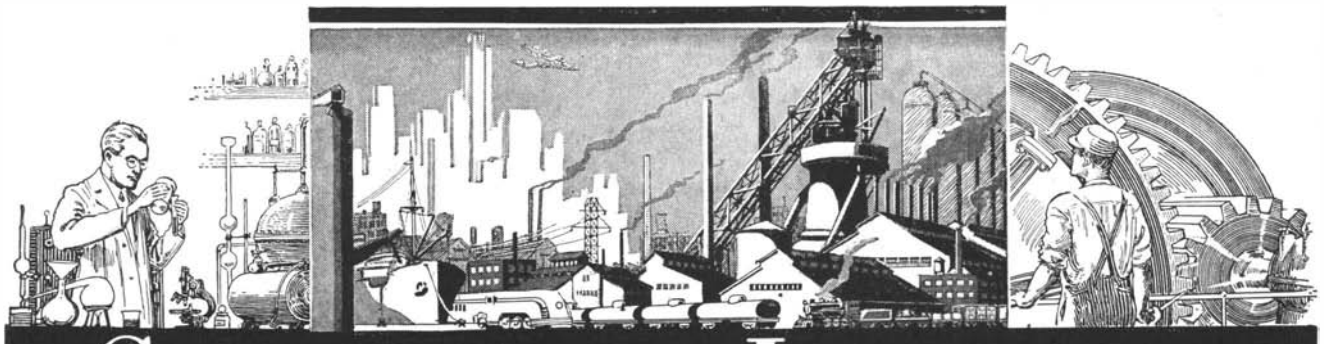
Tissue to be frozen is removed immediately after the animal is killed. It is minced in nutrient solution and placed in small test tubes, which are then sealed with a flame. Storage is under alcohol in a Thermos bottle containing large pieces of solid carbon dioxide ("dry ice"). The thaw is effected by shaking the test tube in warm water. The secret lies in slow freezing, rapid thawing; otherwise, death results.

HOW long may life exist as suspended animation, frozen? Nobody knows. P. Ehrlich has found cancer cells still living after two years, though stored at the fairly high and unfavorable temperature of minus 8. Research is actually just beginning in this line. New ways are being tried. And even present ignorant technique serves to store frozen life indefinitely, ageless. Nevertheless, the point here is not merely the potential development of perfect agelessness though suspended — frozen — animation; it is, further, the obvious, additional aspect of the lability of life, life so modifiable by man. As the decades and the centuries pass, protoplasm's plasticity will emerge as a consideration far vaster in import than any possibility of artificial immortality.

Plant-tissue culture too is practiced. Carl D. LaRue, of the University of Michigan, is able to tell us:

"In the course of recent work, I have observed numerous examples of a surprising length of survival of plant tissues. Various parts of flowers were detached and placed in sterile culture on nutrient agar. Some of these parts have undergone no regeneration and have shown no significant growth but have lived many times as long as similar structures on normal plants. Most of the structures were still vital at the end of the recorded period."

Petals of *Tradescantia paludosa* fall into decay within a day or two after flowering. So it goes in Nature, but not in LaRue's laboratory. "In culture they remained alive for an entire year." Suspended animation? Probably not: rather was normal life abnormally maintained. Youth and beauty need not fade — not so soon, even today. Tomorrow?



SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

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

Glycerine From Petroleum

GLYCERINE is vitally important in a wide range of industries. This sweet and viscous liquid is a by-product of the soap industry and the quantity available is more or less fixed, depending, of course, on soap production. Unlimited quantities of the compound can now be made from petroleum, according to a report by Dr. Evan C. Williams, Dr. H. P. A. Groll, and G. Hearne of the Shell Development Company. This new process may go a long way toward preventing the wild and unnecessary fluctuations in market price of this commodity.

In the new process, propylene, a gaseous component of cracked petroleum, is acted upon by chlorine to produce at low cost allyl chloride. Trichloropropane is readily prepared from that compound. The molecule of trichloropropane is similar in structural design to that of glycerol (or glycerine), and the product is readily convertible into glycerol with the aid of cheap alkali.

Electrostatic Iron Ore Separator

A LARGE percentage of iron still remains in iron ore discarded at the mines because of too low a concentration for commercial separation. To prevent this waste an experimental electrostatic separator is being developed which shows promise of much higher operating speeds as well as more efficient and effective recovery of iron. When this is perfected and put into use a much lower percentage of iron will be lost in discarded ore.

New Locomotive Record

A NEW all-time world record for continuous railroad locomotive performance is believed to have been set on February 25 when Diesel-electric locomotive No. 56 pulled into Washington with the *Capitol Limited* of the Baltimore and Ohio Railroad. This arrival marked the 365th daily run of the locomotive between Chicago and Washington without a miss, for a total of more than 280,000 miles. So far as is known no locomotive of any type ever before has established a record of 100 percent availabilty in such gruelling service for a solid year.

The record is regarded as being the more remarkable because it was made on a 772-mile run calling for regularly scheduled average speed of more than 56 miles per hour —including ten regularly scheduled stops— over a route which includes some of the heaviest mountain grades in the eastern section of the country. The Capitol Limited regularly consists of from 11 to as many as 15 standard weight Pullman cars, ranking it with the heaviest fast schedule passenger trains in the country.

Static-Free Radio Sets

RADIO manufacturers will soon announce special lines of relatively static-free, high fidelity, radio receiving sets equipped to receive programs transmitted by stations that have adopted the Armstrong system of wide-swing, frequency modulation broadcasting. The sets will be designed to receive present standard band broadcasts as well as programs broadcast by stations equipped and licensed to use the patented Armstrong frequency modulation transmitters.

Claims for frequency modulation by Major Edwin H. Armstrong, widely known radio engineer and inventor, include full musical-tone-range reception without distortion, and elimination of natural and man-made static. The development of frequency modulation broadcasting and reception during the last 12 months has reached the present stage where licenses are being issued to radio broadcasting stations for installation of frequency modulation transmitters.

Benzedrine in Alcoholism

THE treatment of alcoholism is more and more being understood as properly belonging in the realm of psychotherapy, even though the practitioners of this branch of medicine are somewhat discouraged by their efforts. The chronic alcoholic addict has a fundamental personality defect which is extremely difficult to change but failure may be due to the fact that the proper psychoanalytic approach has not as yet been found. Nevertheless it is possible to obviate some of the physiologic and psychologic after-effects of acute inebriation

Holder of an all-time world record for continuous service

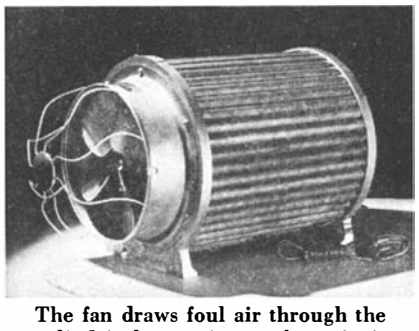
quickly and effectively by the judicious use of benzedrine sulfate.

According to Reifenstein and Davidoff, who have investigated the action of this drug in mental states characterized by depression or self-absorption, acute alcoholic psychosis and Korsakow's syndrome in alcoholics respond well to the use of amphetine sulfate. Acute intoxication, with its attendant boisterousness, can be made to disappear rapidly by the use of this drug. A "hangover" is soon dissipated, both in acute and chronic alcoholism. When the patient is institutionalized, the results are even more striking.

These authors impress us with the futility of this drug as a cure for addiction to alcoholic beverages. Somewhat analogous to vitamin B deficiency therapy in the treatment of alcoholic polyneuritis, benzedrine sulfate merely improves the psychotic and physiologic aberrations which attend acute intoxication. Neither has any effect in altering a habitual tendency toward inebriation. Reifenstein and Davidoff cannot agree with Bloomberg who found that the use of this drug in chronic alcoholism permitted a sufficient period of sobriety for the institution of psychotherapeusis. Nevertheless, it appears that this drug has a definite place in the therapy of some phases of acute alcoholism.—*N. Y. State Journal of Medicine.*

Portable Device De-odorizes Air

A NEWLY invented portable odor adsorber, employing the principle of the ordinary gas mask, is now available for removing unpleasant odors, gases, vapors, smoke and fumes from the air of theaters,

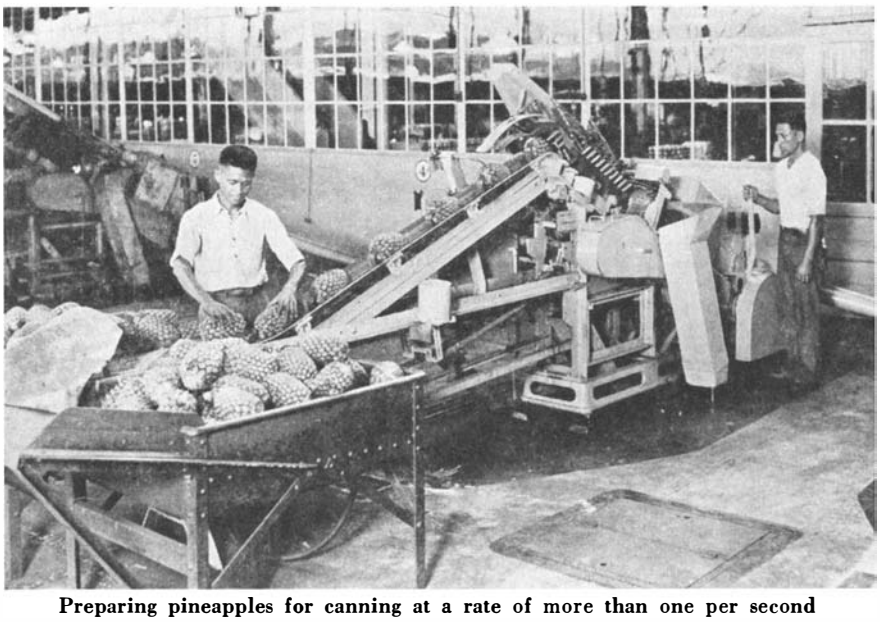


The fan draws foul air through the cylindrical container, where it is purified and delivered to the room

restaurants, offices, factories, hospitals, lavatories, and other places of human occupancy. The device, known as the Dorex "Squirrel Cage" Odor Adsorber, is simple, compact, and has but one moving part—the electric motor which draws the foul air in, purifies it, and delivers it back into the room.

Employing the positive extraction principle of air-odor removal, the Dorex unit uses an adsorption medium composed of a specially processed, highly activated, granular, coconut-shell carbon. One of the most powerful adsorptive agents known, it is able to adsorb and hold all condensable gases and vapors with which it comes in contact. This activated carbon is contained in a cylindrical cage of closely spaced, perforated metal cylinders.

Two types of these new units are offered by the makers, the Dorex Division of the W. B. Connor Engineering Corporation—one for installation on any wall or ceiling where it occupies little more area than an ordinary fan, and the other to be applied to any existing ventilating or air conditioning systems.



Preparing pineapples for canning at a rate of more than one per second

RAY-ABSORBING GLASS

AMONG the many types of glass developed in recent years is a unique one used in welding. It transmits only 3/10,000 of 1 percent of visible light, which is sufficient for seeing the brilliant arc; but it absorbs 100 percent of the ultra-violet, which is harmful to sight, and all but 1 percent of infra-red. Twenty-five years ago, only one commercial welding glass was available and this absorbed only 75 percent of the invisible rays.

Pineapple Peeler

BEFORE the new Ginaca machine was used in pineapple canneries, these Hawaiian fruits were peeled by hand. A good fast worker could average only three or four fruits a minute. Now, the largest cannery in the world, by using 46 machines, has a production record of preparing the fruit and packing 2776 cans per minute. This totals 3,497,388 cans per day or a carload every two and one-half minutes.

In 1910, an inventor named Henry Ginaca was hard at work on a machine which would peel the skins from pineapples. His aim was to do away with the slow and costly hand method.

The first Ginaca machine quadrupled the output. In addition to peeling the fruit, the machine shaped it in uniform sizes for canning. By constantly improving the machine, the number of operations it could perform was increased, as well as the speed with which it worked. By 1913 the Ginaca machine was peeling more than 30 fruits a minute; it sized them, took off the ends, and removed the core. However, it still did not scrape off the pineapple meat from the skins.

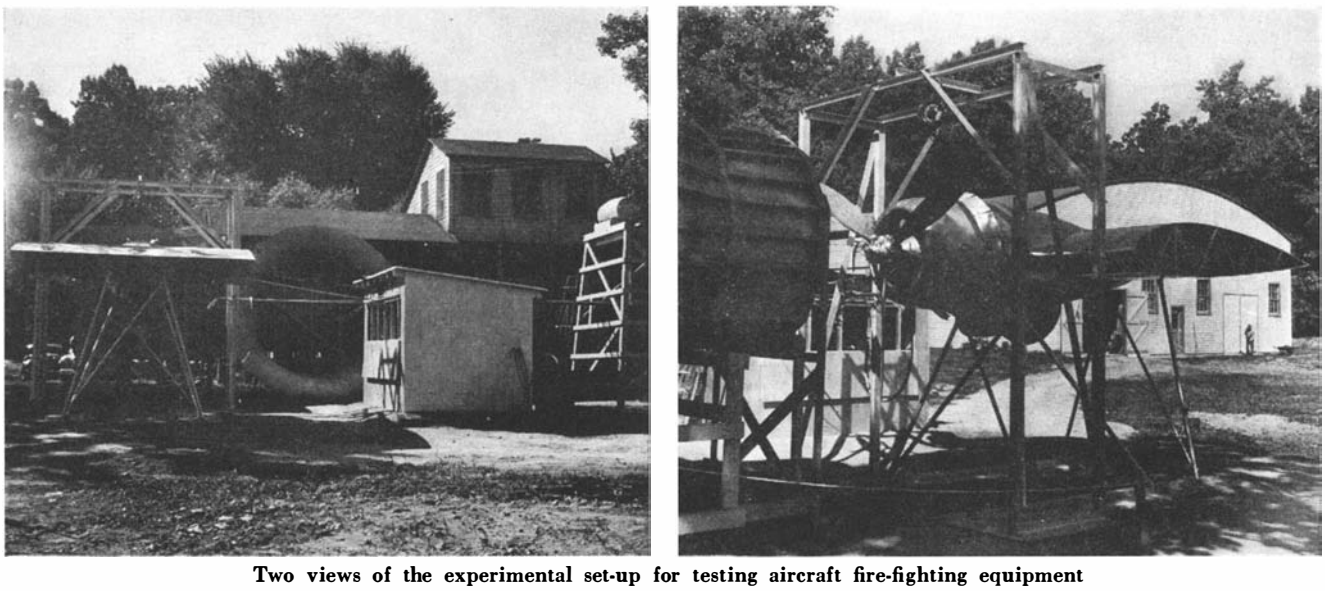
The present Ginaca machine can prepare from 85 to 100 pineapples a minute, depending on the size, and do it more perfectly than by hand. The shells are removed, ends cut off, the fruit is sized to uniform roundness, the core is accurately extracted so the hole is in the exact center, and the meat is scraped from the shell.

When Mr. Ginaca first got the idea for his invention, he was employed by the Hawaiian Pineapple Company. Now this concern uses 46 of his improved machines.

First Colchicine-Made Flower

A NEW flower, Tetra Marigold, which is introduced this spring to American gardens, is unique from the scientific, commercial, and horticultural angles. It has the distinction of being the first flower produced for cultivation which was developed by doubling the chromosome number by artificial means. David Burpee, plant hybridist, reports that in experimental work at the Floradale Farms, Lompoc, California, "dozens of species of plants have been used in our experiments to double the chromosome number through the use of colchicine. In many instances, no results whatever were achieved. In other cases, tetraploids were produced which were definitely inferior to the original plants. In other instances, larger and more rugged plants than the

Burpee and Tetra Marigold



Two views of the experimental set-up for testing aircraft fire-fighting equipment

diploids on which the work was done were produced, but the first one to respond satisfactorily to the treatment on a large scale is the new Tetra Marigold, produced by treating the most popular variety of African Marigold, Guinea Gold. Seeds of the new flower are now available.

Tetra Marigold has larger flowers of a more intense orange than Guinea Gold and the petals are frilly and possess unusually heavy substance which assures longer life for the flowers after cutting. The plants grow two to two and a half feet tall and are very vigorous. The main trunk and branches are thick and heavy, while the flowers are borne on short stems in clusters of six or eight on the end of the branches, each branch making a bouquet in itself when cut. Blooms appear in about 19 weeks from the time seed is planted, and the Tetra Marigold is as easy to grow as other Marigolds.—*C. F. Greeves-Carpenter.*

Baby Clipper

PIPER Aircraft, manufacturers of the well known Piper Cub, have undertaken an ambitious experiment by building a Baby Clipper. One of our photographs shows a trim little amphibian which, equipped with a 75 horsepower engine, cruises at 92 miles per hour, carrying two occupants and 50 pounds of baggage. The stalling speed is 45 miles per hour, and the cruising range is said to be 600 miles. Gross weight is 1500 pounds; wing area is 180 square feet. If small private land planes have reached such a high degree of popularity, then it may confidently be expected that a small amphibian or flying-boat, moderately priced, will be received with equal enthusiasm by private owners.—*A. K.*

Aircraft Fire Prevention

THE Aircraft Section of the Technical Development Division of the Civil Aeronautics Authority (the correct, if unduly long, title) is pioneering in co-operation with the Bureau of Standards in the field of fire prevention in the aircraft power plant. Aeronautical research has a way of centering on the beauties of aerodynamics and structure and it is gratifying to see attention being given to less "beautiful" but equally essential research.

The general program involves the investigation of fire detectors, fire extinguishers, fire-resisting materials, and fuel and oil ignition. A long and exhaustive program of tests is in progress with co-operation of all interested manufacturers.

The experimental set-up is indicated in two of our photographs. The power-plant unit consists of a Pratt & Whitney Twin Row Wasp with a controllable, three-bladed Hamilton propeller. Back of the power plant is the nacelle and wing in almost full scale. A wind tunnel will draw air in through a large opening, and will give a blast of 75 miles per hour on the power plant.

In the test program it will be possible to vary the speed of the blast of air, the intensity of a simulated fire, the location of simulated fire, the type of fire extinguisher, the type of fire detector.—*A. K.*

Flight During Lightning Discharges

IN the *Journal of the Aeronautical Sciences*, E. J. Minser, meteorologist of T. W. A., discusses this subject with a wealth of experience and observation to back his views. Modern metal airplanes, carefully bonded and shielded, suffer little structural damage when struck by lightning —though there is always a hazard. The first lightning discharges encountered were generally considered freaks of nature—"one in a million" events. But as their occurrence became more frequent, a general warning was issued to pilots to keep clear of thunderstorms. This warning, wise as it appeared, did not decrease the number of discharges encountered. Analysis of such events soon revealed that the majority of discharges were not being encountered in thunderstorms but occurred in "cumulus" type of clouds that produce showers. The results of the investigation indicated that the airplane "triggered" a discharge between two cloud masses.

As soon as it was determined that the initiation of a lightning discharge through an airplane in flight requires the passage of the plane between two oppositely charged portions of a cloud, much more specific instructions were issued to pilots:

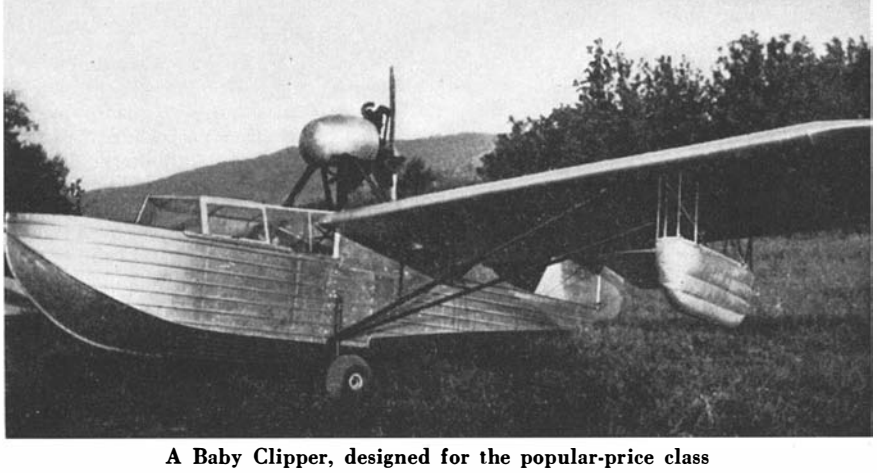
1. Avoid, if possible, instrument flight through large cumulo-type clouds, especially when the temperature is between 25 and 35 degrees, Fahrenheit.

2. If temperature and degree of static and corona discharge indicate the presence of a highly charged zone, reduce speed and descend.

3. If change in altitude is not possible,

NON-STOP

AERONAUTICAL engineers predict that within 18 months airplanes will be capable of flying to Europe with a full load and returning non-stop if necessary.



A Baby Clipper, designed for the popular-price class

keep eyes focussed on the brightly lighted instrument panel. This will prevent temporary blinding if a discharge occurs near the cockpit.—*A. K.*

SYNTHETICS

ORGANIC chemists of the world made approximately 25,000 new chemical compounds last year, an increase of about 6 percent.

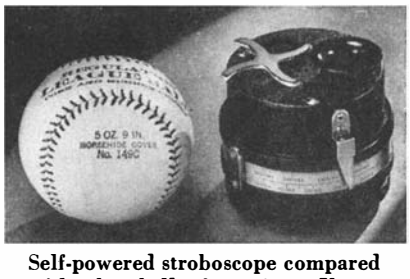
Pressure Cooker Sauce-Pan

THE many advantages of pressure cooking in an aluminum vessel have been incorporated into a standard aluminum sauce-pan by Vischer Products Company. Made in four sizes from one to four quarts, the Vischer Flex-Seal Pressure Cooker cooks foods in a fraction of the time ordinarily required. It enables the housewife to use cheaper cuts of meat satisfactorily, and boasts the well-known good qualities of aluminum cooking utensils. Meats and vegetables retain their color and vitamin content when cooked under pressure.

The new pressure kettle has no hold-down bolts, gages, and extraneous rigging, yet holds a pressure of 15 pounds safely. A thin, strong metal cover is inserted within the lips of the kettle, and is held down by an ingenious and easy-to-fasten hook. As steam pressure is built up in the kettle, the cover is held down more tightly, and pressure-cooking takes place.

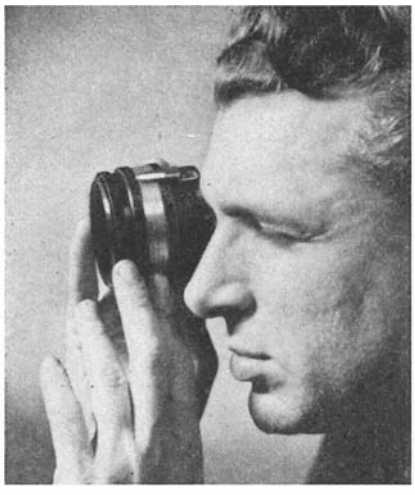
Self-Powered Hand Stroboscope

AS explained in our February article on stroboscopes, "Stopping Time," a rapidly rotating, vibrating, or oscillating object, seen very briefly at the same point once during each cycle, appears to be motionless because each time it is briefly viewed, an impression is made upon the retina of the eye and is transferred to and retained by the brain until the next glimpse. This phenomenon, known as "persistence of vision," has been used for years in various types of stroboscopes, from the ordinary slotted disk type to the type which flashes a light at regular, fast intervals to illuminate the moving object at one particular point of its cycle. Commercial stroboscopes have depended mainly on the latter principle of light flashes.



Self-powered stroboscope compared with baseball for size. *Upper right:* The instrument in operation

In the Strobomeca, a development of Boulin Instrument Corporation, the slotted disk principle is utilized in a hand instrument which is self-powered, requires no electricity of any kind, either from batteries or wire connections. This new device contains a Chronometric motor which drives a slotted disk. The speed is accurately controlled by a spring governor. The motor, wound by a permanently attached key; the disk, protected by a heavy glass panel; and the governor are contained in a three-piece, threaded aluminum housing slightly larger and heavier than a baseball. In use, the instrument is wound and focused on the moving object and then synchronized with the motion of the object, the speed of the object then being read on the instrument's graduations.



The range of this instrument is from speeds of 500 to 100,000 and it may be used at the plant, in the field, indoor and out. No accessories are needed. It is claimed that the accuracy of the spring-wound movement has proved its durability in endurance tests of over 100 hours.

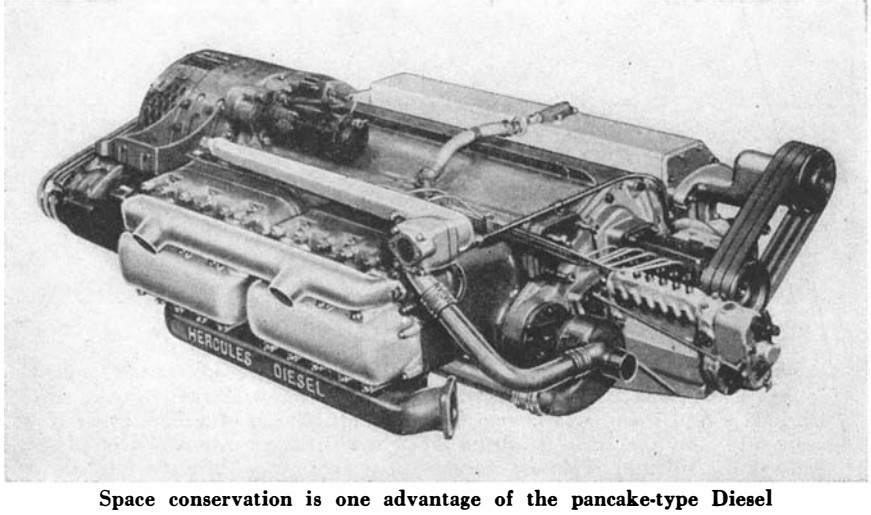
FREIGHT-FUEL

FOR every thousand tons of freight and equipment moved one mile, American railroads now use 112 pounds of fuel compared with 172 pounds of fuel in 1920.

Paint for Hot Metal

HOT metal surfaces are as subject to rust and corrosion as are cold ones but no ordinary paint can be used to give them proper protection. A new chemical rust-preventing paint, named Kemick, has been developed for such hot metal surfaces. This finish, which is made by the American Chemical Paint Company, may be used on hot parts of the automobile engine, such as exhaust manifolds, exhaust pipes, and mufflers. Not only will it protect the metal but it also makes a more sightly engine.

Kemick becomes effective through chemical action with the metal which it covers. Whereas ordinary manifold and engine enamels decompose quickly and completely when subjected to heat, Kemick decomposes only partly, the volatiles are expelled, and chemicals are liberated to react on the metal surface. It does not burn off but retains its color and protective properties and is said to improve with heating.

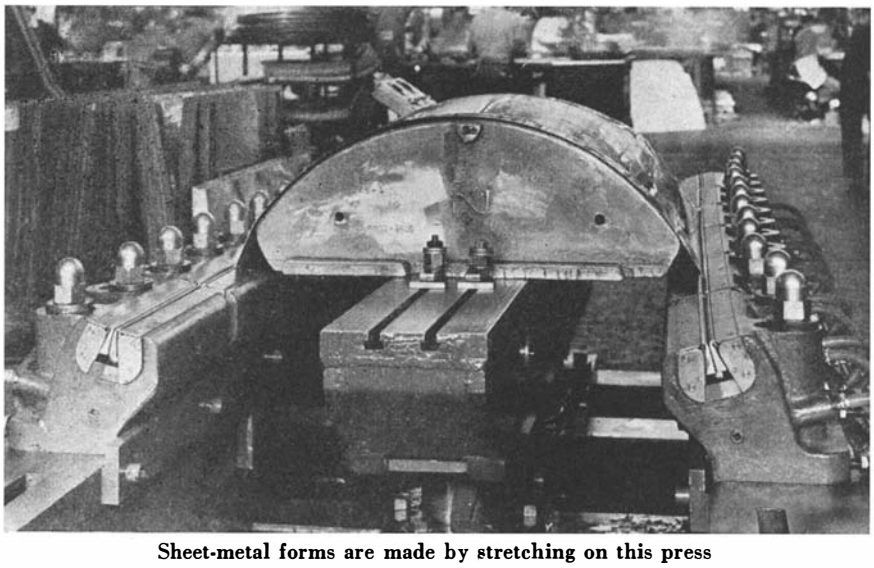


Space conservation is one advantage of the pancake-type Diesel

A Pancake-Design Diesel Engine

FOR reasons of economy of space, primarily, certain gasoline engines have been built with all cylinders horizontal, in what is known as a pancake design. These have the important advantage of conserving space by being installed flat under the floor of truck bodies.

This design has now been applied to Diesels by the Hercules Motors Corporation in a series of high-speed heavy-duty engines. They were developed particularly for applications where limited space requires engines of limited height. Naturally, in placing Diesel cylinders horizontal, much attention had to be paid to a number of special prob-

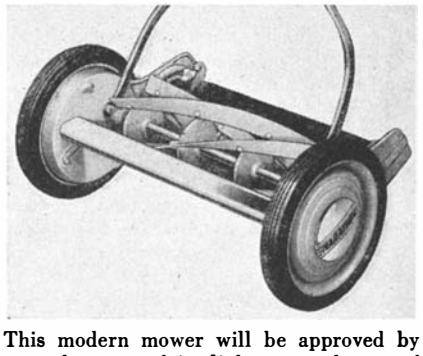


Sheet-metal forms are made by stretching on this press

lems involved, but it is claimed that these were all solved in this design. The three models in the present series are of 176, 191, and 193 horsepower respectively.

Silent Lawn Mower

MODERN lines and silent operation are the outstanding features of the 1940 Marathon lawn mower styled by Glenn W. Tammen of Designers for Industry, Inc., for the F. & N. Lawn Mower Company.



This modern mower will be approved by users because of its lightness and ease of operation, and by owners and neighbors alike because of its silent operation. Wheels and reel spiders are of the disk type. Practically all parts, except the cutting knives, are zinc alloy die castings — light, tough, and practically unbreakable. The wheels are equipped with oversize tires having a "full power" tread which is also a feature of the rubber tread on the roller.

Metal Stretching Press

INSTALLATION of the first metal stretching press to be built and operated in the United States has recently been completed in the huge Middle River plant of The Glenn L. Martin Company. Built by the Engineering and Research Corporation from Martin specifications and first installed by the Martin Company, it is now being used daily.

Primarily, the machine consists of two hydraulic cylinders placed beneath a platen between two rows of independent clamp jaws. The cylinders are attached to the platen in such a manner that they raise or lower the platen vertically. The cylinders then operate in tandem, making it possible to obtain an angular position of the platen if desired.

In operating the press, a form is placed on the platen. The sheet of metal to be stretched is placed over the form and clamped tightly in both rows of jaws. Pressure is now applied on the hydraulic cylinders, causing the platen to move up—stretching the sheet tightly over the form.

When the sheet has been sufficiently stretched so that it hugs the form tightly, the pressure is released and the formed piece also released from the block. It is interesting to note that in the stretching process the thickness of the material is reduced only 5 to 7 percent.

The stretching press is used principally for the forming of large sheets, such as skins, engine cowlings, and so on, which were formerly shaped on a power hammer. It fills a definite need in the industry, principally through absorbing work which once required the use of hand tools, making it possible to turn out the work on a production basis.

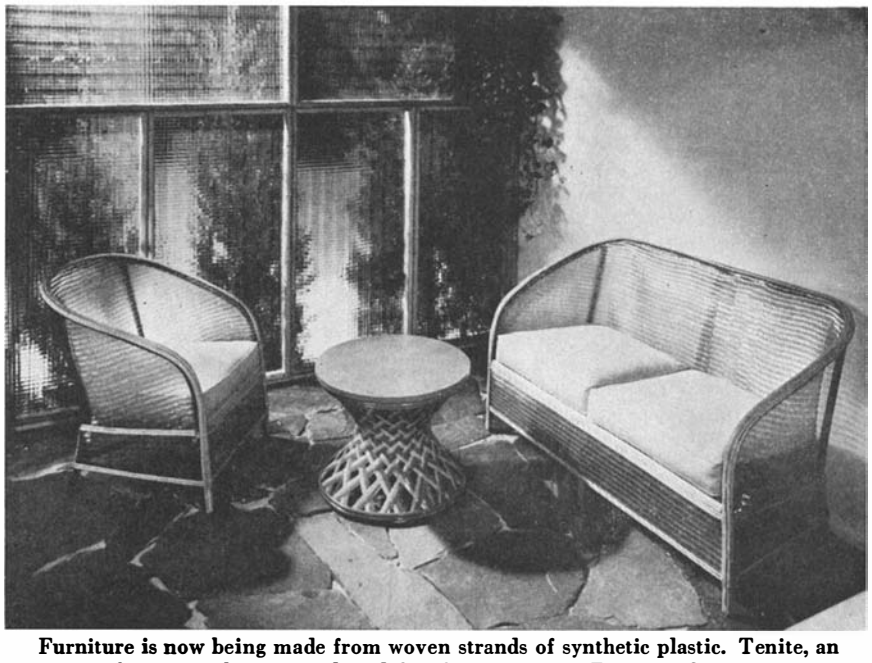
The press does not in any way take the place of the drop hammer, but it appears probable that some parts that are now formed on the drop hammer may in the future be successfully manufactured on the new stretching press.

Fountain Humidifier for Home

THE electric fountain humidifier is the newest development designed to aid in maintaining proper humidification of the air in the home. This ornamental device,

shown in an accompanying illustration, operates from a 110 volt, 60 cycle, alternating current line, and needs no water connection. Its sprays, which are pumped in a circuit, use approximately a pint of water per day. The device uses only 30 watts of electricity which is no more than a small electric light uses.

The humidifier is made of heavy spun aluminum and comes in five attractive colors—bronze, chromium, copper, red, and green. Except for a soft splash of water,



Furniture is now being made from woven strands of synthetic plastic. Tenite, an acetate butyrate plastic developed by the Tennessee Eastman Corporation, is extrusion molded in continuous lengths and woven like reed or rattan for lawn settees, chairs, and tables. A crystal-like matting for wicker-type furniture is machine woven from narrow, transparent strands. Chairs of a more rustic type are hand woven from wide, flat strips of bright, translucent colors. Woven plastic seats have a slight springiness; the smooth surface cannot tear sheer frocks or stockings. Pieces of Tenite furniture, exposed to sun and rain for weeks and then immersed in hot water for 48 hours, showed no deterioration

the device is noiseless. It will not cause radio interference and the manufacturers claim that it cannot leak or get out of order.

DEADLY WIDOW

THE venom of the black widow spider is approximately 15 times more potent than that of the rattlesnake. Hence, the principal reason more deaths are not reported from black widow bites is that she is a timid creature and bites only when cornered.

GLASS MARKING INKS

GOLD Seal Laboratory Inks for labeling small glass surfaces such as microscope slides and small containers are a recent offering of the Clay-Adams Company. These are ready to use with steel pen, brush, or rubber stamp, and write as finely as paper inks. They are non-acid, non-corrosive, non-inflammable; and resistant to acid, alkali, usual laboratory solvents, and high temperatures. They are recommended as well for porcelain refractories and other ceramic materials. Colors are red, white, blue, and black.

INSTRUMENT FOR GIVING SEX HORMONE PILLS

A NEW instrument for depositing "banks" of male sex hormone within the body, in a painless injection in the doctor's office without need for surgical operation, has been described by Drs. Samuel A. Vest and John E. Howard in the *Journal of the American Medical Association.*

"Hormone banks" are the latest method of supplying sex or other gland products to patients lacking a supply of their own. Young men cheated of manhood by a mistake of nature have been given virility by this method, and Addison's disease sufferers have been restored to healthy, normal lives by it.

Instead of injecting a fluid preparation of the hormone, solid pellets of the material have been buried beneath the skin by surgical operation. The pellets form "hormone banks" on which the body may draw as the material is needed. Several months' supply can be given at one time.

The new instrument now makes even the surgical operation unnecessary. In the doctor's office, a wheal is made in the patient's skin by a local anesthetic. The injector instrument, containing the desired supply of hormone pellets, is pushed painlessly through the skin. The pellets or pills are ejected from the instrument, which is then withdrawn.—*Science Service.*

GARAND RIFLE MODIFIED

THE U. S. Army's new self-loading Garand rifle, now in quantity production, has had its muzzle end slightly modified and simplified, to support the bayonet more solidly. A number of minor adjustments have been found necessary in the quantity-manufactured rifles that were not apparent in the earlier rifles produced by slower, small-scale methods, but no major faults have been discovered.

Ordnance men hoot at rumors that the Garand can't "take it" under field condi-

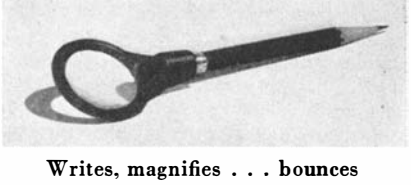
tions. Before it ever was adopted to replace the time-tried Springfield '03 model, it was put through the most severe treatment that hard-boiled Army men could think of. It was dropped off a cliff on rocks and hard ground. It was thrown into water and left there for hours. It was rolled around in sand, kicked around in deep dust, tramped into mud. Picked up and given no more wiping than was possible with the soldier's bare hands, it functioned with as much snap and smoothness as if it had come fresh from the gun rack.

Another criticism was that it would be difficult to clean caked carbon off the front end of the rod that takes the push of powder gases near the muzzle and operates the self-loading mechanism. This rod is released with no other tool than a small screwdriver, and the carbon scraped off with the same instrument.

The sights of the Garand, both front and rear, are coarser than those used in scoring world-beating records with the Springfield. However, it is pointed out, these sights are designed primarily for battle purposes, at 500-600 yard ranges. If fancy shooting is desired, special sights can be fitted on the target rifles.—*Science Service.*

Bouncing Magnifier

DESK or general utility magnifying glasses break, chip, and scratch so easily that it is strange no one has ever thought of mounting them in rubber. The Mark Specialty Company did just that and,



Writes, magnifies . . . bounces

in addition, mounted a rubber socket on one side of the rubber rim so that the magnifying glass may be slipped on the end of a pencil. The resulting device is one that can be thrown around the desk with impunity and it will actually bounce rather than break. These small magnifiers are triple powered and come in six colors.

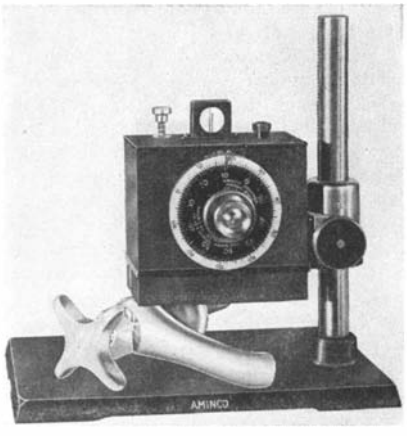
Dry-Ice "Keeps" Ice

KEEPING 350 pounds of glacial ice frozen on a trip halfway across the country is something of a trick, and scientists have accomplished it by packing the ice in solid carbon dioxide (dry-ice). The purpose of the unusual shipment was to study size of ice crystals at different depths in the glacier.—*Solvent News.*

Coating Thickness Tester

THE Aminco-Brenner Magne-Gage, an instrument for measuring local thickness of coatings on metals by the rapid, non-destructive magnetic method, has been improved since its introduction in 1937. The improvement, which greatly increases the utility of the instrument, now makes possible measurement of various types and thicknesses of coatings with only one instrument, simply by interchanging different types of magnets.

The instrument as now marketed will



Checking thickness of metal plate

measure nickel coatings on non-magnetic base metals; non-magnetic, metallic, or organic coatings on magnetic base metals; nickel coatings on iron or steel.

The method is simple, rapid, non-destructive of the coating or the base metal, and is especially advantageous for both works-control and acceptance testing, since it permits testing of a large number of specimens at low cost.

WAGES

THE motor transportation industry is responsible for one seventh of the nation's pay envelopes.

Chemical Pioneer Prospectors

CHEMISTS have joined the search for oil and gas. They are applying microchemical methods to the pioneer custom of finding oil deposits by surface seepages. Unlike the pioneer prospectors, who located only shallow wells by surface seepages and sometimes not even those, modern chemical prospectors hope to develop a method of seepage analysis which will be an accurate guide to underlying oil deposits in any field and will locate wells at any depth.

At present, they are concerned chiefly with the analysis of surface soils, or the gases contained in them, for minute amounts of various hydrocarbons and other compounds which indicate the presence of underlying petroleum deposits. Soil samples from the surface or a few feet below are taken to the laboratory. There, light hydrocarbon components are driven off by vacuum distillation. Such heavy components as waxes are extracted in various ways and analyzed. The presence of such divergent gases as hydrogen, ethane, ethylene, and propane is determined. Liquid hydrocarbons from surface soils, and even hydrocarbon or partly-hydrocarbon soil waxes, are being used as possible indications of underlying oil deposits.

Recently, a highly sensitive device known as the "mass-spectograph," used only in the physics research laboratory for "weighing" infinitesimal atoms, has been put to work. It is used as a modern divining rod, separating and identifying the minute amounts of surface gases which have escaped laboratory analysis.

With the "atom-weigher," it is possible to run a qualitative and quantitative analysis on an unknown mixture of hydrocarbon

gases smaller in volume than the head of a pin. Results of the analysis may be obtained in 10 minutes or less, scientists say.

Another device, newly-developed to aid discovery of new production horizons in already-developed fields, contains a very sensitive electric eye which responds to emissions of Gamma rays from geological structures. Lowered to the bottom of the well and raised slowly, the "eye" registers variations in the Gamma rays given off by each strata, which are recorded automatically at the surface.

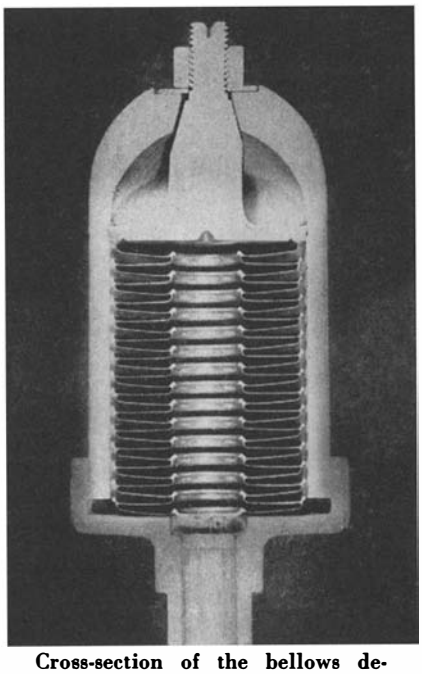
Sun-Ray Filtering Paint

EYE strain resulting from sun-glare is a great enemy of production efficiency. It contributes to poor work, less work, and unnecessary fatigue. A blue translucent material produced by the Skybryte Company is intended to eliminate sun-glare by spraying or brushing on factory windows. It is claimed that this material shuts out all glare yet admits 95 percent of the light; it filters out the heat-producing rays of the sun so that there may be as much as a 15 percent decrease in temperature.

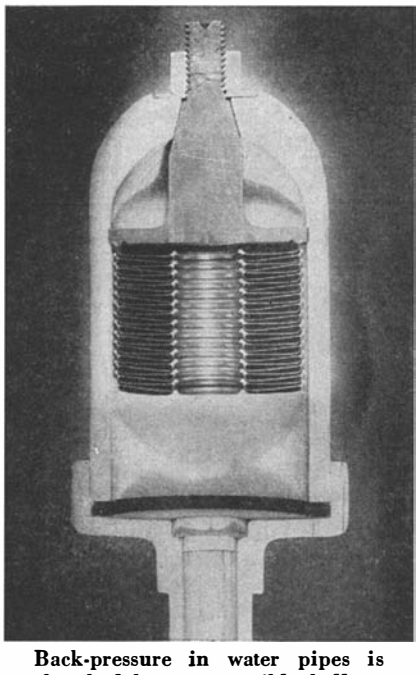
Preventing Water Hammer in Pipes

MANY householders have found to their annoyance that a serious hammering occurs in the pipes every time a faucet is closed. This hammering sometimes causes breaks at pipe connections. Such breaks may not be important in homes but are very serious in industrial plants. The hammering is caused by the great increase in the pressure within pipes when the flow is suddenly stopped by closing the faucet. That pressure may run to as high as 600 pounds per square inch if, for example, the flow velocity is 10 feet per second.

Prevention of destructive water hammer may be accomplished by the use of relief valves and air chambers. Some householders simply mount a five or six-foot length of pipe vertically and close it at the



Cross-section of the bellows device that prevents water hammer



Back-pressure in water pipes is absorbed by compressible bellows

top to hold a column of air in the water main in the basement. However, there is difficulty in keeping the air in the chamber. Positive and permanent relief is obtained by the use of a simple device known as the Wacor Water Hammer Arrester. This consists of a closed metal bellows or compression compartment which is filled with a special compressible emulsion and is mounted in a casing connected to the piping system. With this there is no need for maintaining air in the chamber, for the back pressure is cushioned by the compressible bellows. The arresters are made in different sizes having bellows of different volumes.

When a Wacor Water Hammer Arrester is put on the line, the sealed compression chamber is partially compressed as the water pressure is turned into the system. When a valve or faucet is opened, the bellows expands, but when the valve or faucet is then closed the bellows acts as a spring to take up the shock by compression. The manufacturer claims these devices have been subjected to as many as a million shocks without rupture.

BEETLES

JAPANESE beetles this year will be attracted by traps painted yellow, as that color has been proved to attract more of these beetles than any other color.

Eating Glass

FOR generations laymen have believed that glass, if taken into the food tract in either powdered or chipped form, would be invariably fatal. This belief seems a little too broad in its scope, according to an article in the *Journal of the American Medical Association* which recently answered a query on this subject as follows:

"The ingestion of glass may or may not be fatal. The nature and extent of the harm done, if any, depends on the size, shape, and number of particles ingested

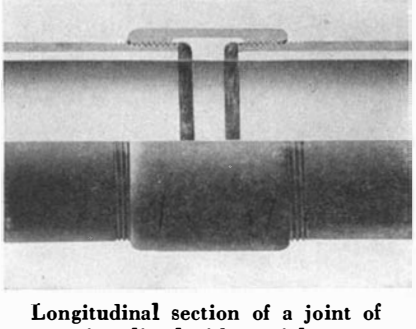
and on the presence or absence of food in the mouth with the glass or in the gastro-intestinal tract at the time the glass is swallowed. The danger lies in perforation of the wall of the stomach or the intestine and in acute or subacute gastro-enteritis. It would hardly be safe to say that the average person can chew up and swallow glass without suffering immediate injury, but it seems to be beyond question that some persons can do so.

"Dr. Walter S. Haines ('Death from Pounded Glass and Other Mechanical Irritants, in Legal Medicine and Toxicology') reported a case in which 'a professional glass eater,' in the presence of Dr. Haines and of Dr. E. F. Ingals, ate half a dozen six-inch test tubes, two good sized lamp chimneys, an ordinary four-ounce medicine bottle, two pieces of window glass, each four inches square, and three slips of colored glass each one inch wide and three inches long, biting the glass off the pieces offered him, chewing it up, and swallowing it much as if it had been an ordinary article of food. The glass eater had eaten a hearty meal before submitting to the test, as was his custom before each exhibition. He was kept under observation for several hours after eating the articles named, but at no time did he show any unfavorable symptoms. He died, however, two or three years later, from a subacute gastro-enteritis, presumably, Dr. Haines says, from the irritation produced by his long continued glass eating. There are other well authenticated reports of similar purport."

Cement-Lined Pipe

An improved process for the manufacture of cement lined steel pipe for transmission of highly corrosive fluids has been perfected by the Jones & Laughlin Steel Corporation. The product is made on a new high-speed mill especially designed for the purpose.

In the J & L process, a special formula, not available on the open market, is used in lining the pipe. A measured quantity of



Longitudinal section of a joint of two pipes lined with special cement

the special mix is placed in the pipe and forced against the walls by a process which, combining centrifugal force with vibration, extracts a high percentage of the water. This, cement experts agree, is desirable in attaining a lining with the highest physical properties. The process results in extremely even distribution of the mixture. After curing, the pipe is given a final inspection and made ready for shipment.

The combination of the special mixture and the process produces an even interior coating in the pipe, so smooth that the lining has a lower friction coefficient than the original pipe, yet so strong that no special

handling in the field is required to protect the lining, except that the pipe cannot be deformed. The pipe can be shipped, cut to length, and fitted just as unlined pipe—the lining being able to withstand without chipping any blow on the exterior of the pipe which does not actually dent the pipe.

Cutting-Off Machine

A NEW machine of the bonded-abrasive wheel type is announced by the American Instrument Company, for cutting glass, quartz, ceramics, metals, commercial

and semi-precious stones, and the like, in the form of sheets, rods, tubes, and blocks.

Cuts up to 3½ inches can be made on materials with flat surfaces Rods, tubing, and the like up to six inches in diameter can be cut by rotating the material as it is being cut.

True, clean cuts are made speedily and precisely by means of a motor-driven 12-inch-diameter rubber-bonded abrasive wheel (0.04 or 0.06 inches thick)—without chipping or breaking the material.

The machine is especially suitable for slicing all kinds of tubing, and makes extremely short cuts that are made only with great difficulty by other means. For example, lengths of 1½-inch-diameter glass tubing as short as 1/32 of an inch can be cut off as easily and quickly as longer lengths, and with smooth, parallel, unchipped edges.

The machine consists essentially of a non-corrosive cutting table, a cutting wheel direct-connected to a 115-volt, 60-cycle alternating current motor, and a centrifugal pump, mounted on a rigid steel stand.

Operations to Correct Deformities of Infantile Paralysis Reported

OPERATIONS in which muscles are transplanted, bones reshaped, and joints fused together to help infantile paralysis patients recover from the deformities and handicaps left by the disease were reported by Dr. Henry G. Hill, of Memphis, at a recent meeting of the Southern Medical Association.

One little girl whose case he described can now stand erect and walk fairly well since operations on both hips, both thighs, both knees, and both feet.

Operations should not be undertaken for at least two years after the attack of infantile paralysis, Dr Hill warned. If the cells of the spinal cord have been damaged but not killed by the infection, they will

eventually return to normal and resume their function of supplying the muscles with nerve stimuli or messages for action, and the paralysis will disappear, provided the patient has received proper treatment during these early stages. This improvement may take two or more years, however. Consequently, the surgeon should wait at least that long before operating to correct or minimize deformities.

Muscle transplantation is suited to patients who have received proper treatment early in the disease. By this operation, the strong group of muscles may be divided and enough of them transferred or transplanted to the opposite side of the joint to restore muscle balance, so the muscular pull is not all in one direction, which in itself may produce deformity. — *Science Service.*

Laboratory Porcelain

A NEW chemical porcelain having remarkable properties is being used in the manufacture of laboratory sinks and other furniture. This new product, Lappware, made by the Laboratory Furniture Company, Inc., is extremely dense, completely vitrified, non-porous, and free from voids, blebs, and minute pore spaces. It is exceptionally tough and difficult to break; its low thermal coefficient makes it highly resistant to thermal shock.

The white glazed surface of Lappware will not discolor, craze, or oxidize, and it does not retain odors. It is fired at a high temperature—2250 degrees, Fahrenheit—thus making it chemically inert to all acids, alkalies, and solvents except hydrofluoric acid, from which it is said to suffer less than a number of other commercial porcelains.

Unique Foundry

THE success of Ford Motor Company metallurgists in developing cast-steel automobile and traetor parts as strong or stronger than the forgings they replace has led to the construction of a big new steel foundry unit in the Ford Rouge plant.

Steel is poured continuously in the new unit, the molds being brought on a conveyor to the pouring spout of the electric holding furnace. Formerly it was necessary to pour intermittently because the steel was melted a few tons at a time in individual furnaces. In addition to saving time, the new Ford method produces more uniform castings by delivering the metal for each casting at uniform heat and composition.

The steel foundry is carefully synchronized. It includes melting furnaces, steel holding furnace, core-molding machines, conveyors, heat-treat and annealing furnaces, and cleaning room. Parts such as plow beams, tractor front axles, tractor radius rods, and wheel flanges can be made in sufficient quantity for 250 tractors a day. This involves pouring from 90 to 112 tons of metal a day. A smaller foundry unit constructed nearby will produce a variety of small steel parts in comparable volume.

Wood as a Paving Material

WOOD has long been employed in the construction of road surfaces, and under favorable conditions, a modern wood-block pavement is quite durable. It is, however, expensive to construct. In recognition

of the many desirable features of wood pavements and in an attempt to use large quantities of low grade and under-sized timber unsuitable for ordinary commercial purposes, the Deidesheimer method has been patented in most European countries, and is called "wood-stone" paving. As the name implies, it consists of both wood and stone.

On a previously prepared macadam base, either treated or untreated, the wood is placed in the form of cylindrical blocks, four to ten inches in height, which are cut from saplings or other undersized timber, preferably hardwood, with a diameter of from two to five inches. The blocks are cut to the requisite length at the site, barked, and then impregnated, immediately prior to laying, in a vat of Wolman salts. These treated cylinders are then placed on the prepared base in an upright position and tamped or rolled. Stone chips are then used to fill the gaps between blocks, subsequent rolling and watering forcing the blocks into the base and the stone chips into the wood, keying the surface together. This surface may be treated with an asphalt emulsion, which further fills the voids between the blocks, and a sprinkling of fine stone chips which are rolled into the exposed tops of the cylinders, forming a waterproof and durable surface. The preparation of the base would be governed by the character of the traffic to be carried by the completed road. — *N. V. Felsovanyi, in American Forests.*

Who Was Shakespeare?

(*Continued from page* 264)

26th, *The San Francisco Argonaut* carried an editorial entitled "Who Was Shakespeare?", paying high tribute to the importance of the X-ray and infra-red evidence.

Newspapers in France, Switzerland and Holland have also played up the story. Charles Boissevain, a well-known journalist of Geneva, is translating the complete Scientific American article into Dutch for publication in the Lowlands.

Letters received by us from readers fell into three classes:

Those whose writers objected to doubt being cast upon the identity of the "officially approved" Bard of Avon, those whose writers demanded more proof of Lord Oxford's identity before drawing any conclusions, and those — evidently already possessing some acquaintance with subsidiary evidence connecting Oxford with the Shakespearean authorship — whose writers greeted the publication of the X-ray and infra-red investigation as an event, charged with important historical and biographical implications. We quote a paragraph from one of these latter, written by Fred H. Colvin, editorial veteran of the McGraw-Hill Publishing Company:

"The disclosures made by modern photographic methods show clearly that the old paintings had been altered. The resemblance of the faces and features, as shown, together with the careful study of the hands, ring and wild boar device, should convince the most skeptical. It has long been a

mystery to me why so many cling with a sort of blind loyalty to the idea that an illiterate butcher boy could have written of life and places of which he could have known nothing whatever."

One of the very last letters written and signed by the late Lord Tweedsmuir, the scholarly Governor General of Canada, expresses his thanks to a friend for sending him a copy of the January Scientific American. As a historian and writer of mystery stories, Lord Tweedsmuir (John Buchan) appreciated the evidence disclosed by the dissection of the Ashbourne painting:

"I have read the article by Mr. Barrell with very great interest. Will you convey to him my thanks?

Yours ever,

TWEEDSMUIR."

For the benefit of readers of the January issue who demanded more evidence, we publish on page 264 an X-ray photograph of the Ashbourne portrait which was crowded out of the original article.

This shows that underneath the rearranged hair which "Shakespeare" wears in his Ashbourne picture is the same type of large ear with the wide anterior opening that very peculiarly characterizes Lord Oxford in both of his inscribed portraits.

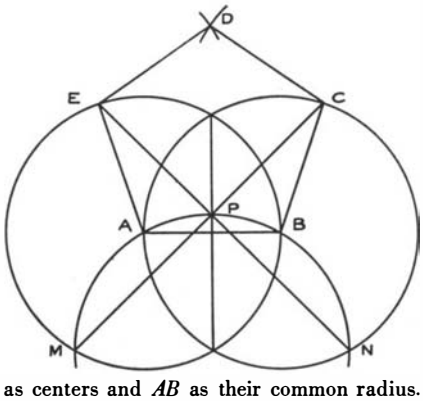
We would also reiterate that the evidence of the *three* disguised Shakespeare portraits which connects them with Oxford's personality in so many ways cannot be logically attributed to commercial art fakers who "accidentally" got hold of the portraits at various times and fixed them up to palm off on gullible Shakespearean enthusiasts.

The disguises that have been applied to the original Oxford paintings bear so close a similarity, and are of such ancient application in the opinion of competent experts, that it is apparent that the work was done at a time when all three pictures were available to a small group, such as the original family owning them. There is no record of any of these pictures, on the other hand, having been bandied around among unscrupulous art dealers. Each of them has an "heirloom," rather than an auction room, background. King William IV received one as a gift from a member of the Sidney-Herbert family of Penshurst Place. This ancient Kentish manor was one of the homes of Lord Oxford's son-in-law, Philip Herbert Earl of Montgomery, to whom the First Folio of the plays of "Mr. William Shakespeare" was dedicated in 1623.

PROBLEM: THE PENTAGON

FINAL problem of the series offered our readers by Lieutenant-Commander Kaplan is as follows:

The accompanying sketch shows a method of constructing a regular pentagon *ABCDE*. Two circles are described with *A* and *B*



as centers and *AB* as their common radius. A third circle *MAPBN*, of the same radius, is passed through *A* and *B*. Through *P*, the point of intersection of this circle with the common chord of the first two circles, lines are drawn from *M* and *N* which cut the original circles at *E* and *C*. With these latter points as centers, and the same radius as that of the three circles, arcs are swung which intersect at *D*, the final point of the construction. Show whether the method is exact; and if not, determine the error of approximation by evaluating the angles at the five vertices of the pentagon.

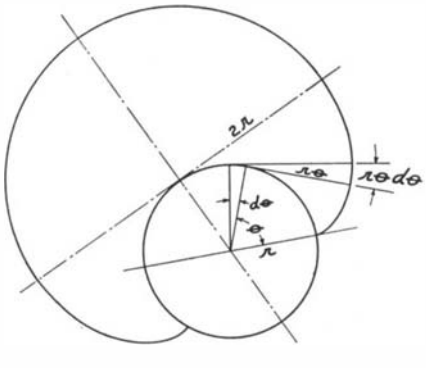
SOLUTION OF THE SECOND CIRCULAR PASTURE PROBLEM

LAST month's problem read as follows: A circular fence encloses a field 200 feet in diameter. A cow is tied by a rope 200 feet long to a point on the fence, and outside the enclosure. Over what area will the cow be able to graze?

In a private communication to the Editor, Commander Kaplan had said: "In spite of the brevity of the solution, this is not an easy problem. The integration is rather differently accomplished than ordinarily. The usual method of approach would lead to a much longer solution." "*Why* didn't the Editor tell us this fact *last* month, when it would have done some real good?", many a reader is going to say to this. Well, isn't mathematics like that? Did the professors ever give the poor victims advance tips in examinations? Ours didn't. This is a cruel world, without a doubt.

The solution:

The cow will be able to graze over a semi-circle of radius $2r$, and the two equal areas which lie between the circular field and the curve traced out by the free end



of the rope as it winds around the fence. The element of area for the latter may be taken as the triangle shown in the accompanying sketch, and the area of each loop will be expressed by the integral,

$$\frac{r^2}{2}\int_0^2 \theta^2\, d\theta = \frac{4}{3}r^2$$

The entire area encompassed is therefore

$$2\pi r^2 + \frac{8}{3}r^2$$

and, since r in the problem given is 100 feet, this evaluates to

$$20{,}000\left(\pi + \frac{4}{3}\right) = 89{,}498.52 \text{ sq. ft.}$$

YOUR FIREARMS

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; science has so developed them that millions yearly find sport and recreation in their use. Hence this monthly department presenting a wide variety of discussion regarding firearms, their handling, and their accessories. Suggestions from readers will be heartily welcomed.*—The Editor.

THE TEST OF TIME

WHEN Theodore Roosevelt said, "The old days were great because the men who lived in them had mighty qualities," he could have added that the doughty individuals referred to injected into many of their actions and some of the products of their hands a goodly portion of those same "mighty qualities." Take firearms, for example. Samuel Colt introduced his famous Single Action 6-shooter, .45 caliber "Peacemaker" in 1872, and followed with the equally well known and similar "Frontier" model in .44 and .44-40 calibers, a gun which has changed but little during the past 68 years. John M. Marlin perfected his repeating, lever-action rifle in 1880 and 10 years later applied the principle to a solid-top, side ejection .22-caliber rim-fire rifle, known then as Model 1891 and today as Model 39-A. These are but two instances of those "mighty qualities" of which "Teddy" Roosevelt spoke, instances in which men of earlier days so nearly attained perfection in gun craftsmanship that artisans who followed their footsteps have been unable to improve the basic features of these two firearms.

Although refined by later-day experts and engineers, the Colt Single Action Army Revolver of today is still fitted with the original "Peacemaker" type of hammer, trigger, action, and rod ejection mechanism initiated by Samuel Colt 68 years ago. As of old, the gun is available with barrels of 4¾, 5½, and 7½ inches, and the weight has varied little. The splendidly told, profusely illustrated story of Colt arms, "A Century of Achievement," depicts both guns, and, as may be seen from the pictures in that book, the similarity of lines and details is striking. Save for the grip and the front sight, the 1873 "Peacemaker" and its 1940 counterpart are practically twins.

John Marlin made gun history and created a sensation when he brought out his .22 caliber, lever-action repeater in 1891. Not the least among the original features still found in the same gun, 49 years later, are the deep-cut Ballard rifling, noted for accuracy, and the ease with which all working parts may be exposed for cleaning and oiling by the turning of a single screw. This was accomplished by making the cover plate a part of the stock, thus separating the receiver into two halves. That portion of the receiver to which the barrel is attached carries the breech bolt and the ejector. The other half of the receiver, to which the stock is fastened, houses the finger lever, hammer, trigger, cartridge carrier, and other working parts, all of which are securely attached and impossible to lose when the rifle is apart or in take-down condition. In addition, the 39-A remains, as at the time of its inception, the only lever-action, .22 repeater manufactured.

We've no intention of belittling the exploits of pioneers in other fields, but it does seem worthy of note that in few products have there been less basic changes during the past half century. With everything being "streamlined" and brought "up to the minute" these days, it's gratifying to know that in the realms of handguns and rifles, at least, certain basic principles have so successfully withstood the multiple tests of time, world-wide distribution, and varied usage that it has been difficult to improve on them. Continued universal acceptance of the underlying methods of operation of Samuel Colt's "Peacemaker" and John Marlin's lever-action is a tribute, indeed, to

Retaining the best features

Easy to clean

Marlin's Model 1891, after 49 years, becomes Model 39-A, above

those who today direct the policies of their respective houses by carrying on the sound tenets of firearms manufacture originated many decades ago by Messrs. Colt and Marlin.

Mossberg's Triplets

It has long been more or less an axiom in firearms circles that when O. F. Mossberg & Sons, Inc., announces something new in rifles, the .22 caliber section of the gun world sits up to take prompt notice. The heralding of the three latest Mossbergs, Models 42M, 46M and 51M, has proved no exception to this rule. In the order named they are a 7-shot clip repeater, a 22-shot tubular repeater, and a 15-shot automatic, all .22 caliber, all Manlicher, Mauser, or Military type — whichever name you prefer — and all rugged and built for dependability and accuracy. Each member of this new family of "M's" is equipped with hooded ramp front sight with four permanently attached inserts, No. 2A rear sight with screw adjustment for windage and elevation, No. 4 microclick peep sight which swings out of the way, permitting use of open or 'scope sights. They all have detachable swivels, nonbreakable molded trigger guard with finger grooves, and in the cases of Models 42M and 46M, a Mauser-type bolt which hugs the stock and doesn't interfere with 'scope mountings.

If you've ever had a "flash-back" occur while shooting, you'll appreciate Mossberg's new cover plate, which is attached to the bolt and moves over the ejection port hole when the bolt is closed, to provide additional safety for the shooter and to help keep dirt and other foreign matter out of the loading port. If you like a clip-type rifle, you'll find the 42M exceedingly practical, for the butt-plate has a "trap door" and the stock is cut out to permit insertion of an extra clip of 7 shells. If you dislike loading, you'll like the capacity of the Model 46M.

No flashbacks with the new Mossberg bolt-action .22 rifle. A plate covers ejection port when bolt closes

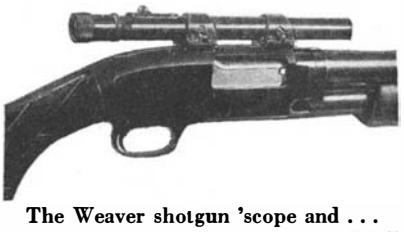
Right: In the same gun as shown above, an extra clip is carried in the stock

On the other hand, if you're of the automatic school of firing, the 51M fills the bill and handles .22 regular or high-speed long rifle cartridges, either lubricated or dry, without any change, and you can pack 15 of them into the magazine.

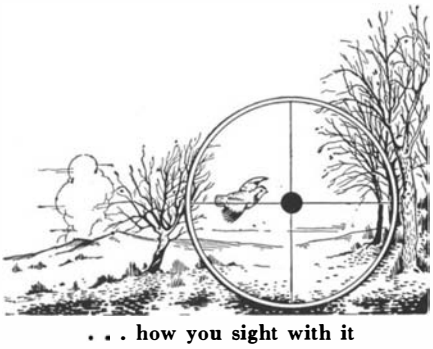
The Mossbergs prefer that the shooters of America christen this new family of "M" models, so this is a case of "Name it and you can have it." There'll be a check for $100 and choice of any of the 3 models as first prize in this name contest. Second and third prizes are $50 and $25 respectively and, again, the winners have a choice of the new guns in addition to the cash awards. We've a good supply of Mossberg catalogs and entry blanks for this contest, so let us know if you want them. There's no catch to this, nothing to buy. Be kind of nice to have a new gun this season, wouldn't it?

From the Mail Box

Following publication of the story, "Shotgun Heresy" in the January issue, we received a number of reader inquiries requesting more information on the one-power (no magnification) shotgun 'scope, made by the W. R. Weaver Company, for use in trap, skeet, and wing shooting. Now comes a note from "Bill" Weaver enclosing copy of a letter from T. K. Lee, Birmingham, Alabama, who reports complete satisfaction on a South Caro-



The Weaver shotgun 'scope and . . .



. . . how you sight with it

lina quail hunt with the Weaver 1-X 'scope on a 12 gage Winchester pump scattergun, and who writes: "I don't recall missing a shot that was in the open or where the bird was in sight."

Claiming equal success in dove and crow shooting, Lee also spoke of breaking 49 birds in skeet, "heavily dusting the lost bird," while at the 16-yard traps he won a turkey shoot with another 49. But the extreme versatility of this Weaver 'scope, and, incidentally, of Lee's marksmanship, too, is shown in the following quotation from Lee's letter: "Past Saturday we varied our rifle program a little and did a good deal of shooting at aerial stuff with the .22 and this 'scope. For lack of something better, we used black walnuts, which measure 1 to 1⅛ inches when hulled and are a pretty stiff target for this stuff, when pitched about 20 feet high. I had one run of 24 straight, taking all shots, whether good tosses or not. I find it very definitely easier than with peep sights or open sights and no trouble to put in repeat shots. Mine is mounted on a Remington pump .22, but if I had it on an automatic, I could put in three to four shots easily."

All of which bears out Weaver's own claim that "the 1-X 'scope is unbeatable for many kinds of rifle hunting, especially large game and moving game, for fast shots and in wooded country. For rifle," Bill

continues, "a flat top aiming post is used instead of the large, coarse center dot designed for shotguns." We have on hand a supply of Weaver's folders, describing and picturing his 'scope, and you're more than welcome to one, if you'll just drop us a line.

Pittman-Robertson Act

OF importance to all who buy guns and ammunition was the recent address by Albert M. Day, Chief of the Division of Federal Aid in Wildlife Restoration, Bureau of Biological Survey, to the North American Wildlife Conference in Washington. From the 10 percent excise tax on sporting arms and ammunition, Federal appropriations have been made to states which have given specific legislative assent to Pittman-Robertson Act provisions, the Federal Government bearing 75 percent and the respective states 25 percent of the cost of these undertakings. Some fine work has been accomplished, such as taking submarginal lands out of agricultural production in 15 states to provide badly needed range for deer, elk, moose, and bighorns, and food, cover and sanctuary for grouse, turkeys, pheasants, quail, Hungarian partridge, ruffed grouse, sharptails, rabbits, and other species of birds and animals. Projects for purchase of areas to restore conditions for waterfowl and fur bearers are being considered in six other states. Re-vegetation of lakes and water courses, re-seeding of burnt-over areas, re-allocation of game populations, and research laboratory work are among other activities, all tending to improve the nation's wildlife resources. Summing up, Day said: "If the game departments confine their activities to those of the caliber undertaken during these early stages, Pittman-Robertson will, in truth, become, as its sponsors predicted, the greatest boon to wildlife conservation since the passage of the Migratory Bird Treaty Act in 1918."

Pot-Shots

AT THINGS NEW

The American Insurance Group now issues an "All Risk" insurance policy on guns, cases, ammunition, extra sights, and other shooting equipment at a rate of 1 percent on the amount of insurance, subject to a minimum annual premium of $5. Protection is afforded at home, in the field, wherever the insured property may be.

Smith & Wesson presents to the handgun fraternity their new S. & W. "K-22 Masterpiece" as a worthy successor to the famous S. & W. "K-22 Target Revolver." Incorporating a 6-inch, precision drilled, reamed and rifled barrel on the frame of the veteran .38 M. & P. target gun, with an over-all length of 11-1/8 inches and a weight of 35 ounces, the Smith & Wesson folks have produced a .22 caliber handgun which embodies even greater speed, accuracy, and ease of handling than the world-known "K-22." The cylinder, with recessed head space, is chambered for the .22 L.R. cartridge, as well as any other rim fire .22. New developments which command attention are the S. & W. micrometer rear sight, which provides positive two-point click adjustments for windage and elevation —and these adjustments will not shoot loose; the "Speed Lock" hammer, which offers shorter, faster, easier cocking, and allows grip to remain unchanged during fast fire. All-in-all, this "K-22 Masterpiece" is a "he-man's" gun, made "with the rugged precision of a French 75," to quote Cy Bassett, of S. & W. Want a folder? We have some.

American Optical Company has developed a synthetic sponge sweatband for elimination of the hot-weather perspiration problem, faced by all target-shooting devotees. It is adjustable to any head size by an elastic band; may be worn with or without a hat; is washable.

Harrington & Richardson Arms Co. has introduced a new six-shot target revolver, known as "Eureka" model. It weighs 30 ounces, has six-inch barrel with sights adjustable through large-headed screws, and choice of 11 different sizes and styles of grips, with standard equipment No. 4 thumb-rest type. Gun has leaning rear sight to remove possibility of shadow. To preserve the set pull in pounds and to offer smoother, sharper action, trigger pull is adjusted by means of rounded edges, rather than sharp edge hammer notch. Cylinder latch is on left side for easier handling; thimble and extractor are heavier; lifting ratchet has two points, all tending to increase wearing qualities.

We've a Hunch that most gun owners are also the possessors of fishing rods of one kind or another, so we just have to mention three splendid angling publications which, to us, are The Books of the Moment. They are, "No Life So Happy," by Edwin Lewis Peterson; "Fur, Feathers, and Steel," by Reuben R. Cross; "The Fly Tyer's Handbook," by H. G. Tapply. If you fish, you'll like 'em all; if you tie your own lures, the latter two should be on your "must" list.

Glad Rag Products Corp. offers a polishing cloth, approved by Good Housekeeping Institute, which is sufficient unto itself without paste, powder, or polish. In either 10 or 20 cent size "Glad Rag" performs brightening miracles on all metal sporting equipment with a minimum of "elbow grease" — works equally well on silver, too, so if you don't find it in your sports cabinet, look in the kitchen.

New Method Mfg. Co. has a product, "New Method Gun Bluer," which immunizes guns against exterior rust, corrosion, and dampness, is easily applied with a camel's hair brush, and restores highly polished blue finish. "New Method" is not a "chemical" cleaner, but is a hard, perfectly colored lacquer.

Attention, you gun collectors and gun clubs of the Louisville and Lexington, Ky., area! Take a few minutes from your first-of-the-season trout fishing and visit the collection of antique guns and arms being shown during May at Stewart's Dry Goods, Inc., Louisville, Ky. The firearms in the exhibit are supplied by International Studio Art Corporation, were formerly part of the William Randolph Hearst collection.

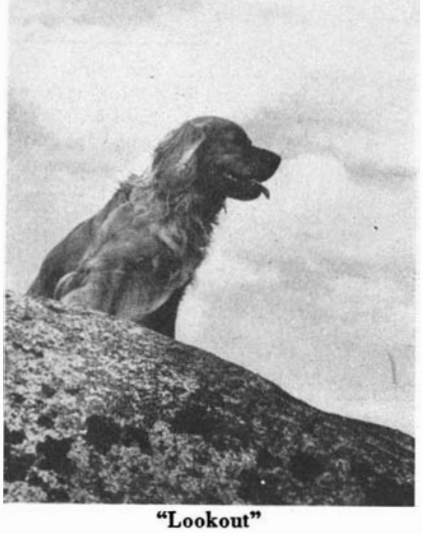
Conducted by JACOB DESCHIN, A.R.P.S.

Dogs

DOGS are wonderful playmates but exasperating camera subjects. Particularly is this true of the younger set, who appear to be on the go every minute of their lives. Dogs are best photographed when they show the appearance of being on the alert. On the surface this would seem to be easy to do, but in practice it will be found one of the most difficult of all photographic "assignments." The dilemma facing the photographer of dogs is that, although most characteristically pictured when "busy," the dogs will generally be sufficiently quiet for leisurely photographic work only when at rest.

Needless to say, photographing dogs calls for an alertness on the part of the camera worker perhaps greater than that of the subject itself. At the same time that he attempts to keep the dog interested in one thing or another, the photographer must also think of the picture. This means that he must watch patiently for a good pose and be quick enough to capture it with his camera. As the dog moves about, ready to dart this way or that at a moment's notice, the photographer must follow the dog's lead and move the camera viewpoint in unison with the unpredictable movements of the dog.

"Patsy"



"Lookout"

"Siesta"

However, in spite of the obstacles, many good dog pictures are made and some of the best are the work of amateurs. It is chiefly a matter of watchful waiting for a good pose plus ample lighting conditions, agreeable background, and full exposure.

As for lighting, undoubtedly the outdoors on a bright day is the ideal because there is so much light about that the dog can move in perfect freedom (as it will anyway) and still be suitably lighted in one pose or another. Indoors, the dog's movements are greatly restricted, photographically speaking, because only a small area is lighted and unless the dog remains within that area, it will not be illuminated and therefore cannot be photographed. However, there is a logical solution to this problem in the use of the synchronized flash. Since the lighting source, attached to the camera, moves with the camera, and is "flashed" in the same instant as the shutter is opened, the subject is bound to be lighted during the only period you care about: the moment of exposure.

Ample lighting is important in dog as well as general animal photography,

because one of the most valuable features of dog pictures is the manner in which the texture of the subject shows up. For this reason, also, full exposure is necessary in order to take advantage of all the available lighting. At the same time, the worker must be sure to use a shutter speed brief enough to stop the movement of the dog so that the subject is sharp on the resulting negative. It is true that a little off-sharpness in the legs as the dog jumps into the air, for example, may add to the impression of movement, but it is best not to take too many chances with this; a complete blur may be the result.

Perhaps it is safe to say that pictures of dogs in movement should not be taken at shutter speeds slower than 1/100th of a second. Many inexpensive cameras are equipped with shutters having this as top speed. Those which do not would best be restricted to dog poses which show only moderate movement, or those instances when they are well pictured in quiet, restful attitudes.

When you photograph a dog—or any other subject—you must not forget that you also include the background in your picture. A poor background — one, for example, in which there is such distracting material as telephone poles, picket fences, and so on — may spoil an otherwise fine picture. Therefore, select a suitable background and try to induce the dog to move in that area. The greater this area, the simpler your problem. If the area must be restricted, for one reason or another, your work becomes more difficult.

In this connection, we cite an experience in photographing an Irish setter against a background of trees. Particularly were we interested in two of the trees, one to the left of the foreground, the other, curve-shaped, farther back. We wanted to get the dog to pose between these two. We were not quite sure just what pose we wanted, and did not bother too much about this because we felt that any agreeable pose would be suitable provided the dog stopped somewhere between the two trees and near the large straight one in the foreground. Luckily there was a bench nearby where we could sit and patiently wait for the picture. We threw an apple where we thought it would do the most good but Patsy simply snatched it up and ran off quick as a flash. We tried it again and again with somewhat the same result. Every once in a while Patsy would stop to

By Edward A. Schultz, from the Fourth International Leica Exhibit

"Silhouette"

rest but too far off for our purposes. Finally, she stopped for an instant in the foreground, attracted by something off to the left and as she did so, we snapped quickly and so obtained the only usable negative. The procedure took about an hour but the result is one of our favorites: Patsy, an ardent lover of the woodlands, pictured in an atmosphere most congenial to her nature.

Automatic Control in the Darkroom

A DEVICE that takes one more worry off the shoulders of the darkroom worker and assists in doing better work with the enlarger is the new Bee Bee Dual Control Auto-Timer, just introduced. The two

circuits of this device make it possible to turn off the safelight while switching on the printing light or to reverse this procedure at the termination of focusing or exposure time. When the darkroom worker touches a toggle switch, the exposure is started and is terminated automatically at exactly the time selected. Further, once the mechanism is set, it is possible to repeat exposures of exact duration; the mechanism resets itself without further attention.

Operation of the Dual Timer is accomplished by the use of a self-starting synchronous motor. The whole device weighs only five pounds and measures 4⅛ by 4½ by 5½ inches.

"Photospot News"

A MONTHLY bulletin addressed to camera clubs has been inaugurated by Raygram Corporation, New York City, for the purpose of acquainting club members with "the latest in photographic news,

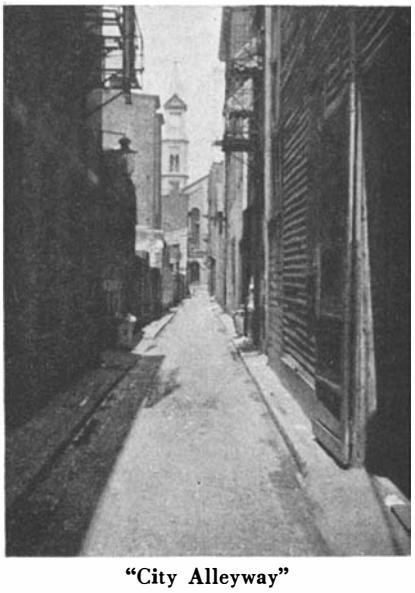
views and previews." It will be edited by Albert Greenfield, photographer, traveler, and a well known figure in photographic circles. Primarily designed as a news bulletin, it will contain description and illustrations of new photographic equipment as well as other news and notes of interest to amateur and advanced photographers. Camera clubs interested in receiving this bulletin should write to Photospot News, 425 Fourth Avenue, New York, N. Y.

Shooting Alleys

AN alley is a short, very narrow street or passageway. People actually live in alleys. Remember Henry Carey's Sally:

"Of all the girls that are so smart
There's none like pretty Sally;
She is the darling of my heart,
And she lives in our alley."

Clarence Tolle, of Cincinnati, Ohio, does not live in an alley but alleys seem to fascinate him. His town is full of them, and

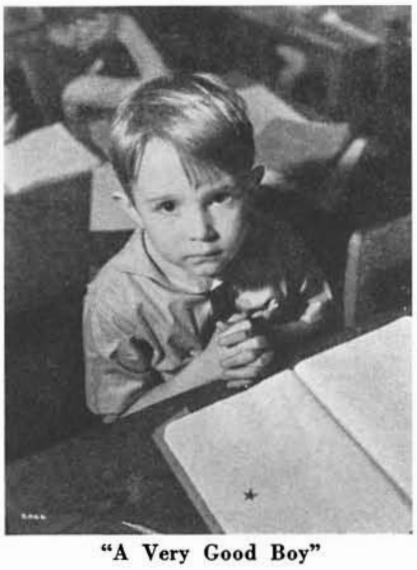


"City Alleyway"

he likes nothing better when out with his camera than to make a round of the alleys and take pictures of them under various lighting conditions. As a result, he has a considerable collection of alley pictures taken in his city; one of these is reproduced here. He doesn't care what other people may think, but an alley to him is No. 1 on the list of picture possibilities in his town.

Best School Picture

THE accompanying reproduction, "A Very Good Boy," photographed by Ambrose J. Hickey, staff photographer of New York City's Board of Education, was chosen in a poll of New York City's 37,000 school teachers. The vote was taken to select the best pictures that have appeared in Superintendent of Schools Harold G. Campbell's annual report called, "All the Children." It received a total vote of 5062, two and a half times as many as that received by its nearest competitor. Second place was given to a picture entitled "The Youngest Artist," which showed a kindergarten boy at work before an easel; third place to "Boy Building Blocks"; and fourth place to a picture entitled, "Charge d'Affaires Bag," which showed a little boy trudging to school with a brief case almost half as



"A Very Good Boy"

big as he is, but containing only one book. Dr. Campbell, in commenting on the first choice of the teachers, said that its popularity was due to its human appeal and to the fact that it was typical. "It might have been taken at almost any school, anywhere in the country, at any time," he said.

DEVELOPMENT BY INSPECTION

THE often desirable method of developing films by inspection may be practiced with the slower brands of film by comparing the developing film with a standard negative. However, unless this guide negative is unfixed, it will not do for this purpose. The unfixed-out salts must remain in the guide negative in order that it may match the developing film which, even with development complete, looks denser than the final, fixed negative will be. To obtain the arrested development which normally is done by fixing in a hypo bath, the comparison negative, according to a tip in the *Gevaert Sensitizer*, is developed, washed for a short time, and then bathed for a short while in a 2 percent potassium iodide solution.

ACID-RESISTING ENAMEL

FOR the chap who is making his own wooden darkroom sink or table, we have recently come across a preparation that seems to serve the purpose with full protection against damage. The material is known as Tuf-On No. 274 Enamel and is especially adapted for use on articles connected with photographic work and developing. We asked the manufacturers for details and this is their report:

"This is an acid-resisting coating made from Bakelite resin, which will protect all darkroom equipment from hypo, developers, acids, and so on, and when used on trays or racks will keep solutions free from contamination. It can be applied to wood or metal solution tanks, reels, table tops, and so forth.

"The material is applied by brush just as it comes from the can, and will set in about 15 minutes and dry in one hour. However, at least eight hours should be allowed before strong solutions come in contact with it. One coat is usually sufficient to cover any surface, but if a second

coat is necessary, it would be best to allow eight hours for drying before the second coat is applied.

"The only precaution necessary in applying the material is that the surface be smooth and dry and free from dirt, wax or oil, so that the enamel has a good opportunity to make a strong bond with the surface. If a surface is oily or has been waxed, then it should be cleaned by wiping with plenty of turpentine, wiping off the excess with a dry cloth. Rough or rusted surfaces should be smoothed with sandpaper before an application is made. This material comes in aluminum, black, gray or clear."

Temporary Lens Board

OCCASIONALLY you may wish to try out a friend's lens on your camera or to experiment with a lens before deciding to make the actual purchase. This is provided, of course, that your camera permits of interchanging lens boards. To go to the expense of making a special lens board is out of the question. An effective temporary lens board may be made of a thick piece of cardboard cut to the required dimensions. In the center of the board a hole is cut, the diameter of which is slightly smaller than that of the lens barrel. Now "screw" the lens barrel threads into the cardboard hole. The barrel threads will cut threads into the cardboard and so hold the lens firmly in place while you put it through its paces.

History in Photographs

THE formation of a Contemporary History Division "to collect and disseminate photographic information that will be of aid to historians," is announced by the Photographic Society of America. The plan is to work through existing agencies and coördinate the activities of those now engaged in this field rather than to set up a separate organization. The committee's first chairman is Dr. A. J. Olmsted, Chief Photographer and Custodian of the Section of Photography of the Smithsonian Institution and the U. S. National Museum of Washington, D. C.

One of the most interesting sections of the Division will be that devoted to stereoscopic slides and cameras, this phase to be under the direction of Robert Dennis, of Brooklyn, New York, reputed to be the owner of the world's largest collection of slides, a total of more than 100,000, and old stereoscopes.

The Photographic Society of America has also instituted an interchange of stereoscopic slides for individuals. "Each participant," acording to the announcement, "will add a slide to the group that is sent for his inspection before sending it on to the next individual. When the collection returns to him at the end of a couple of months, he will remove his old slide and substitute a new one. There is evidence that there are more users of stereoscopic devices in this country than anyone would believe and the Society feels that such a service would fill a definite need."

Another plan being worked out by the Society is for the interchange of Kodachrome slides. The plan is to have two sections; one for clubs and one for individuals. The first will work along the same lines as the present Club Print Interchange

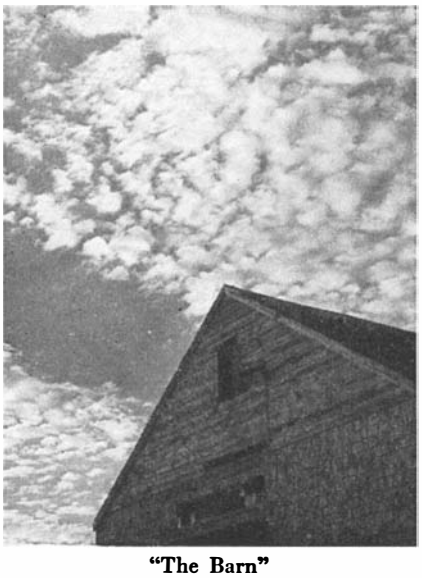
and Loan Exhibit Service of the Society; that is, Kodachrome sets of approximately 50 slides will be collected from a single source and made available for club showing.

The individual section will consist of the work of the participants. Each member will add one of his own slides to the set he receives before passing it on to the next individual. He will contribute one slide per month to provide 12 different groups circulating among units of 52 members.

Anyone wishing to participate in such a service should communicate with the Secretary of the Photographic Society of America, 10 Park Avenue, New York, New York.

Clouds Save The Day

THE presence of clouds is always a good excuse for a picture, and subjects which ordinarily hold no promise can frequently be worked in very nicely when shot against



"The Barn"

the background of an attractive cloud effect. A barn of itself may or may not offer a picture possibility, but in combination with clouds against a dark field of sky obtained with an orange filter, it may well justify a shot, as in the present case. Angle composition seemed to tie the picture into one piece.

Leica Manual 1940-41

COMPLETELY revised to include the latest information on miniature camera photography, a new printing of the "Leica Manual," designated as the 1940-41 edition, has just been issued. A new filter factor table is included, film groupings have been changed to coincide with recent advances in films for miniature cameras, and new information is included on developers, exposure, projection, stereo-projection, lenses, Leica accessories, and so on.

Don't Argue With The Instruction Book

"AFTER all," says the concluding sentence in the foreword to an instruction booklet for one of the Filmo cameras, "we made the camera, so first try our way of using it." There's a lot of common sense back of that, obvious though it may appear to be. Over-confidence and eagerness to get going with the new outfit frequently induces people of newly purchased cameras to use the camera before they have read the instructions. The consequence too often is that something jams because some little gadget was not properly adjusted, although reference to a single line in the instructions would have avoided the accident.

"We have had a good many comments on that sentence, all of them favorable," say Bell & Howell, the makers of the Filmo cameras. "Before the book went to press, we tried out the statement on several disinterested individuals, and as the reaction was 100 percent favorable, we dared to include it . . . One new owner in New York City visited our office just to meet the boys and to congratulate us on having the temerity mildly to twit the owner."

Personally, we believe that one of the principal reasons people do not read instruction books as thoroughly as they should is because they are not always as clear in their explanations as they should be. Also, the size and appearance of the type and general layout is not attractive enough. Our advice, if anyone wants it, is this: make the instruction book as good-looking as your advertising literature, and it will be read.

WHAT'S NEW
In Photographic Equipment

If you are interested in any of the items described below, and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them. Please send a stamped envelope with your request.

KODAK ADVANCE ENLARGER (complete with 98mm, *f*/11 lens, $27.50): Specifications: Takes all popular amateur sizes, including 3¼ by 5½ inches (from which 3¼ by 4¼-inch area may be projected); lens interchangeable with any lens mounted for use in Kodak Precision Enlarger; magnification up to 5½ diameters on baseboard with standard lens, up to 13 diameters with 2-inch lens (for greater enlargements head and bracket may be swung to project on floor); baseboard 17½ by 22 inches, natural finish 5-ply maple, pre-sealed under pressure to prevent warping (same base as supplied for Kodak Precision Enlarger); column rigid nickel-plated brass tube, 1-1/16 by 24 inches, vertical, set in die-cast aluminum base bracket; support bracket of die-cast aluminum with knurled screw; enlarger head attached with two knurled and slotted screws and removable at will, to use column as copying stand; lamp-house of sheet metal, aluminum finish, parabolic interior curve optically designed to insure even reflection of light to negative—opal diffusing screen approximately ½ inch above negative; lamp 75-watt opal No. 211 Mazda Photo Enlarger Lamp.

ALBERT FOUR-WAY SAFELIGHT (complete with filters and stand, $3.95): Through simple adjustment, choice of four basic filters provided: diffused white light for viewing; red for orthochromatic film; green for panchromatic; green-orange for enlarging and contact paper. Lamp adjustable to provide reflected or partially reflected light for handling ultra-fast film. Four filters built into oblong box with one filter on each side. Box itself slides into lamp.

To change filters, operator draws out filter box, rotates it to proper color and returns it to light. Adjustable ball and socket joint for directing light at any angle.

EFFECTIVE LENS APERTURE KODAGUIDE (10 cents): For use in copying and small-object photography, when lenses are used at other than normal extensions. Covers all lenses from 25mm to 30 inches focal length, and lens-to-film distances from 1 to 64 inches. One dial setting, for a known lens-to-film extension, indicates effective values of *f*/ numbers at that degree of extension, and also gives correct factor for increasing or decreasing shutter time at indicated *f*/ number setting, to obtain normal exposure.

TROJAN EASEL ($6.65): Will take up to 11- by 14-inch paper, providing borders ranging from ⅛ of an inch to 1½ inches. Channel grip simplifies inserting paper accurately. Paper firmly held in place by clock spring masking bands which lie flat and prevent fogging at edges. Borders easily adjusted to paper sizes by exclusive spring mechanism which eliminates need for tightening screws. Easily visible, large white numbers.

BELL & HOWELL DE LUXE MODEL HOME FILMOSOUND ($343): Complete in polished walnut cases. Projects either sound or silent 16mm movie film. Illumination by 750-watt lamp. Complete information available on request.

KODAK PROJECTION PRINT SCALE ($1): Testing device for determining exposure time and choosing correct contrast grade of enlarging paper. Scale is four-inch disk divided into 10 numbered sections which decrease clockwise in density. Test print is given 60-second exposure, with scale placed on top of sensitized paper in paper holder. After print is developed, correct exposure time, in seconds, can be read directly from best sector, as printed.

COMMANDER ELECTRIC EXPOSURE METER ($20): Employs photometric principle. May be used under wide variety of light conditions. Does not require approaching the subject but is employed from the position of the camera. Also adaptable for use as an enlarging exposure meter. "Miracle Eye" feature gives average reading of entire scene, whether near or far from camera. Maker's claim is that the "Miracle Eye" makes is possible to measure light on any detail of a scene, to obtain reading on object unfalsified by stray light, background, and reflections, to measure an area of light as small and as dim as flame of a candle 100 feet away.

KEMP WHIRLPOOL ACTION PRINT WASHER ($1.50): New in design and principle. Adjusts and converts any sink or basin into efficient print or negative washing tank. Hypo-laden water, drawn off the bottom, is constantly replaced with clear water flowing at any rate of faucet flow.

LAFAYETTE DURALUMIN COMBINATION TABLE-TOP TRIPOD: For use with miniature cameras of all types. Weighs only 8 ounces complete, but said to be capable of providing support for weight of about 100 pounds. Three rubber tipped duralumin legs screw into supporting collar, which contains "extension neck" permitting adjustment of camera on tripod from heights of 11 inches to 17 inches. Neck completely removable from supporting collar. May also be used as handy neckpod by employing full leather strap attached to bottom of extension neck.

UTILITY CUTTER (Handle and one blade, $1.00; extra blades, 60 cents per dozen): Adjustable device for holding cutter blades in proper position. Metal frame fits hand; uses heavy-weight blades that slide into handle when not being used. Cuts cardboard of various weights, heavy wallboard, or light veneer wood. Polished aluminum handle with wing locknut.

CHARDELLE FLASH CALCULATOR (50 cents): Rotating device fitting pocket for determining shutter speed and *f*/ stop for various flash bulb sizes at different distances. Disk carrying row of shutter speeds and row of distances, the former ranging from "open" and 1/50 to 1/1250 of a second, and the latter from 6 feet to 68 feet, is lined up against a row of Weston film speeds ranging from 4 to 100. As disk is turned, the desired distance is set against the speed of the film being used. The *f*/ stops are on a separate disk, which is turned until one of four different light conditions (outdoors night, interiors very dark, interiors average, and outdoors daylight) stands opposite a number designating the bulb being used. A table on the back of the calculator, which is laminated, provides a list of Weston speeds for the most popular films and a list of Chardelle illumination factors, or numbers, for the most frequently used flash bulbs.

HAYNES "SALON" ENLARGING PAPERS: Coated with a bromide emulsion which, the maker states, is literally loaded with extra silver. The result is to produce blacker blacks and to bring out deep shadow details that are often lost with other papers. The paper base itself is of pure rag stock of great strength. "Salon" paper does not require special handling. Dries to slightly greater contrast than when wet. Supplied in three different grades.

MIGHTY MIDGET ADAPTER ($1.25): Equipped with built-in ejector for use with Mazda No. 5 Photoflash bulb. Centers bulb in reflector. Ejector discharges bulb instantly when slight pressure is applied. Ejector has standard screw type electric bulb base and may be used with all synchronizers now on market.

WABASH SUPERFLOOD REFLECTOR LAMP ($1.10): Inside-silvered, self-reflecting, outside-frosted. Average burning life six hours at 115 volts. Lamp and reflector a single unit. Silver lining sealed inside bulb provides brilliant reflecting surface. Oversize bulb gives oversize reflecting surface. Special silver-lined neck disk redirects what would otherwise be neck-wasted light. Scientifically correct coördination of bulb, filament, and reflector.

TIMIT ($12.50): Combination enlarging exposure meter and automatic exposure switch. Employs test strip principle but by automatic operation. Also automatic time switch for exposing enlargements.

CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, *conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers. If an answer is desired by mail, enclose a stamped, addressed envelope. Queries should be specific, but Mr. Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials.*—The Editor.

Q. I am an amateur portrait photographer, but recently a friend, who owns a beauty salon, asked me to take some pictures of her hair styles for a display. Can you give me details as to lighting, camera angle, and filter? I have a good miniature view camera, tripod, and four No. 2 Photoflood lights with diffusion screens.—F. G.

A. Your objective is, first, to light the hair in such a way that the details of the hair dress will show up clearly, and, secondly, to adopt that angle that will present the subject to best advantage and give as complete a picture of it as you can in a single shot. Therefore, you should use one front light tilted down towards the head a little, depending on the pose, and another light from the side and slightly back of the subject; this second light should be at an angle of about 45 degrees to the head. The best effect is achieved with spotlights. A compromise can be effected with your lights by using cardboard with a hole cut in the center. Your lighting should be well balanced because it is the complete head dress that interests you and not just a detail of it. Make sure that no dark "pockets" are left where light has failed to reach the hair. This can be done either by manipulating the lights or altering the pose. The camera angle will naturally be somewhat above the head level. Orthochromatic film is recommended for most purposes; panchromatic where the hair is very dark or very fair. Filters are not necessary.

Q. I have a 616 Kodak Special camera with *f*/4.5 Kodak Anastigmat lens. There are some small air bubbles in one component of this lens. Does this indicate an imperfection; will it cause any defects in the pictures?—H. R. E.

A. When we answered a similar question some time ago saying that small air bubbles would have no practical effect on the image, we were "jumped" upon by a reader. We are taking no chances this time and will quote from others. L. P. Clerc, Hon. F. R. P. S., in his "Photography, Theory and Practice": "Beginners have a tendency to consider the bubbles seen in *every* anastigmat as a defect. The sole effect (of these bubbles) is to diffuse about one thousandth part of the light — an absolutely negligible amount." E. J. Wall, F. R. P. S., in his "Dictionary of Photography": "A lens is not necessarily bad when bubbles are present in the glass, but . . . it is the exception for a high-class optical firm to send out a lens in which *large* bubbles are visible, although a number of small bubbles may be present in a high-class anastigmat without being any practical disadvantage." Henney and Dudley's "Handbook of Photography": "Bubbles in a lens generally act merely as direct obstructions to light and, unless of unusually serious magnitude, are insignificant." So there!

Q. We understand that there is a special type of film used for copying manuscripts. Can you inform us on this subject? Also, what size camera would give best results when copying pages up to 8½ by 11 inches?—W. L. P.

A. Any camera from the 35mm miniature type up may be used for copying manuscripts, the camera lens being suitably supplemented with tubes or close-up lens or simply by extending the bellows of the camera. In the latter case, the longer the available bellows extension the more versatile it is in this regard. For the miniature cameras, positive film should be used for your purpose. In the larger size cameras, commercial or process film is used.

Q. I own a Linhof Technika, size 9 by 12cm, with a Zeiss Tessar *f*/4.5, 15cm lens. My problem is what lens to purchase for portraiture. Can I use a telephoto lens? Many say a telephoto will not give me the perspective of a long focal length lens; that I will have a larger image, but with distortion. Could I use a simple rapid rectilinear lens which is of 10-inch focal length?—C. F. P.

A. The rapid rectilinear lens will do the trick very well, but of course, the slowness of the lens, usually *f*/8, may be somewhat of a deterrent in portraiture, particularly where children are concerned. However, if the lights are strong and near enough to the subject and you employ the very fast film emulsions, this should prove no great handicap. So far as distortion is concerned, this is caused by a near viewpoint and not by the design of the lens. At a good distance from the subject, say eight feet or so, there should be no distortion in perspective with a telephoto lens.

OUR BOOK CORNER

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PARTNER OF NATURE

By Luther Burbank

COMPILED and compressed into one volume, this is a collection of the famous plant breeder's writings. The principles of plant breeding, rivalry of plants, new flowers and new colors, harnessing heredity, breaking the rules, planning a new plant, interesting failures, fixing good traits, building a new fruit, plums, berries, practical pollenization, seedling propagation, grafting and budding—these are the chief subjects covered, all in a direct, unpretentious and non-technical way. (315 pages, 5½ by 8 inches, 29 illustrations.)—$3.10 postpaid.—*A. G. I.*

THE PHOTOGRAPHIC PROCESS

By Julian Ellis Mack and Miles J. Martin

DESIGNED as a text book for college use, the thoroughness and systematic treatment that has gone into the preparation of this book will be appreciated as well by the general reader with a genuine curiosity to know just what makes photography tick. In the words of the authors, the book is "not intended to be either a handbook of practical methods or an exhaustive reference work," but "is concerned chiefly with the principles and basic techniques of the process." (586 pages, 7½ by 10¾ inches, 15 full-page photographic reproductions, numerous illustrations.) — $5.10 postpaid. — *J. D.*

THE OSCILLATOR AT WORK

By John F. Rider

THE idea behind this book, as stated in the author's foreword, is to get the users of oscillators and signal generators better acquainted with these instruments — how they function, the uses to which they can be put, and how their performance can be checked. The first nine chapters are devoted to descriptions of the several types of vacuum-tube and electro-mechanical oscillators which are in common use today. The tenth chapter deals with the modulation of oscillators, with particular attention paid to frequency modulation, which is becoming of increasing interest in the communication field. The next two chapters consider the requirements of signal sources in regard to their design and performance. Chapter XIII tells how to check the various types of signal sources and the different troubles which might arise. Inasmuch as this book is aimed at the radio serviceman, a chapter is devoted to the testing of receivers and the part that oscillators play therein. The last chapter describes the various oscillators that are incorporated in superheterodyne receivers and how they can be checked. Many different laboratory tests are described in the Appendix. This book should be of particular interest to the student and laboratory worker who desires a better knowledge of oscillators and signal generators. The functioning of these instruments is clearly explained without the use of intricate mathematics and the latter portion of the book should prove of great value. (256 pages, 5½ by 8½ inches, illustrated.) —$1.60 postpaid.—*A. P. P.*

THE PHILOSOPHY OF JOHN DEWEY

Edited by Paul Arthur Schlip

SEVENTEEN great thinkers, including Bertrand Russell, George Santayana, and A. N. Whitehead, scrutinize the writings of the great American philosopher, and at the end Dewey writes a rejoinder. All this constitutes virtually sitting in a university seminar with Dewey and his outstanding critics. (708 pages, 6 by 9 inches, one illustration.) —$4.10 postpaid.—*A. G. I.*

PRACTICAL ELECTRICAL WIRING

By H. P. Richter

RESIDENTIAL, farm, and industrial wiring of all types of electrical equipment from the simplest socket to electric motors and transformers is discussed. One section is devoted to theory and basic principles; another to actual wiring, residential and farm; and a third to actual wiring, non-residential projects. A highly practical, well illustrated book for every technician. (503 pages, 5¾ by 8½ inches.) — $3.10 postpaid. — *F. D. M.*

TELEVISION

By V. K. Zworykin and G. A. Morton

"ELECTRONICS of Image Transmission," the subtitle of the present book, is a simple yet accurate statement of its content. In the text, the authors have gathered the scattered literature regarding electronic television and have presented it in compact form for the reader who desires a detailed survey of this newest of practical means of communication. The book is divided into three general parts: fundamental physical phenomena, the field of television as a whole, and an analysis of the components of electronic television. This is a thoroughgoing book that requires study if the reader is to gain the greatest benefit. (646 pages, 6½ by 9½ inches, thoroughly illustrated with drawings and photographs.) —$6.10 postpaid.—*A. P. P.*

WOODWORKING AS A HOBBY

By Emanuele Stieri

PRACTICAL instructions for planning a workshop, choosing and using hand tools, are followed in this manual by detailed chapters on the use of the bench saw, lathe, jig saw, jointers and shapers, and the drill press. Other chapters deal with types of wood, making joints, wood finishing, and using glue. Final chapters describe projects such as shelves, coffee table, magazine rack, corner cabinet, pipe rack, and gate-leg table. The book is by a man who obviously has used the tools, not merely an "armchair" woodworker. (268 pages, 4½ by 8 17/64 inches, 227 illustrations.)—$3.10 postpaid.—*A. G. I.*

THE STOREHOUSE OF CIVILIZATION

By C. C. Furnas

MEATY is the outstanding word with which to characterize this book which will be widely read by thinking people and kept for reference afterward. It combines with a comprehensive view of our natural resources—minerals, plants, animals, fuels, salts of the sea, and energy from the sun—a mature discussion of the problems of converting them into the goods and services of our civilization. The long chapter on social impacts and implications will provide much food for thought to those who like to think; likewise will the long chapters on the chemical age (synthetic compounds) and on the energy supply. (562 pages, 5½ by 8½ inches. 38 charts, 14 figures.)—$3.35 postpaid.—*A. G. I.*

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ALL types of plumbing for the farm as well as for metropolitan houses and buildings. Includes details of installation of all piping and equipment for sanitation and for drinking water. Latest types of farm disposal units are explained in detail. (388 pages, 5¾ by 8½ inches, over 300 illustrations.) — $3.10 postpaid. — *F. D. M.*

NO LIFE SO HAPPY

By Edwin Lewis Peterson

TO the trout fisherman, as to few other men, the pleasures of retrospection and anticipation rank high among the fascinations of his favorite sport. The author of

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this volume so successfully awakens memories of sights, sounds, and smells of the stream as to cause the angler-reader to ruminate nostalgically on piscatorial adventures of the past, and simultaneously to anticipate more extensive angling excursions in the future. The author has aptly said: "It is nothing to those who do not feel it; it is everything to those who do." This is a book packed with sound fishing lore, wrapped tastefully in a series of experiences concerned with a quest for the giant trout, "The King." W. J. Schaldach has provided nine illustrations in harmony with the outdoor spirit of the book. (221 pages, 5½ by 7¾ inches.) — $2.60 postpaid. — *A. D. R., IV.*

EXPERIMENTING AT HOME WITH THE WONDERS OF SCIENCE

By Eugene Hodgdon Lord

MANY of the simple home experiments on which noted scientists of today cut their eye-teeth are collected in this excellent volume of 98 interesting "tricks." They include such things as boiling water in paper bags, chemical fires, matches that won't burn, flame-proofing cloth, making sugar crystals, telephoning through a string, magic handkerchiefs, chemical gardens, and electricity and magnetism. An excellent volume for the youngster with a mechanical bent, and for hobbyists. (243 pages, 6½ by 8 inches, well illustrated.) $2.10 postpaid. — *F. D. M.*

THE COMPLETE GUIDE TO SOILLESS GARDENING

By Dr. William F. Gericke

IT had to come — this comprehensive and authentic guide by the man who invented soilless gardening. Others have followed Dr. Gericke's footsteps in experimentation and a number of books have been written by them; however, here is the complete discussion of all phases of this fascinating work from start to finish by the one man who should know most about the subject. It tells what the grower, amateur or professional, wants to know concerning chemicals, apparatus, various crops and flowers, with also a chapter on the economics of this new scientific method of growing food plants. (285 pages, 6 by 9¼ inches, 59 photographs.) — $2.85 postpaid. — *F. D. M.*

THE BOYS' BOOK OF PHOTOGRAPHY

By Edwin Way Teale

ALTHOUGH this book is directed particularly at the younger amateur photographer, it should find many readers among those older in years yet young in experience. It runs the whole gamut of photography from history to modern practice. Not only is the reader told how best to handle his camera but is also guided briefly, yet sufficiently completely, through the simple phases of darkroom work that will enable him to go on to more advanced fields. The text is written in a light vein; in many cases it touches much too briefly on certain aspects of the subject, but this is not too much of a drawback when the scope of the whole book is considered. (252 pages, 5½ by 8½ inches, a large number of drawings and full page photographic reproductions.) —$2.10 postpaid.—*A. P. P.*

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

READERS of this department will recall the description, published here in April, 1939, of a 10″ off-axis reflecting telescope made by Norbert J. Schell, 1019 Third Ave., Beaver Falls, Pa., around an off-axis mirror made by T. G. Beede, Youngstown, Ohio—a mirror figured the same as if it were a section cut out of a larger mirror and to one side of the center. Figure 1, reproduced from that description, will recall and explain this telescope. In use, it gave refractor performance in a reflector, because diffraction from the diagonal was eliminated, as was astigmatism, the shortcoming of the crude Herschelian.

The same team—Schell and Beede—have now gone one step further—the criss-cross off-axis telescope. Schell writes:

"Here is a sketch (Figure 2) of the horrible details, also photographs (Figures 3 and 4), of this telescope as it appears when put together in a rectangular plywood tube. The performance is pretty sweet—better than the simple off-axis. You ask me to tabulate the specific advantages. Here they are:

1: Long-focus primary—easier to figure than short focus.

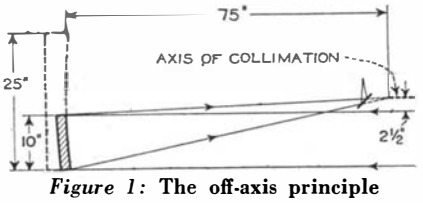

Figure 1: The off-axis principle

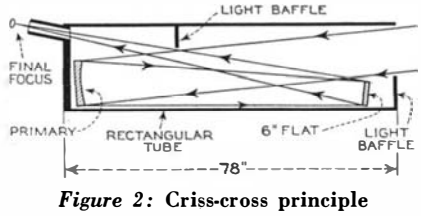

Figure 2: Criss-cross principle

2: Folded-back focus, a-là-Cassegrain—most convenient observing position.

3: Flat only half the size of the primary—easier to make than full size.

4: Tube length only half as long as focus.

5: Disposition of surfaces permits light baffles, eliminating any light not reflected from primary.

6: Wooden tube—better than metal. Also, because of the shape of this tube, most of the light is kept away from sides of the tube, reducing tube air-current troubles.

"This combination of mirrors can be arranged for use of a warmed observing room, by shooting the light from the flat up the polar axis—no added reflections being necessary.

"This arrangement of a long-focus mirror and half-size flat was thought up by Beede. The only part I contributed was to twist the main mirror around 180° and thus bring about the criss-cross feature.

"No particular trouble was encountered in getting a good alinement.

"The mounting shown was made in a hurry, to try out this design. It is stiff enough, but no considerations of appearance went into it.

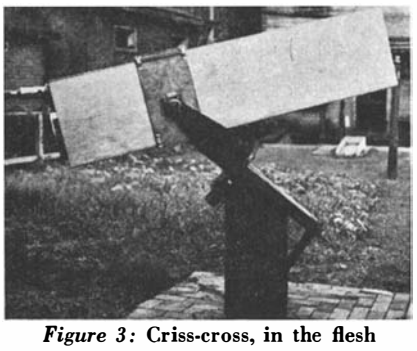

Figure 3: Criss-cross, in the flesh

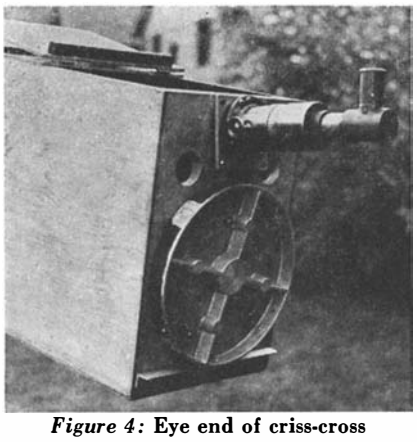

Figure 4: Eye end of criss-cross

"The 10″ mirror works as a section of an imaginary paraboloid of 46″ diameter. This is necessary in order to get far enough off axis to introduce the 6″ flat at the position wanted without obstructing the light reaching the primary.

"The primary mirror has a 148 1/2″ focal length and is offset 19″ from the theoretical axis. The 6″ flat is 67″ from the primary and the focus is 81 1/2″ from the flat."

MORE of Beede's mirror work: "Enclosed," writes Leo J. Scanlon, of Valley View Observatory, 186 Van Buren Street, Pittsburgh, Pa., "are pictures (Figures 5 and 6) of a 6″ Cassegrain telescope—the world's best—made for me as a token of appreciation by two other amateurs. The 6″ mirror and secondary were made by T. G. Beede of Youngstown; the mounting, tube, and tripod by Emmor Kelley, of Brownsville, Pa., (he of anniversary whistle clock fame—see this department, Oct. 1938). Beede did a perfect job on the mirrors, and Kelley has produced the finest telescope of his career.

"The tripod has tension-taker-uppers at the headjoint to make it secure. The legs are braced by a special device attached under the tripod head.

"The tube is of Micarta, cloth base, finished in several coats of black Duco rubbed to a satin surface. It is removable from the mounting, this being done by unscrewing the two trunnion bolts. Incidentally, these can't fall out when unscrewed. The cell has a ventilating plate (Figure 5) which can be opened or closed at the turn of a knob near the eyepiece.

"The yoke was fabricated by welding 2″ tee-section steel girders and is exceptionally rigid. The slow motions in RA and declination are velvet smooth and have no backlash, as there are provisions for eliminating this or for applying tension to the bearings in both coördinates. The tripod head and polar axis housing are of cast aluminum.

"The only contribution I made to the telescope," Scanlon continues, "is the method of adjusting the secondary mirror. I gave Kelley the idea and let him work it out—so all the credit for its success belongs to him. The secondary mirror is held by the usual fins to a ring. This ring can be tilted in any direction, or made to approach or recede from the main mirror, by using a screwdriver on three adjusting lugs at the eyepiece end of the telescope, through the holes shown by the arrows (Figure 5). Turning these lugs operates a left-right bushing at the ends of the rods supporting the framework for the secondary. This framework (Figure 6) slides down into the tube and is guided and spaced by additional lugs bolted to the inside of the tube itself. The secondary adjustment is then quite simple; just remove the eyepiece and look in while you adjust with a screwdriver from the rear of the cell. Any slight error of adjustment is immediately corrected. You can

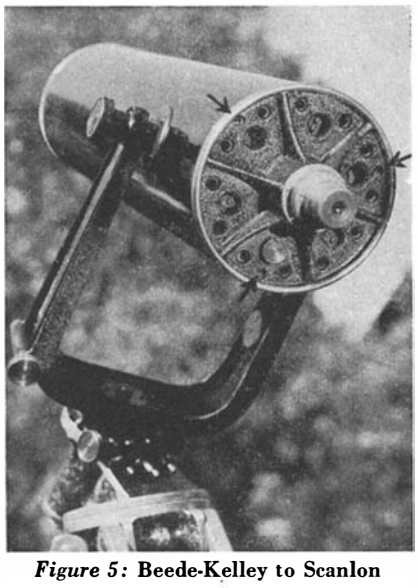

Figure 5: Beede-Kelley to Scanlon

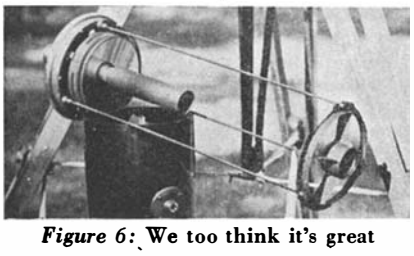

Figure 6: We too think it's great

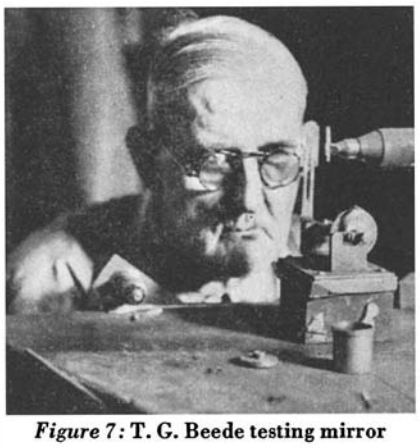

Figure 7: T. G. Beede testing mirror

Figure 8: Beede and 20" cellular

line it up perfectly while looking at a star. I think it's great!

"Figure 6 also shows the light-shield for cutting off direct illumination from the field to the eyepiece, during daytime use—though it is left in permanently."

Concerning tubes such as the one used on this telescope, Scanlon writes: "There are two kinds of tubes available at the Westinghouse Company in West Pittsburgh, Pa. One is a laminated Micarta paper tube rolled under pressure on mandrels and glued with a Bakelite varnish. The other, also Micarta, is a cloth material wound on a mandrel in similar fashion, same varnish binder of Bakelite cement. Each is baked to harden and is quite as strong as aluminum, without the metallic drawbacks."

For several years your scribe has been hearing echos of Beede, of Youngstown, Ohio, mentioned above in connection with two telescope descriptions, generally from the direction of western Pennsylvania. Leo J. Scanlon some time ago told your scribe that he was an old-time worker of most remarkable skill. N. J. Schell, mentioned above, also discovered him and so did others. Yet, never a written word or a syllable came from the man himself, until one began almost to believe him legendary, like Homer. Thanks to Schell, who has now provided some requested personality notes, and to Beede's sidekick, Leo F. Grandmontagne, Box 833, Youngstown, Ohio, who finally managed to get him to submit peaceably to being photographed (Figures 7 and 8), Beede comes at last into focus.

He is about 68 years old, a retired master

plumber and plumbing contractor, and started making mirrors in 1898, after visiting an elderly clergyman named Dr. John Peate, of Greenville, Pa., who, after 16 years of mirror making, had cast a 62" mirror, said now to be at the Smithsonian Institution. He has been making mirrors ever since, mostly as an amateur. He was once visited by Prof. Ritchey. "Beede does not hurry his work," Schell states, "but when he turns a job loose you can swear by it. On jobs, such as flats, his methods are tried and sure, and he carries them through without any back-tracking, and in surprisingly short time considering the quality of the finished product. He does all his work by hand.

"He has his own methods of preparing Carbo and rouge," Schell continues, adding, "I have seen some of his Carbo that he has floated three hours. He does not use emery for finishing, saying it is too slow, and that the fine Carbo produces a better surface anyway. He floats his rouge and classifies it as fast-cutting, slow, and so on. He makes laps with a pen knife that look like the idealized drawings in the book, then coats them with mixtures of about three kinds of wax. He uses coal-tar pitch."

Beede is said to have a keen sense of humor despite the relaxed expressions of the photographs. "He is an indefatiguable worker, with unlimited patience," Schell states, "and can produce a beautiful, smooth optical surface of any kind whatever, with perfect edges and correct within limits too close to measure with the knife-edge test, and do it right along. He is considered by a host of amateurs who know him as the dean of amateur telescope makers. The Mahoning Valley Academy of Science is preparing to honor him for his development of a method for figuring off-axis mirrors.

"Why hasn't Beede ever told the world about himself?" Schell was asked. "He is by no means gabby," was the reply, an understatement.

CREDIT is due to William R. Harlow, an amateur telescope maker and freshman at Miami University, Oxford, Ohio, for an invention consisting essentially of the application of a stroboscope to a telescope, for improving definition when observing. Prof. A. E. Douglass, director of the Steward Observatory at the University of Arizona, who has had many years of actual experience at the eyepiece in observing Mars both there and at Lowell Observatory, states that he believes the idea fruitful, and it is hoped that other amateurs better situated for trying it out than Harlow will now do so.

Harlow states that he has made a 6" reflector, a 10" Cassegrainian, a 6" simple refractor, and then an 8" achromatic refractor, working on the last-named from J. R. Haviland's instructions in "ATMA." Then he tackled his stroboscopic application. "A careful examination of the shimmering of an image," he states, "will show that about 75 percent of it is harmonic, the remaining 25 percent erratic, due to the varying air currents." These things are described by Prof. Douglass in his chapter on "Atmosphere, Telescope and Observer," in "ATMA." "If some form of stroboscopic disk is interposed somewhere along the light beam," Harlow continues, "with a rheostat control on the disk motor, a lot of shimmering will be stopped.

"The slot in the disk should be a trifle wider than the light beam at the point along the tube where it is applied. With one slot (Figure 9, upper left) a speed of half the motion of the image will stop it; with two slots (upper right) quarter the speed; and so on. I found it worked best at the declination axis, where the vibration was least. The motor should be cushioned in some way."

Perhaps one's first thought on noting this description is: "But won't the illumination of the image be greatly reduced?" No, it would not, as Harlow explains, "because of the persistence of vision—though this would be detrimental in photography where there is no such phenomenon."

J. R. Haviland, to whom this communication was shown, thought "it really is something, if it works." Professor Douglass

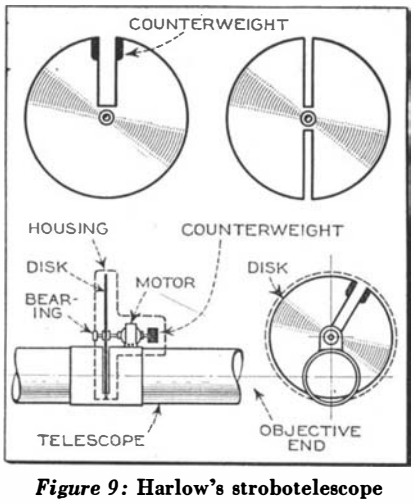

Figure 9: **Harlow's strobotelescope**

commented as follows: "I am a lot interested in Harlow's stroboscopic device. I am satisfied that a substantial amount of the flicker in the image is harmonic. I think this applies to a star or small object like a satellite of Jupiter. [One of Professor Douglass' specialties is the observation of Jupiter's satellites. Another is tree ring research; he is the scientist who has dated many old Indian structures in the southwest by means of the rings in the timbers found in their ruins.—*Ed.*] I suspect that, in the case of a disk the size of Mars", Professor Douglass continues, "the situation is most complicated. Atmospheric currents are not so easy to study on a planetary disk as on a star.

"Harlow's stroboscopic device will work when the telescope lens is small compared with the wave of the currents in the air, for then you have good definition (but low power, limited by diffraction effects) and a swaying image. This stroboscopic device would decrease or stop the swaying of the image and is a very neat idea; but in a larger aperture which covers several or many waves at once this device, as described, would not aid because the image does not sway but is badly confused due to the varying refraction of the many slopes of the air waves, all in the objective at once.

"So the device should work for a small telescope, 2 or 3, and sometimes 4 or 5, inches, depending on large size of air waves and freedom from cross-currents or local currents (which I used to call ripples), but with increasing aperture (5 to 10 inches) the results might or might not be good (I am thinking of conditions in a

good climate such as here in Arizona). For bigger instruments, up to the giant reflectors, it would do no good at all. However, the idea is fruitful. Is there any way some harmonic correcting device could be made to work in a big aperture? For example: On an observation night make a sketch or a photo of the waves as seen without the eyepiece and in full aperture; transfer this to some dichromated gelatin photographic film on good glass, that displays variable thickness of film without blackening; insert this in the beam and have it vibrate transversely to the waves on a motion found to match the shifting of the waves themselves. This would be very difficult. It might better be tried the following way: Make a film (or choose one of a lot on hand), place it in the beam (by motion along the beam it might adapt itself to the proper size—refractive power of wave slopes would be more difficult to match), and then add the stroboscopic slit of Harlow's, adapting the rate to match the wave changes.

"Thus, in short, if a transparent pattern could be made to effect wave correction in some one position of the waves with reference to the telescope lens, then the application of Harlow's stroboscopic device could, I think, be made to pick out the majority of the instants of time when that correction would be an advantage either in photography or visual work."

Commenting on this, Harlow states that he has no facilities to carry the idea further, hence the idea is presented here for other amateurs or professionals to carry on. Harlow adds that he had himself discovered what Prof. Douglass pointed out—that the effect diminished as the aperture increased, and that he had had better results with his 3" refractor than with his 8" reflector and 10" Cassegrainian, but had not known whether or not this would always be true.

WHETHER reflectors with open tubes are superior to those with closed tubes is the subject of a perennial debate. Most recent slant on this is found in the January number of *The Journal of the British Astronomical Association*, where Dr. W. H. Steavenson's opinion is pointed out. For a telescope which is to be used in the open, the disadvantages of the closed tube would be outweighed by the advantages. Most lattice tubes are used under domes, but if used in the open, dewing of the mirror may occur. Two other members pointed out that they find that aluminized flats do not dew in the way that silver flats would under the same conditions.

The same number of *The Journal* contains a six-page article by M. A. Ellison, son of the late Rev. W. F. A. Ellison, describing a Hale spectrohelioscope which he has just completed. This is the second in Great Britain, (by an amateur), A. M. Newbegin having made the first, two or three years ago. M. A. Ellison says the work required two and one half years, and that the performance has come up to expectations.

THE TELESCOPE, popular astronomical journal, March-April number, has a noteworthy, 10-page article on the 200" reflector, by Anderson and Porter. Two thin dimes, Harvard College Observatory, Cambridge, Mass.

STELLAFANE Convention, Sat., Aug. 10.

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

HANDBOOK OF AERONAUTICAL VOCATIONS, by Walter Van Haitsma, is a 48-page pocket-size booklet that presents facts regarding aviation as a career. In the first part of the book are outlined the advantages and disadvantages which will confront those who seek positions in the aeronautical industry, this being followed by a comprehensive chart which enables the reader to evaluate his own inclinations in terms of possible positions in aviation. A chapter is devoted to schools and another to helpful suggestions. *Zeeland Record Company, Zeeland, Michigan.—25 cents.*

FASTER DIESEL POWER is a 32-page catalog, printed in two colors, describing the "HD-14" — said to be the fastest and most powerful crawler tractor on the market. The catalog illustrates the tractor as well as its component parts, and gives details regarding the work which it can do. *Allis-Chalmers Power, Tractor Division, Milwaukee, Wisconsin. — Gratis.*

WABASH EXPOSURE GUIDE is a 16-page booklet published for the camera workers who make flash pictures, flood pictures, or home movies, which packs essential information in a small space. All popular roll films, film packs, miniature films, and cut films are listed, together with complete exposure tables. *Wabash Photolamp Corp., 335 Carroll St., Brooklyn, New York. — Gratis.*

CHAIN STORE STATISTICS is a 34-page statistical analysis of the history, business volume, capitalization, and current financial position of 30 leading chain store companies. The conclusion is that despite discriminatory legislation, public opinion is placing the stamp of approval on the advantages of the mass distribution services of chain stores. *Merrill Lynch & Co., Inc., 40 Wall Street, New York, N. Y.*

CARNEGIE INSTITUTION OF WASHINGTON, YEARBOOK FOR 1939, is a 394-page summary of the past year's research in astronomy, biology, physics and geophysics, and other sciences as conducted by this nationwide institution.—*Carnegie Institution of Washington, Washington, D. C.—$1.00.*

BURKE & JAMES, INC. CATALOG NO. 340 is an 84-page compilation of bargains and announcements for camera owners. It lists the items available in the company's 43rd annual spring clearance sale. Fully illustrated. *Burke & James, Inc., 223 West Madison St., Chicago, Illinois.—Gratis.*

SMASH HITS OF THE YEAR is a 36-page well illustrated booklet that presents, pictorially and graphically, the facts about automotive accidents in 1939. Special features in the booklet include statistics and editorials on a wide variety of traffic safety phases. The information given here serves to drive home forcefully the necessity for increased vigilance on the part of all those concerned with the operation of motor vehicles. *The Travelers Insurance Company, Hartford, Connecticut.—Gratis.*

THE RAILWAY HANDBOOK 1939-1940 is a 96-page paper-covered booklet designed to provide the student of railroading with a concise collection of useful statistics. The chronology of railroad history includes items of outstanding importance. The text is largely concerned with British railway practice but some of the statistics are world wide. *The Railway Publishing Company, Ltd., 33 Tothill Street, Westminster, S. W. 1, England—Two shillings, sixpence.*

LINK-BELT CONVEYORS IN AMERICAN INDUSTRY is a 48-page illustrated book which tells in picture and text of the many different applications of mechanical elevating and conveying equipment for handling both packages and loose bulk material. Easy-to-understand charts show how much better the American worker fares than do workers in other countries, in this particular case the evidence being based on the use of conveyors to make work easier. Request your copy of this booklet, No. 1700, on business letterhead. *Link-Belt Company, 307 N. Michigan Avenue, Chicago, Illinois. —Gratis.*

FREQUENCY MODULATION COMPONENTS is a single-sheet bulletin that shows how to construct a unit which permits the reception of frequency modulation transmitters on present receivers. With the adapter described, the audio frequency amplifying system of a standard receiver is employed. All parts are listed, a wiring diagram is given, and prices are quoted. Request Bulletin 105A. *Browing Laboratories, Inc., 750 Main Street, Winchester, Massachusetts.— Gratis.*

TYPE K POTENTIOMETERS AND ACCESSORIES describes two types of precision instruments for general laboratory use. It also discusses a number of accessories which are necessary for certain types of procedure. An added feature is the description of the thermionic amplifier which adapts potentiometers to measurements in high-resistance circuits such as those in pH measurements using the glass electrode. Prices are given. *Leeds & Northrup Company, 4907 Stenton Avenue, Philadelphia, Pa.—Gratis.*

RAILROAD CAPACITY is a reprint of an address presented by M. J. Gormley, Executive Assistant, Association of American Railroads. The text surveys the entire subject of railroad traffic while an appendix presents a series of graphs which show the problems involved and the results being obtained. *Association of American Railroads, Transportation Building, Washington, D. C.—Gratis.*

LIGHTNIN MIXERS is a 16-page illustrated catalog showing a wide variety of mixers for industrial purposes. It includes types which can be adapted to almost any process of mixing, dissolving, blending, washing, and other industrial purposes where a reliable method of mechanical agitation is needed. The catalog describes permanent as well as portable mixers. Make your request for it on your business letter-head. *Mixing Equipment Co., Inc., 1090 Garson Avenue, Rochester, N. Y.—Gratis.*

LEGAL HIGH-LIGHTS

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

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar
Editor, Scientific American

Corporate Names

WE have previously pointed out on this page that the right of a person to use his name in connection with the operation of his business is not without legal restrictions. Thus, where a person has built up a large business under his family name and the name has become identified in the minds of the purchasing public with his business and product, a new-comer having the same name is not permitted to use his name in connection with a competing business, at least without an accompanying statement explaining that there is no connection between the parties.

The courts are even stricter in applying this principle to the use of a family or personal name by a corporation. This is illustrated by a recent case in the New York State Supreme Court involving a well-known designer of dresses. The complainant in the suit was the seller of gowns and dresses made by a well-known designer named Turner and the gowns were known variously as Turner's Gowns or Turner's Creations. Defendant was a corporation engaged in the business of selling dresses and it adopted the name "Turner's Gowns Limited." The defendant acquired its name from one of its incorporators whose name at that time was Pauline Jacobs but who had previously been married to a man named Turner. Since the incorporator's name at one time was Pauline Turner it was argued that the defendant corporation had the right to use the name Turner as part of its corporate name. The Court held that a corporation may not adopt the name of an individual incorporator and use it to deceive the public or to defraud others who have built up a business under the same name. An injunction was granted, restraining further use of the name.

Equitable Morality

IT is axiomatic that he who seeks the aid of a court of equity must come into court with clean hands. In other words, a court of equity will not give aid to a person who has acted inequitably with reference to the subject matter of the dispute that he is asking the court to act upon.

A recent case based upon this principle illustrates that the courts have not as yet been affected by the wide-spread public indifference to or toleration of gambling. The manufacturer of a game of chance similar to a lottery brought suit for trademark infringement and unfair competition against a competitor, charging that he was using his trade mark in connection with the sale of a similar game. The competitor made a motion to dismiss the suit on the grounds that the plaintiff was guilty of unclean hands in that he was using the trade mark in connection with the sale of a gambling device. The Court sustained this contention and dismissed the complaint, stating:

"In this case the complaint shows on its face that the complainant seeks the aid of a court of equity in the use of a device universally condemned as iniquitous."

Sawdust Heels

A PATENT for a shoe heel made primarily from sawdust was recently held to be valid and infringed by a federal district court. The owner of the patent brought suit against a shoe manufacturer charging that he was using a heel which infringed the patent. The patent covered a heel comprising a molded block of sawdust and a soluble binder saturated with nitro-cellulose. In making the heel the patent suggested mixing hardwood sawdust with glue and then shaping it in a suitable mold under pressure. When the molding operation was completed the heel was then soaked in nitro-cellulose. The Court found that the patented heel was new and represented an improvement over prior composition heels and accordingly held the patent to be valid.

Concealment

THE patent laws provide that in any suit for patent infringement there shall be no recovery of profits or damages for any infringement committed more than six years before the filing of the suit. One of the purposes of the law is to prevent a patentee from unfairly permitting an innocent infringer to infringe a patent for many years and then, after the infringement has been built up to substantial amounts, bring suit for patent infringement and recover large damages. However, this provision of law appears at times to work a hardship on a patentee. This is illustrated by a recent suit for patent infringement in which the infringement occurred more than six years prior to the institution of the suit.

The patentee contended that the infringer concealed the infringement from him and accordingly he was not in a position to institute the suit at an earlier date. It was argued by the patentee that the six-year period should be computed from the time that he received actual knowledge of the infringement and not from the actual date of infringement. The Court rejected this argument, pointing out that the provision of law was a positive one and prevented a patentee from recovering for an infringement which occurred more than six years prior to the institution of a suit, even though the infringement might have been concealed. This provision of law accordingly places a rather harsh burden of vigilance upon a patentee; he must not only file suit promptly against a person who openly infringes his patent but also he must discover and prosecute those who are fraudulently and secretly infringing his patent.

Strict Construction

A PATENT that has not gone into commercial use is commonly referred to as a paper patent and is strictly construed by the courts. This is illustrated by a suit for infringement of a patent for a method for heating electro-conductive materials in electric welding machines. The patentee charged that the manufacturer and user of a spot-welding machine infringed the patent in suit.

It was pointed out to the Court by the defendant that there were decided differences between the patented machine and process and the machine and process which was charged to infringe the patent. The patentee argued that while there were differences, the machine and process used by the defendant were really equivalents of the patented machine and process. In considering the question of infringement, the Court found that the patent in suit had never gone into commercial use and accordingly was a paper patent and not entitled to a broad construction. Under the circumstances the Court held that the patent was not infringed.

In reaching its conclusion, the Court stated as follows:

"Moreover, considering Thompson's patent as a paper patent, for there is no proof of any commercial use, it must be strictly construed."

Interurban

A FEDERAL court recently held that a manufacturer of street signs using the name "Municipal" as part of its corporate name could not prevent a competitor from using the word "City" in its corporate name. Both of the parties were engaged in the manufacture and sale of highway signs and their principal customers were state governments, municipalities, and other political subdivisions. The plaintiff's corporate name was "Municipal Street Sign Company, Inc." and the defendant's corporate name was "City Street Sign Corporation."

The plaintiff contended that the similarity between the two names would lead to confusion among customers. The Court rejected this contention, however, pointing out that they did not sell to the general public but to government officials who were well informed about the companies from whom they purchased equipment.

In this connection the Court made the following statement.

"We must not forget that it is not the general public that is the purchaser of street signs, but that the purchasers thereof are officials and engineers of public sub-divisions of the State, who would ordinarily be well informed about the company from whom they were purchasing, and would not be deceived by names of such different sounds, even although the meaning of them might be the same."

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