April 1940

# TECHNOLOGY REVIEW

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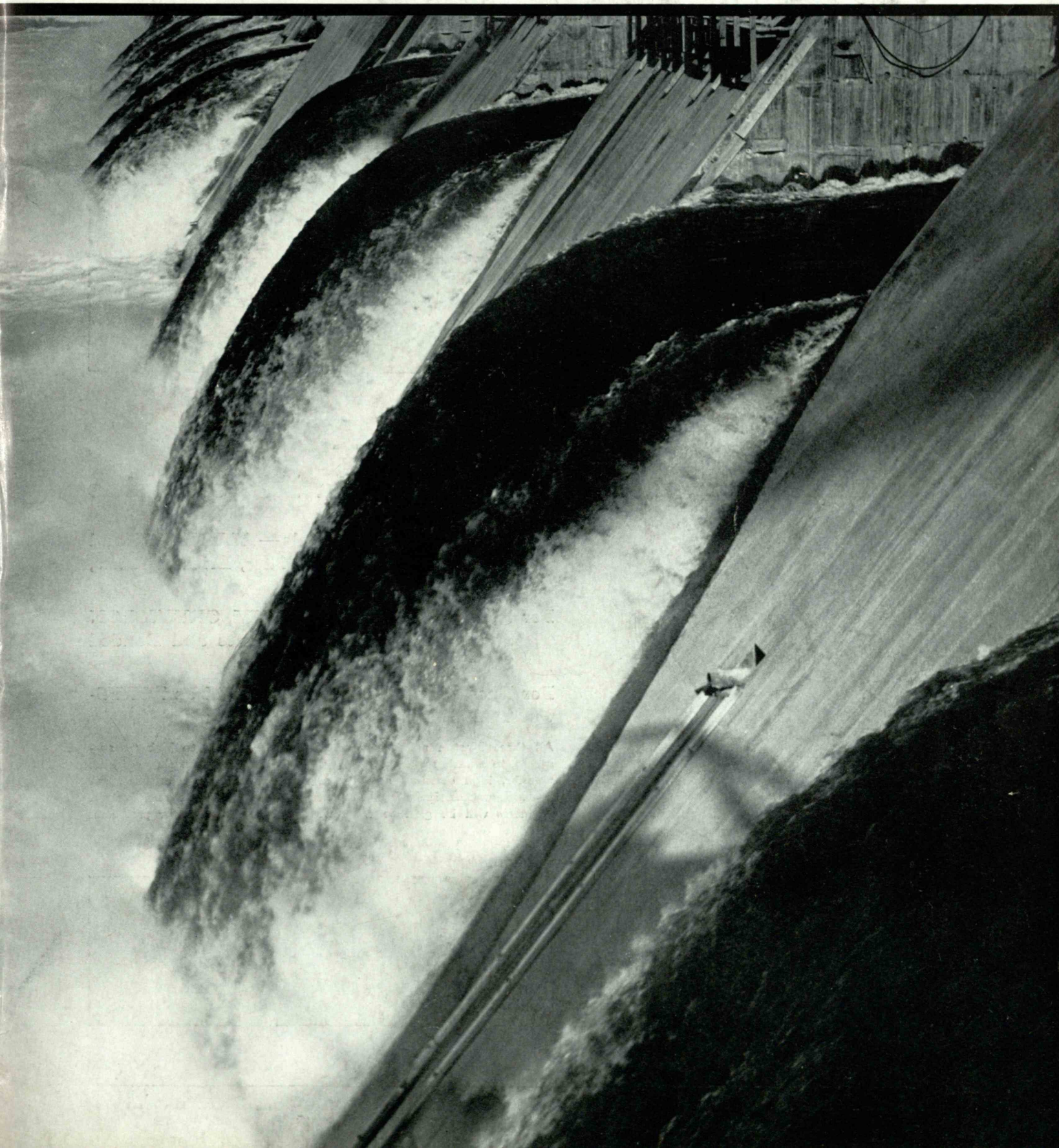

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# THE TABULAR VIEW

LANGUAGE in its psychological aspects has been a matter of serious study for BENJAMIN LEE WHORF, '18, for some ten years, his concern with the science of linguistics being the outgrowth of a hobby. In this issue of The Review (page 229), he raises provocative questions of the ways in which our thinking may be imperceptibly influenced by the automatically accepted patterns of the grammatical system which we happen to have inherited. With the Hartford Fire Insurance Company since 1919, and special agent since 1929, Mr. Whorf investigated spoken Aztec in Mexico in 1930 under a grant from the Social Science Research Council. He has worked on the decipherment of Mayan hieroglyphs, on Aztec and Hopi grammar, and on the classification of North American Indians. He received membership in Sigma Xi in 1937 for his linguistic research and was lecturer in linguistics at Yale in 1938. ¶ Recipient, last year, of the Chemical Industry Medal awarded by the Society of Chemical Industry for valuable industrial application of chemical research, ROBERT E. WILSON, '16, discusses (page 232) recent recognition of a once wasted product as a raw material of amazing versatility now affording a rich harvest to the petroleum industry and to the chemical industry as well. Dr. Wilson's article, which is based upon his medal address, reflects the thoroughgoing knowledge which is his through varied experience with both these industries. President of the Pan American Petroleum and Transport Company, he has also been associate professor of chemical engineering at the Institute and was director and vice-president in charge of research and development for the Standard Oil Company of Indiana. ¶ To discuss dispassionately the comparative effectiveness of democratic and totalitarian states when the affairs of the world are so seriously disarranged as in our times is a delicate and difficult task. It was done to great approbation by STUART A. RICE, chairman of the United States Central Statistical Board, Bureau of the Budget, before the winter meeting of the Institute's chapter of Sigma Xi, in an address upon which is based the article by Dr. Rice in this issue (page 235). Dr. Rice earned degrees at the University of Washington and at Columbia University and has taught sociology at Dartmouth, the University of Pennsylvania, and the University of Chicago. ¶ The history of the establishment of schools of architecture in America is essentially the history of WILLIAM R. WARE (1832 to 1915). A graduate of Harvard, he came to the Institute in 1865 as its first professor of architecture, practically founding Technology's School of Architecture, the first in America; in 1881 he was called to a similar post at Columbia and again founded a great school. Hence, the discussion of architectural education which he first presented in December, 1865, and which is abridged in The Review (page 237) is a document of much historic note. ¶ Appropriate to the watery month of April is the photograph which comes to our cover from the United States Bureau of Reclamation — spillways at Coulee Dam.

# MAIL RETURNS

### *Goblin or Demon?*

FROM ERNEST H. HUNTRESS, '20:

This fellow on the cover of the March Review appears to be traveling under an alias. The chemists all know him as Maxwell's demon, the hypothetical intelligence which Maxwell devised as a means of illustrating possible limitations on the second law of thermodynamics. The law is statistical and can therefore be evaded by the application of directive action on the elements making up a statistical group. The trigger action by which atom smashers seek to release the energy of the atom by the expenditure of an amount of energy smaller than that to be released is an example.
*M.I.T., Cambridge, Mass.*

FROM C. KING CROFTON, '22:

To clear up a great deal of speculation, will you please tell us what causes the shadowy figure on the cover of your March issue? I have read the explanation on page 177, but, although I am glad to know his name, I still am in the dark as to what causes him.
*Rochester, N. Y.*

[The shadow is cast by the base of the pilaster on each side of the doorway as it intercepts light from an elevated roadway lamp at each side of the steps.]

### *Control of War Materials*

FROM CLARK S. ROBINSON, '09:

In reply to Professor Dwight's question in the March Review (page 178) in regard to the peacetime storage of strategic raw materials, it will be interesting to repeat in part the following statement issued by the Army and Navy Munitions Board on January 19: "On October 11, 1939, the Army and Navy Munitions Board in an official release called attention to the possibility that abnormal exports of certain materials classified as strategic might weaken the national defense position of the United States with respect to such materials in spite of the best efforts of the government to assure an adequate supply of these commodities. . . .

"While the more patriotic and responsible dealers and manufacturers in the United States are co-operating with the Army and Navy Munitions Board in its efforts to maintain an adequate supply of these materials in the United States, others, apparently through lack of appreciation of the situation or for other reasons, are continuing to engage in export activities detrimental both to the industrial economy of the nation and to the national defense. The War and Navy departments believe that unless the method of voluntary co-operation can be counted upon to operate with complete effectiveness, it will become necessary to use other means to deal with the situation which has developed with respect to the export of crude rubber and tin."
*M.I.T., Cambridge, Mass.*

### *Placing the Coolidge Dam*

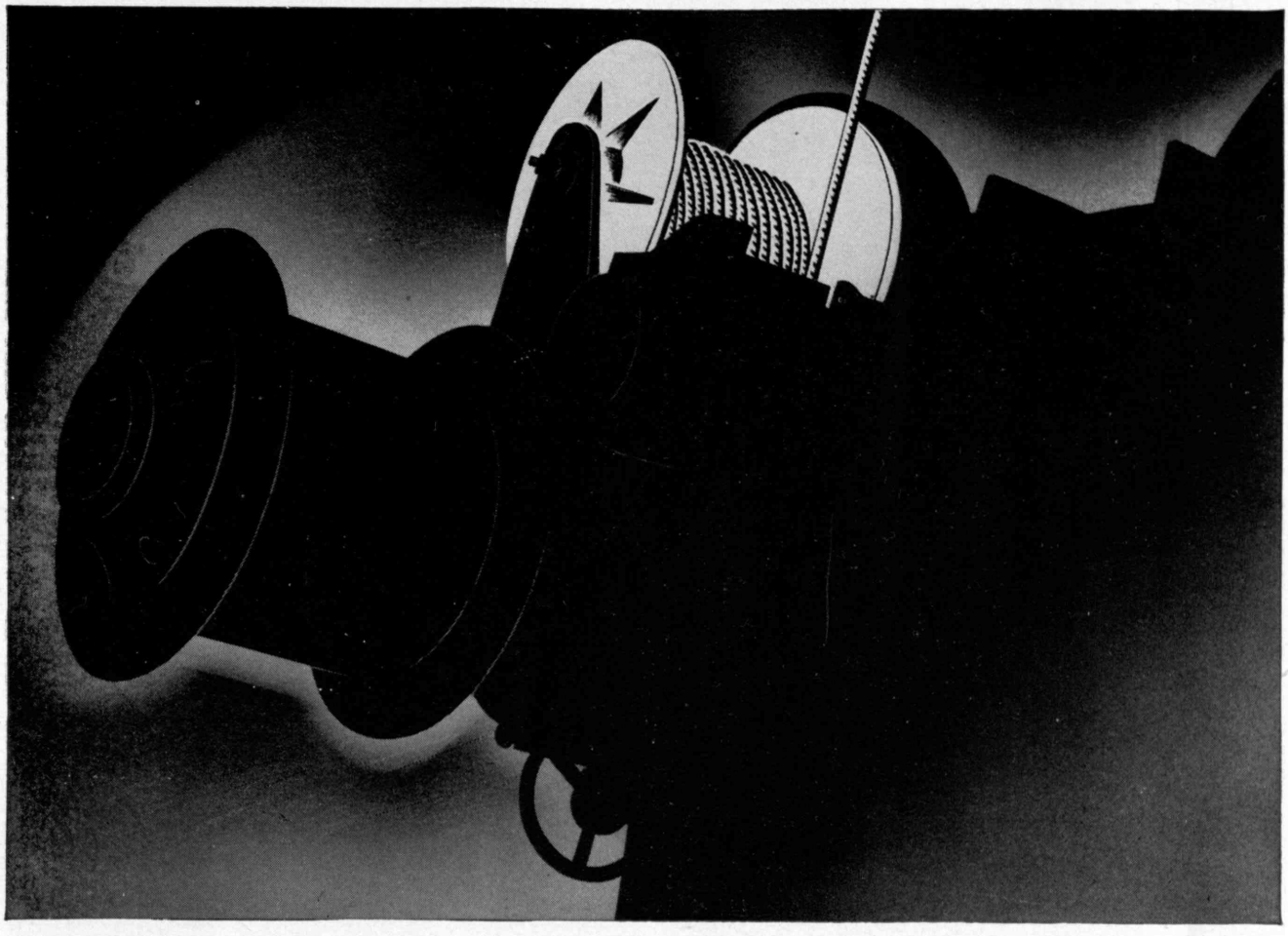
FROM CHARLES E. STARBIRD, '22:

Your very interesting February number shows on page 147 a fine reproduction from a photograph credited to Charles Miller. It carries the caption: ". . . This scene by the Coolidge Dam on the Gila River near Yuma. . . ." This is hardly in accordance with the facts. The Coolidge Dam . . . forms San Carlos Lake near Globe, Ariz. . . . I came out here in 1934 and, while I sometimes go back to Boston for a visit, I am sold on this wonderful "Valley of the Sun" and its marvelous climate.
*Phoenix, Ariz.*

### *Credit Where Due*

FROM HENRY C. MABIE, '36:

Credit belongs only where due. Though I contributed the photograph appearing on page 149 of your February issue, I am not the photographer who took it, for which reason the credit line naming me should not have appeared.
*Jamaica Plain, Mass.*



# AGAIN A MODERN MATERIAL SAVES WEIGHT, SIMPLIFIES DESIGN

Around an oil derrick a cat line hoist that doesn't function when wanted is of mighty little use. But it is not so easy to combine the needed strength and service capacity with simplicity and lightness.

It is not easy. But it has been done—by the use of a modern material for the hoist housing, a Molybdenum (0.65% Mo.) iron. The strength and toughness of this iron safely permits light sections. And it also helps keep construction simple. The fine, close grained structure permits the machining, in the housing itself, of surfaces sufficiently smooth to serve as outer races for the drive and drum shaft roller bearings. Premature wear or Brinelling of these races is forestalled by the hardness of the iron.

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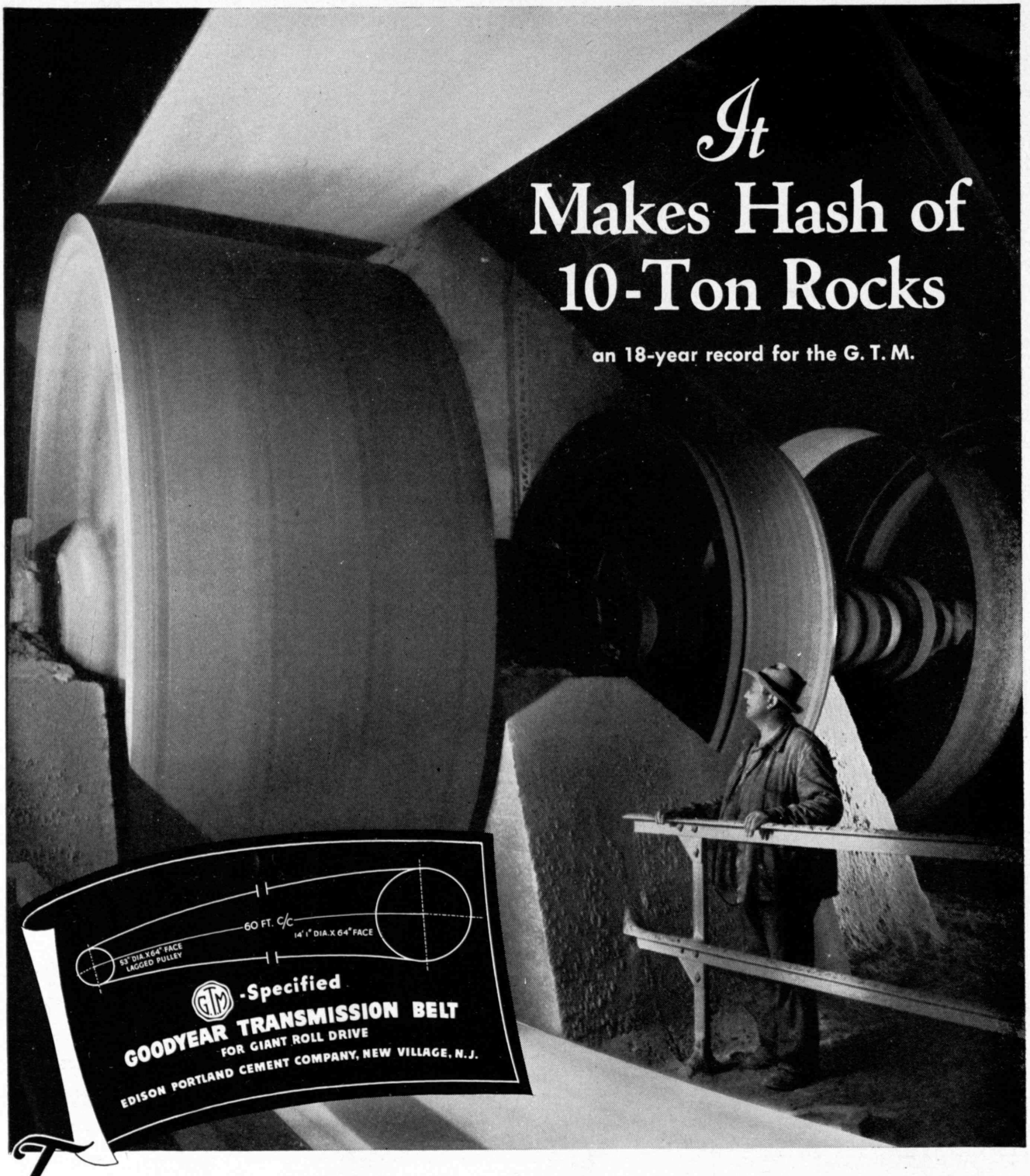


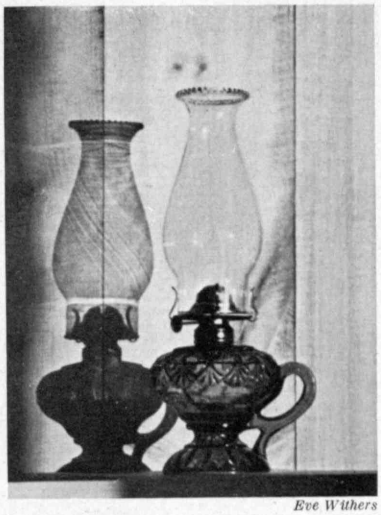

# *It* Makes Hash of 10-Ton Rocks

**an 18-year record for the G. T. M.**

*To make cement, huge limestone boulders weighing up to ten tons are ground to smithereens at the Edison Portland Cement Corporation plant at New Village, New Jersey. The impact is terrific — the strain upon the belt that drives the giant crusher tremendous! To get a belt that could take it the plant called in the G. T. M. — Goodyear Technical Man — just 18 years ago. The belt he specified, a Goodyear 9-ply rubber transmission belt is still pulling this crushing load. Four years' service was once thought remarkable on this belt-killer, but the Goodyear belt has already beat that more than four times over! That is why it pays to consult the G. T. M. — he saves you time and expense by the correct application of rubber to your toughest problems. To bring him to your plant, write Goodyear, Akron, Ohio, or Los Angeles, California — or phone the nearest Goodyear Mechanical Rubber Goods Distributor.*

THE GREATEST NAME IN RUBBER

GOODYEAR



*In the shadow of the light*

*Eve Withers*

# THE TECHNOLOGY REVIEW

*Title Reg. U. S. Pat. Office*

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THE COVER

SPILLWAYS OF COULEE DAM

*From a photograph by the United States Bureau of Reclamation*





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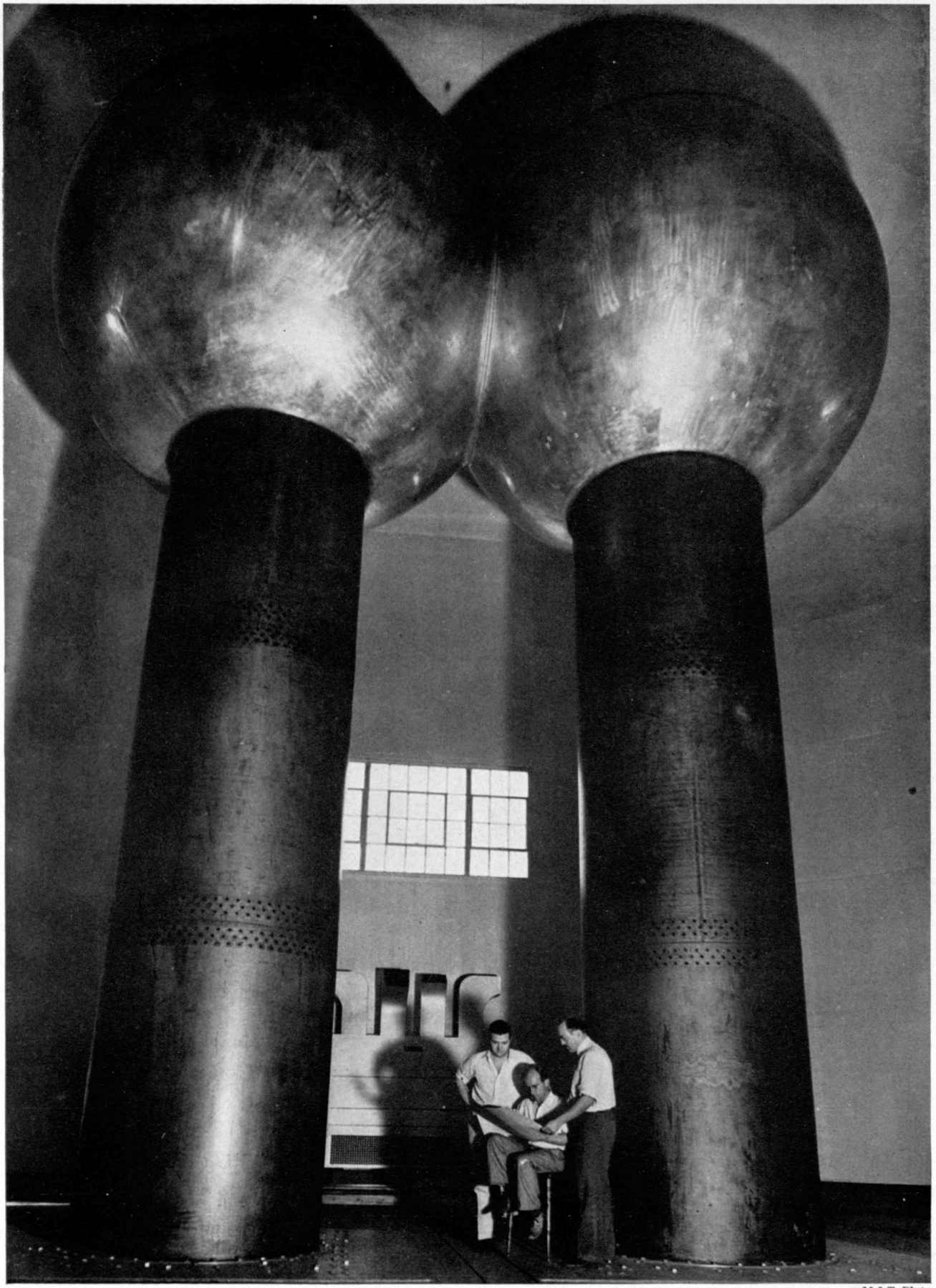


*M.I.T. Photo*

THE
TECHNOLOGY
REVIEW

Vol. 42, No. 6 April, 1940

# The Trend of Affairs

## *Physicists' Vices*

OUR modern physicists, who do the world's worrying about what goes on inside the atomic nucleus, usually seem wholly content in their abstractions. They have even further complicated the situation for us during recent years by denying more and more emphatically the possibility of drawing a picture of the atomic nucleus. Physicists are now becoming convinced that nothing is there but electrical forces which blend into one another and lend no sharp lines for portraiture.

But even the physicists themselves despair of having anything to put their fingers on, anything to show, as it were, for their mathematical labors. On such occasions they sit down to sketch designs and construct models which might represent the various atomic nuclei if the observable data were not strictly what they are. This activity gives them something to look at, but they hesitate to show their "doodles" — regarding it a mild heresy to draw pictures of things that are not there.

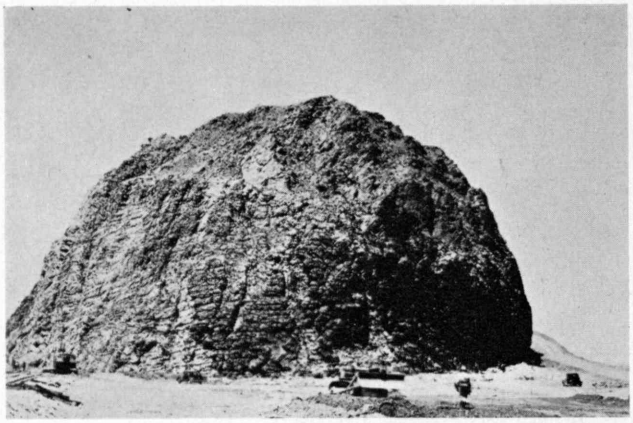
We recently attended one of the regular Harvard-M.I.T. colloquia, which was addressed by M. Stanley Livingston, Assistant Professor of Physics, who was in charge of the construction of the Institute's cyclotron. He was indulging in the secret vice, as he called it, of actually drawing pictures of the atomic nucleus. To prepare the way for this ultramicroscopic portraiture, he gave a concise review of what is known, or believed to be known, about the properties of the nuclei of atoms.

A nucleus can be assumed to be composed of two kinds of particles: protons and neutrons. They are about equal in mass, but the proton carries one unit of positive charge, whilst the neutron has none. In any stable atom, the nucleus contains as many protons as there are negatively charged electrons gyrating about it, so that a balance of charge exists. Additional weight is given by the presence of neutrons in the nucleus. Atomic nuclei may exist in all combinations of protons and neutrons, from hydrogen, which has a single proton for a mass of 1 and a charge of 1 ($_1H^1$), to that of uranium, which has 92 protons for a charge of 92, plus 146 neutrons to bring the weight up to 238 ($_{92}U^{238}$).

Matter in nature does not occur in all of these forms, because the characteristics of the nuclear binding forces favor certain combinations of protons and neutrons. The greatest binding forces exist between proton and neutron, being 50 per cent greater than those between two protons or between two neutrons. There appears to be exceptional stability in combinations of pairs of protons with pairs of neutrons. Thus it is easy to understand why helium, with a pair each of protons and neutrons, carbon with three pairs of each, and oxygen with four pairs of each, are such stable elements. Here an analogy may be drawn between these nuclear forces and the forces which bind whole atoms to one another to form molecules of discrete size. In a hydrogen molecule, for instance, it is a pair of one type of particle — atoms — that form a self-sufficient whole; in the nucleus, two each of two types of particles form the most stable combination.

In nature there exists an element to account for each possible charge from 1 to 92. By bombarding the nuclei of these naturally occurring elements, the physicist has added and subtracted neutrons at will, thus changing their weight without altering their electrical charge or their chemical properties. Abnormalities thus formed

◀ *Looming in the adjoining frontispiece are the spheres of Technology's giant electrostatic generator, by means of which three new forms of radioactive indium have lately been created artificially by bombardment of the metal with high-voltage x-rays. Manifestations of the new activities became apparent at slightly under a million volts, and the yield mounted slightly as the voltage was increased. The group who thus confirmed findings of Notre Dame physicists and carried the advance still farther include Drs. Robert J. Van de Graaff, Lester C. Van Atta, and Chester M. Van Atta; and Doyle L. Northrup — all of the Department of Physics.*



are isotopes, of which each element may possess several, and some as many as ten. Many of these isotopes have been found also in nature, the most notable being heavy hydrogen, which possesses a nucleus of a proton and a neutron.

Now to examine a nucleus in the process of being altered; hydrogen has a simple nucleus and will serve our purpose. Actually the atomic weight of hydrogen is not exactly one, but a little more; the nucleus alone weighs 1.00813 units. The neutron weighs 1.00893 units. When a neutron combines with the hydrogen nucleus to form an atom of heavy hydrogen, the ensuing weight of the nucleus is found to be .00233 of a unit less than the sum of the weights of the two original particles. The lost mass has been transformed into energy, liberated in the form of a gamma ray, leaving this new nucleus with less potential energy and therefore with less ability to disintegrate. We say that the nucleus has gained "binding energy," which is really a negative quantity. Calculations show that this binding energy is equivalent to 2,170,000 volts, which is just the amount of energy a gamma ray must possess to break up the atom of heavy hydrogen into its original constituents.

Many similar experiments in atom smashing have allowed physicists to form various pictures, mostly mental, and to draw various analogies designed to show some order in what has previously seemed a tremendous complexity of nuclear mass and energy. One analogy compares the atomic nucleus to a waterdrop, in which the molecular forces causing surface tension of the water are similar to the forces resulting in the binding energy of the nucleus. Within the outer envelope we may imagine for convenience that smaller globules exist, containing a pair each of protons and neutrons, the grouping which appears to have such unique stability. Additional neutrons may be sprinkled about in the interstices to add weight and supplementary binding.

The waterdrop analogy has particular value in suggesting the fission of the uranium atom, which has been the most startling bit of atom smashing completed during the past year. High-speed photographs have shown that a falling drop of water often vibrates back and forth from the general shape of a vertical cucumber to that of a horizontal pancake, until finally it may stretch so far in the cucumber shape that surface tension may constrict it in the middle and divide it into two separate drops. Perhaps an analogous vibration is set up within the uranium nucleus by the particles which bombard it. Being the largest and heaviest of them all, the uranium nucleus always was inclined to be ungainly — a little too obese for inner atomic comfort.

*The age-old fascination of a big noise and a change in the face of the earth — 86,000 tons of rock brought down by 28,400 pounds of dynamite in a Pennsylvania quarry of the Lehigh Portland Cement Company. The twenty-seven shot holes were from 61 feet to 106 feet deep, 6 inches in diameter. The beginning of the blast was evidenced by the treelike smoke formation in the first of the three adjoining photographs.*

## *Thumb and Theory in the Furniture Business*

TO the casual observer of life in the Machine Age, one of the era's minor mysteries is why the making of refrigerators differs so profoundly from the making of Louis XIV bedroom sets. For the products usually identified with the Machine Age, rapid progress is practically a point of honor. In 1914, for instance, an average factory employee took 187 hours to earn the price of an electric washing machine. In 1938 a much improved apparatus cost only 62 hours of labor, a 67 per cent drop. For the automobile the cost changed from 4,514 hours to 1,098 hours in the same period.

For the furniture business, however, this drop is of the order of 35 per cent if the charge for a moderately priced bedroom set is taken as indicative. Considering the greatly improved performance of the washing machine and automobile, furniture's statistical picture seems not too bright.

*Engineering News-Record*