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THE WISCONSIN ENGINEER

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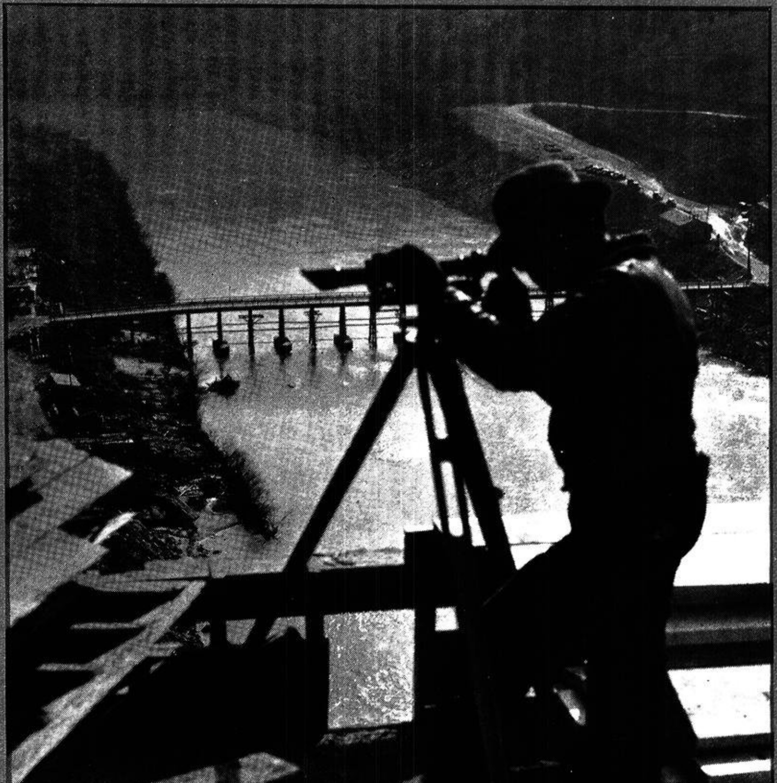
T V A

The First Job

All Figured Out



JANUARY **1937**

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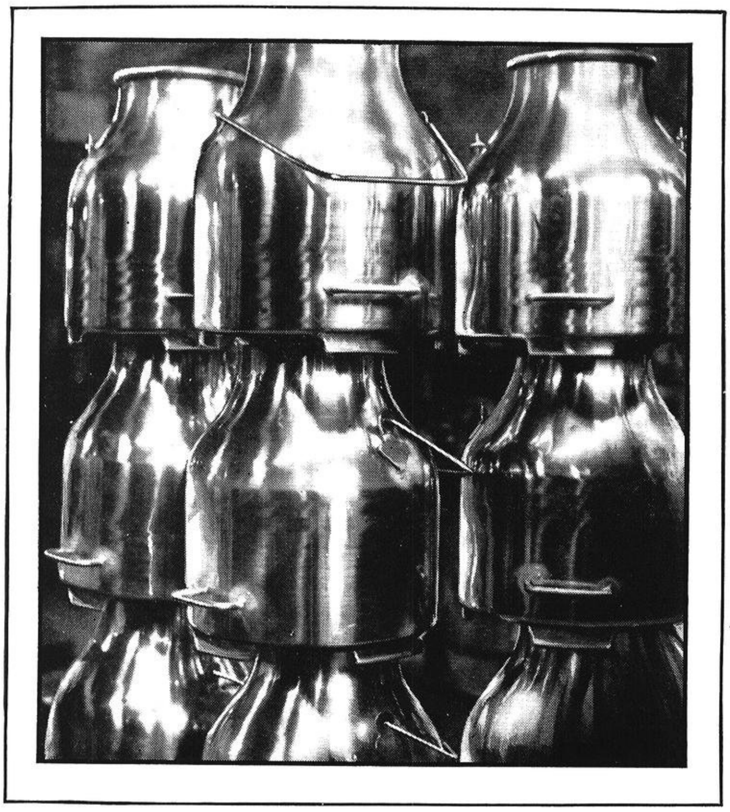

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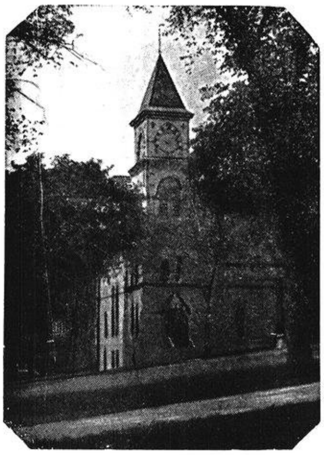

Music Hall

WITH THE CONTRIBUTORS . . .

• TVA—the greatest job of economic planning ever undertaken by any government is described in an interesting manner in this month's lead article beginning on page 63.

• Have you wondered how the suspension cables of a big bridge were designed? In a recent issue of Harper's, Mr. H. J. FitzGerald described the procedure in language so simple that even an L & S student could understand it. See the article on page 67.

• We have spilled the beans on what our engineer prom king has been doing all his life on page 71.

• Maybe you will get some idea of what your future job will be like on page 76.

The Wisconsin Engineer

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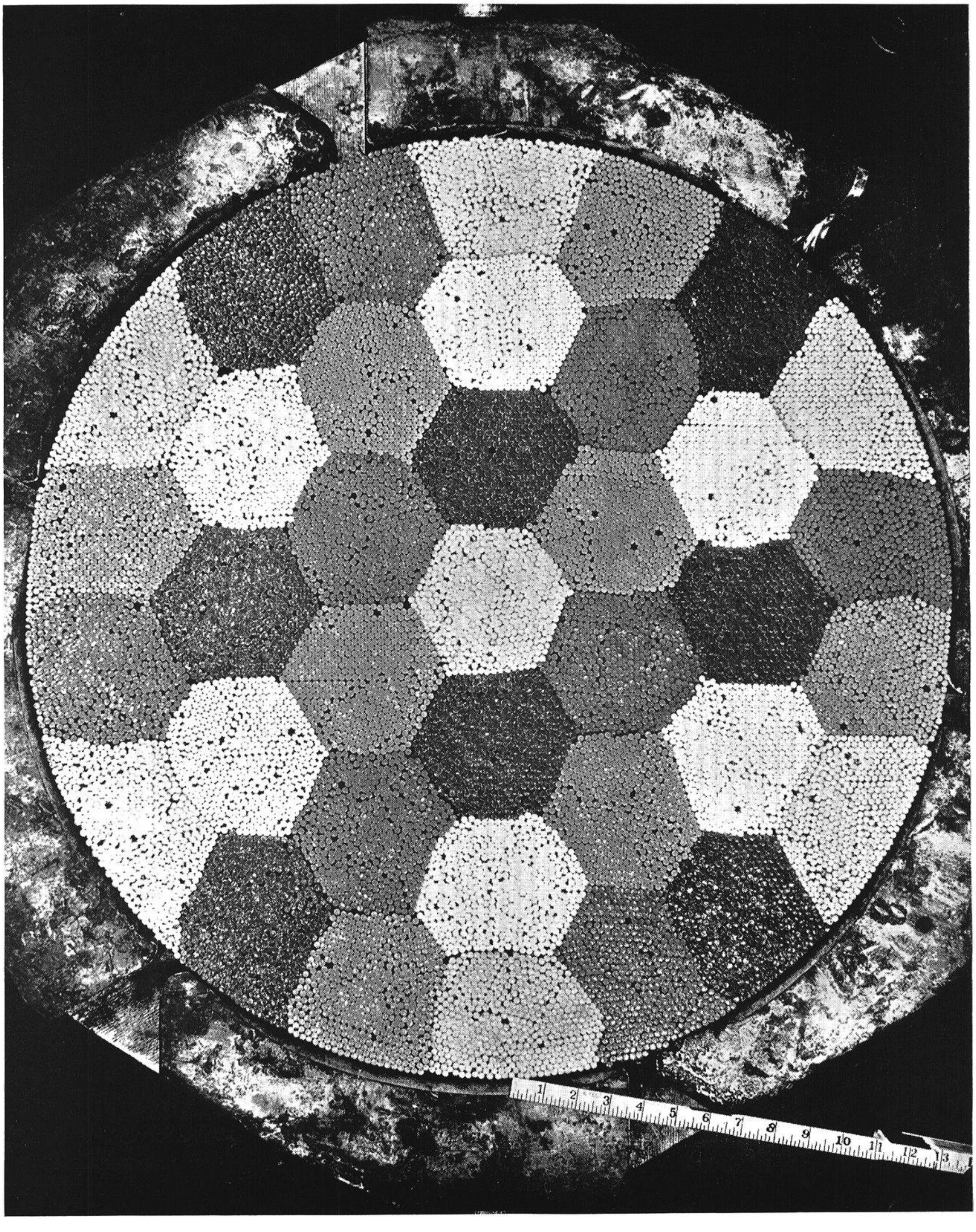


SAN FRANCISCO - OAKLAND BAY BRIDGE CABLE

ECONOMIC PLANNING

IN THE TENNESSEE VALLEY

by ROBERT E. WRIGHT, m'39

Illustrations courtesy Tennessee Valley Authority

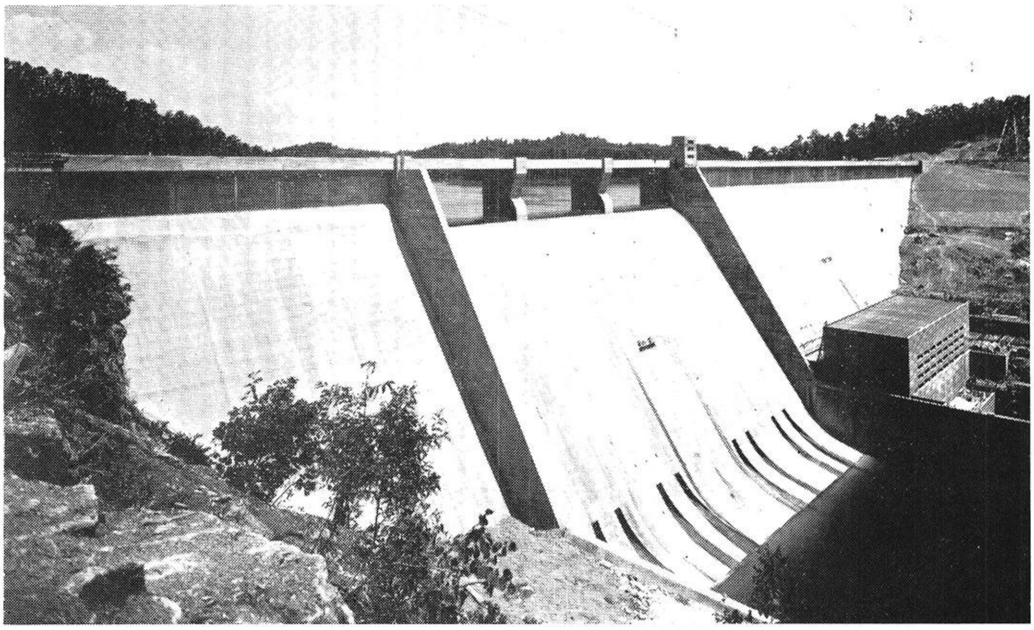
BACK in 1933 a vast engineering project was started in the Tennessee River Valley. It is a project which seeks to develop a large region to its fullest extent by large scale engineering and economic planning. It is readily seen that the project is being worked out on a large scale when we know that for the last three years no less than 15,000 men have been steadily employed; that during that time two great dams have been completed, and four more dams commenced; and that the project is taking place in seven states affecting the lives of 2,000,000 people. By 1940 it is planned that six or more dams will be completed and it is estimated that they will have a power producing capacity of 1,600,000 kilowatts. At the same time other important work is going forward at a rapid pace. A large region is being reforested, a huge soil erosion control program is being worked out, new fertilizers are being developed and great plants are being built or modernized to produce the new fertilizers. Moreover, a river is being made navigable for a distance of 650 miles. In short it is an immense project that touches upon many important and interesting developments.

Reasons for Development

Tracing the story back to its beginning we recall that the United States started to build Wilson Dam on the Tennessee River when it entered the World War. This dam was located at Muscle Shoals where power could be produced in large amounts very cheaply. The electric power produced there was to have been used in the fixation of nitrogen for use in munitions. Since Wilson Dam could not be completed soon enough to generate power, the two nitrate plants which were built near Muscle Shoals were operated by electricity generated by steam power. Work was begun on Wilson Dam in 1916 but due to delays it was not completed until 1925. By that time about $160,000,000 had been spent on the dam and nitrate plants. Most of the delay in completing the dam was caused by conflicting ideas in Congress about what should be done with the dam. The subject was debated in Congress for many years and two bills which sought to put Wilson Dam to some use were vetoed by presidents because they "put the government in the power business."

In 1933 President Roosevelt thought that this great investment had been idle long enough and that the Tennessee River Valley was a good region to try out ideas in social and economic planning. He therefore wrote a message to Congress asking that a corporation be created to develop the Tennessee River Valley. His message to Congress describes almost exactly what is being done today and for that reason is worth quoting. In this message he said:

> "The continued idleness of a great national investment in the Tennessee Valley leads me to ask the Congress for legislation necessary to enlist this project in the service of the people.
>
> "It is clear that the Muscle Shoals development is but a small part of the potential public usefulness of the entire Tennessee River. Such use, if envisioned in its entirety, transcends mere power development; it enters the wide fields of flood control, soil erosion, afforestation, elimination from agricultural use of marginal lands, and distribution and diversification of industry. In short, this power development of war days leads logically to national planning for a complete river watershed involving many



Norris Dam

states and the future lives and welfare of millions. It touches and gives life to all forms of human concerns."

The last half of the message describes the powers he wanted the TVA to have. Since his message so clearly represents the powers the TVA actually has, I believe it should be included here:

> "I, therefore suggest to the Congress legislation to create a Tennessee Valley Authority—a corporation clothed with the power of government but possessed of the flexibility and initiative of a private enterprise. It should be charged with the broadest duty of planning for the proper use, conservation and development of the natural resources of the Tennessee River drainage basin and its adjoining territory for the general social and economic welfare of the nation. This Authority should also be clothed with the necessary power to carry these plans into effect. Its duty should be the rehabilitation of the Muscle Shoals development and the coordination of it with the wider plan."

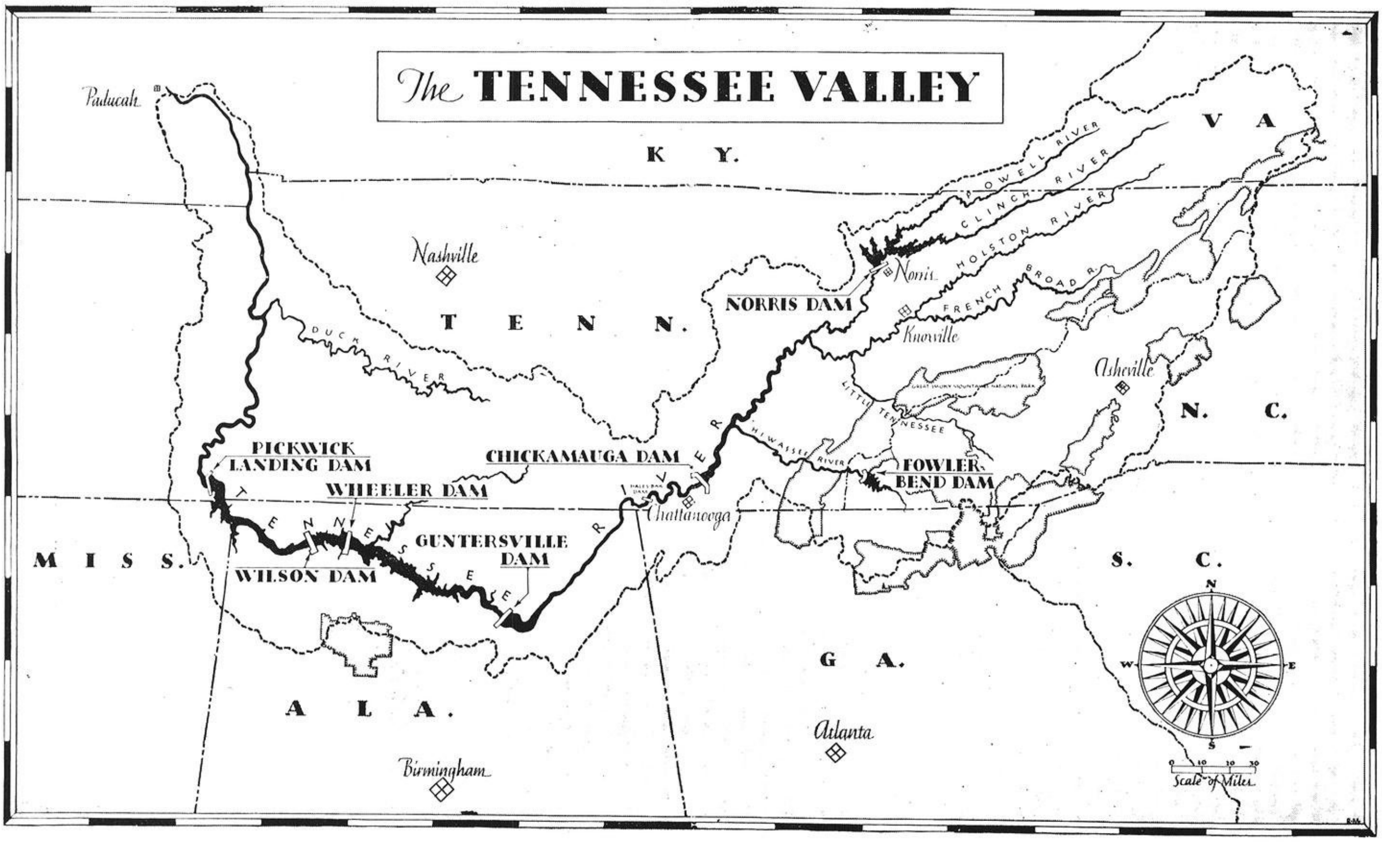
Congress passed the act creating the Tennessee Valley Authority on May 18, 1933. The administration of the program was placed in the hands of three directors. Arthur E. Morgan was appointed chairman with a nine year term. Morgan is a civil engineer and was president of Dayton - Morgan Engineering Company. He had planned and superintended the construction of 75 water control projects and was thus very eminently qualified to take charge of the dam construction and general management of the project. Harcourt A. Morgan, who is no relation to A. E. Morgan, was appointed for a six year term. His general duty is the development and production of fertilizers. David E. Lilienthal was appointed for a three year term which expired in 1936. He was reappointed for a nine year term. He supervises the transmission and sale of electric power and also heads the legal division of TVA.

Since the act creating TVA was passed in 1933 great progress has been made in the Tennessee Valley. The TVA is doing many different things, but nearly all that it is doing is in some way connected with one of these six objectives:

1. Flood control works on the Tennessee River to prevent the loss and damage caused by floods in the Tennessee Valley and help control floods in the lower Mississippi region.
2. A channel nine feet deep for navigation from Knoxville to the Mississippi River.
3. Distribution of cheap hydroelectric power.
4. Modernization of the nitrate plants at Muscle Shoals for the production of fertilizers developed by TVA chemists.
5. Soil erosion control throughout the valley.
6. Decentralization of industry so that Tennessee Valley residents can live on farms while working in factories.

TVA's Dam Building Program

The dam building program begun by TVA in 1933 is an extremely important part of the whole program, for the



NORRIS DAM—265 feet high: 1,872 feet long: reservoir, 2,570,000 acre-feet water normal level, 3,400,000 at capacity: shore line 705 miles; power, two 66,000 horsepower generators. Completed, 1936.

GUNTERSVILLE DAM—80 feet high; 3,980 feet long: single-lift lock, 40 feet: reservoir capacity, 951,000 acre-feet water; shore line, 584.6 miles. No initial power.

WHEELER DAM—72 feet high; 6,335 feet long: reservoir capacity, 1,260,000 acre-feet water: single-lift lock, 50 feet; shore line, 951 miles; initial installation, two 45,000 horsepower generators. Completed, 1936.

WILSON DAM—137 feet high; 4,860 feet long: power: 9 generators, capacity 261,400 horsepower: two locks in tandem, each with 44.5-foot lift; reservoir capacity 500,000 acre-feet. Completed, 1925.

PICKWICK LANDING DAM—107 feet high: 7,715 feet long: single-lift lock, 66 feet: reservoir capacity, 1,032,000 acre-feet; shore line, 550 miles. No initial power.

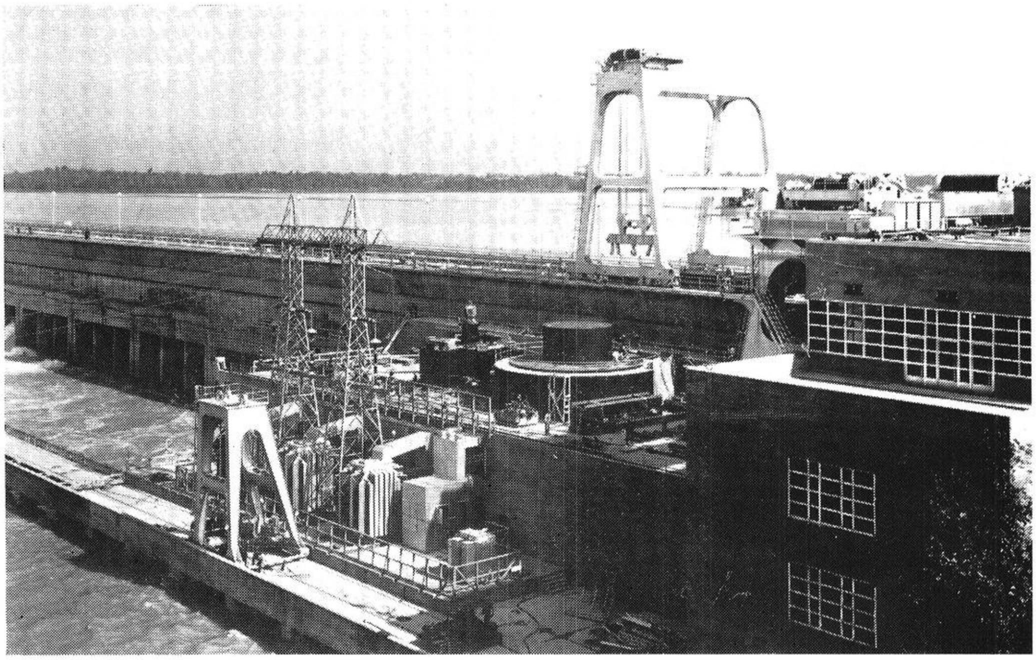
CHICKAMAUGA DAM—104 feet high; 5,685 feet long; single-lift lock, 55 feet; reservoir capacity, 742,000 acre-feet; shore line, 712 miles. No initial power.

FOWLER BEND DAM—300 feet high; 1,265 feet long; reservoir capacity, 450,000 acre-feet; shore line, 150 miles. No initial power.

reason that it carries out the first three objectives of TVA—flood control, navigation, power production.

Army engineers under authorization of Congress had prepared a most extensive and complete survey of the Tennessee River during the years 1922 to 1928. This excellent survey was of great value to TVA when it took it over in 1933. The survey of the Army engineers proposed two alternative plans for making the river navigable. The first plan was rejected, but is worthy of notice. It called for the construction of 32 low-lift dams that would have provided a narrow navigation channel but would have had no value for flood control purposes. Moreover, these low-lift dams were unsuited for power generation and would have permitted great fluctuations in the water levels of harbors along the river. The low-lift dams would have been cheaper to construct than the higher dams eventually built, but would not have had nearly the same ultimate value. The other plan, which is the one TVA is working upon, called for the construction of seven or more dams (in addition to the dams then on the river: Wilson Dam, and Hales Bar Dam). This system permitted flood control and likewise provided a minimum nine-foot channel for navigation. It also permitted the the use of water power for the production of electricity.

In 1930, before the TVA had been considered, Congress had authorized the construction of a nine-foot channel to Knoxville. It is therefore probable that a large number of dams would have been built on the Tennessee River in any event, but since TVA has taken over the development of the river it will mean that the river will be used to its fullest capacity rather than for navigation alone.



The Power House at Wheeler Dam

Dams Built by TVA

A few years before TVA started its work, Wheeler Dam had been started by Army engineers. TVA took over work on this dam in 1933 and since that time has completed the lock and dam there.

(Below the accompanying map of the Tennessee Valley will be found a brief description of each of the dams on the Tennessee River.)

Since 1933 Norris Dam has been completed at a cost of about $31,000,000. It was constructed on the Clinch River, an important tributary of the Tennessee River. This dam acts as a storage reservoir to provide water for the Tennessee River in times of drouth and as a flood control measure in times of excess rainfall. Peculiar topographic conditions have permitted a very large reservoir to be developed above the Norris site. The storage reservoir will have an area of 34,200 acres and will have a shore line of 700 miles.

In December, 1935, work was started on Guntersville Dam which will be completed by 1940. Pickwick Landing Dam, Chicamauga Dam, and Fowler Bend Dam were all begun at about the same time and will all be finished around 1940. Four other dams are recommended to be built on the Tennessee River or its tributaries before the entire development will be complete. These dams have not been definitely planned yet, nor has Congress appropriated the money necessary for their construction. Many of the dams that are being built are worthy of study from an engineering viewpoint.

Work on all these dams is staggered so that as soon as one dam is completed work is started on the next. This means steady employment for both the engineering and construction staffs and is far more efficient and economical than several staffs working from time to time.

Flood Control

The flood control features of the dams the TVA is building is a very important consideration. As the largest tributary of the Ohio, the Tennessee system is one of the most important factors in Mississippi floods. Control of the Tennessee River will prevent flooding not only in the Tennessee Basin, but it will contribute substantially to flood relief in the lower Mississippi. The prevention or control of floods in such a large region will mean a very great saving in life and property.

The navigation possibilities are also worth noting. The report of the TVA to Congress which was published in March, 1936, gives a hint of the possibilities of the Tennessee River for navigation. "A comprehensive survey of future tonnage possibilities made by the Army engineers

. . . estimates that in 1950 traffic will be 17,800,000 tons, with an annual freight saving of $22,800,000." There is reason to believe, therefore, that navigation on the Tennessee River, its tributaries and connecting rivers will become of great national importance.

While the water is being controlled for navigation and flood control purposes it is also generating electric power. Generating facilities have been increased at Wilson Dam, and generators have been installed at Norris Dam. The electric power is used in the construction of new dams, operation of navigation locks, and in the operation of electric furnaces at one of the nitrate plants. Surplus electricity is being sold at wholesale to municipalities, cooperative power associations and private power companies. The constitutionality of this part of the program is not completely settled, although the U. S. Supreme Court rendered a decision last February that was interpreted by the TVA as a victory. The power production capacity of the completed system will be very great, and is far greater than if the dams being built by TVA were privately owned. If privately owned each dam would likely be operated entirely for individual benefit without regard to the dams below, so that a very great waste of water would result.

Soil Erosion Control

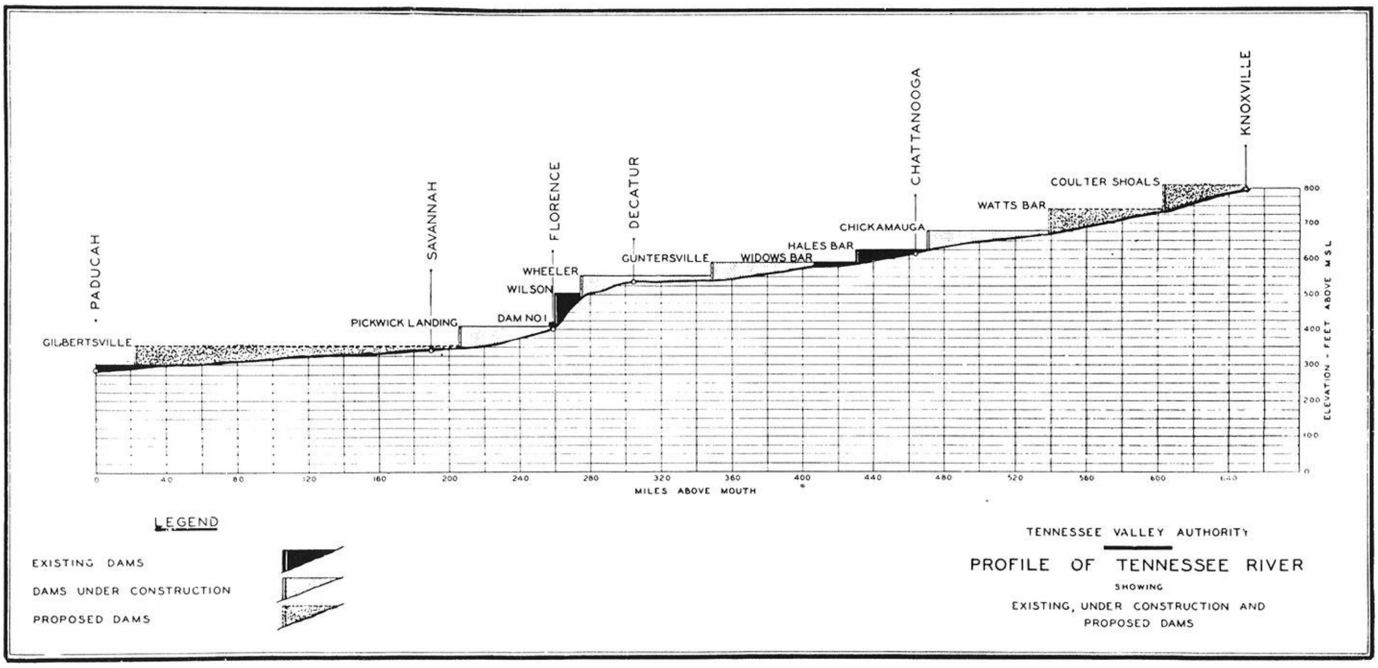
There is one factor that can destroy all the possibilities of these dams. That is the factor of soil erosion. Eroded soil in the form of silt is carried away by the river and is eventually deposited behind the dams. As the deposit behind a dam increases the dam becomes more and more useless until it is finally of no value at all. The United States Soil Conservation reports that on Deep River in North Carolina during the past 40 or 50 years, 11 of 15 power reservoirs have entirely filled with the products of erosion. This is a tremendous waste, both from the viewpoint of valuable damsites destroyed, and the value of the land washed away. For these reason the TVA is taking active steps to protect its dams and save soil by preventing soil erosion. It is teaching farmers correct methods of control, the kind of crops to plant to prevent erosion, the way to plow, and the kind of land not to plant at all.

The University of Georgia has translated soil erosion losses into dollars and cents. In an acre of bare ground 112,316 pounds of soil were washed away, while on an acre of woodland over the same period of time only 115 pounds of soil washed away. To replace the plant foods washed away on the wood tract would cost five cents an acre, but on the bare soil it would cost $59.15. Had these wasted plant foods stayed in the soil, they would have been sufficient to make an acre of land yield 50 bushels of corn for four separate seasons. To prevent this waste TVA, in addition to teaching farmers proper methods, has planted considerable timber at places where soil erosion losses are greatest.

At the same time in order to restore the fertility and prosperity to eroded areas the TVA is conducting experiments on fertilizers, developing new varieties, and manufacturing it with electric power from TVA dams at the modernized nitrate plants at Muscle Shoals. The experiments that the TVA has conducted in this field are very interesting and alone would make a good article. TVA chemists developed a new fertilizer which they called triple superphosphate. Selected farmers tested one half the field with the new fertilizer, then planted the whole field with clover. The difference in yields was amazing. The TVA accordingly produced 40,000 tons of this fertilizer with its own electric power, and distributed it free to 20,000 farmers. With it farmers are growing forage crops, forestalling erosion and enriching land.

Decentralized Industries

Five of TVA's six objectives have now been mentioned. The sixth is to attract and develop decentralized industries in the region. Four basic groups of living emerge from the TVA plan. There will be first, the isolated



farms, well equipped with electricity. The second group will be small towns, in each of which it is planned to locate a factory or other single manufacturing enterprise producing principally for consumption near at hand. The workers will work on the farm part time and in the factory part time. The third group will be the larger towns consisting of larger plants, but the workers in slack times will work in gardens rather than farms. The fourth group is the large industrial development. The completed TVA plan visualizes an industrialized countryside, completely equipped with electricity.

It is interesting to note that decentralized industry is not a new or untried idea, but one that has been advocated by Henry Ford and others for years. Henry Ford has developed 15 of these small farm-industry groups near Detroit. In each group there are from 15 to 400 men. According to **Business Week** for April 11, 1936, General Motors in 1935 spent $50,000,000 on a program which was developed around a decentralization of its primary manufacturing units.

So we get some idea of the scope and objectives of TVA. It is probably one of the most interesting developments in America today and one on which intelligent people should be informed. Engineers especially should have a wide interest in the project because it is so closely allied with engineering in many of the aspects of its work. Much will be heard of TVA in years to come and probably if this development meets with success the same plan may be used on other great rivers in the United States.

ALL FIGURED OUT

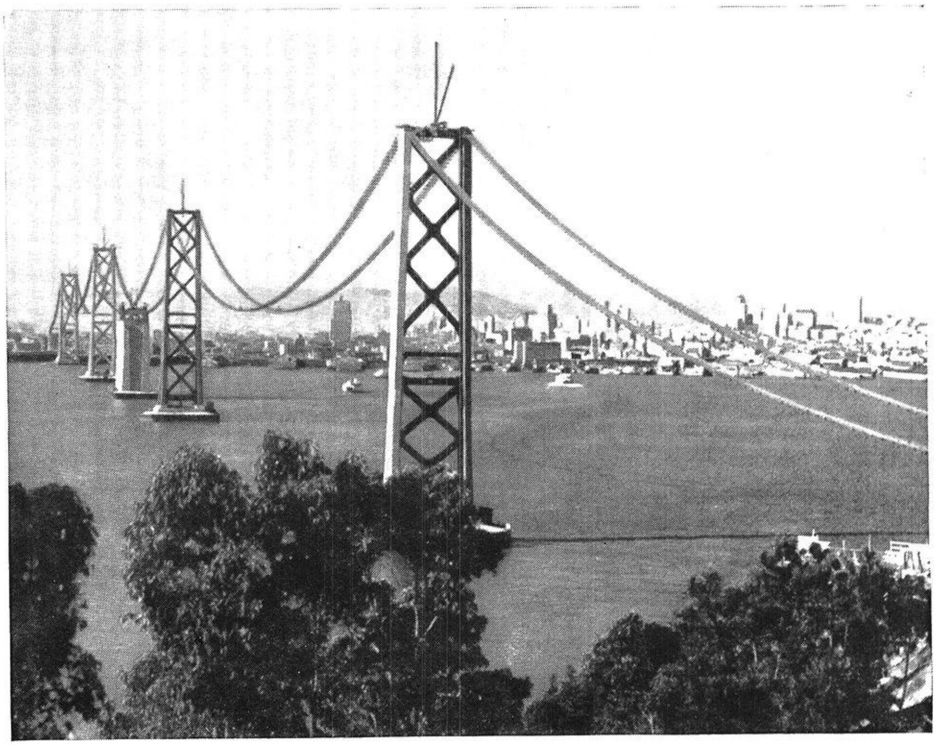
by HAROLD J. FITZGERALD

This unusual article is reprinted through the courtesy of Harper's

OUR SHOES sank into a springy network so suggestive of chicken wire that we stepped lightly in the fear of pushing our feet through it. Between its strands we saw a broad surface that seemed to have been daubed crudely with greenish paint and left full of ridges, but which we knew from having just left it was San Francisco Bay. The interval was occupied by about four hundred feet of air and an occasional sea gull.

From below, the festooned cable had looked like a slender but quite solid thing up against the sky. But as we came out onto the catwalk we discovered that it was made up of 37 smaller cables, and that each of these was a bundle of 474 wires clamped together every few yards. The bundles, or strands, as the engineer called them, ran shoulder-high beside us apparently out of and into infinity, and for no reason that we could see had the multitudinous motion of a bunched herd of galloping cattle. Later the strands would be packed tightly together to form the 28¾-inch cable of the biggest bridge in the world, and the combined strength of the 17,464 pencil-like wires would support the heaviest loads ever hung from anything in history.

On our way across the anchorage the engineer had showed us how the strands were looped through 37 eyebars embedded in thousands of tons of concrete, and then he had said a curious thing. There were not really 17,464 wires; there was one wire which ran back and forth across the three-mile reach of bay 17,464 times. This came as a shock to those of us who had supposed the cable could be pulled up or let down to the proper length before being fastened permanently, and someone remarked that it didn't leave much room for adjustment. The engineer laughed and said no, it didn't.



—General Electric Review

Piers and towers of the West Crossing, between Yerba Buena Island and San Francisco

As we filed out along the jouncing wire netting, I thought of that single wire weaving endlessly across the bay, becoming more and more irrevocable with each loop; and of the possibility that they would have to take the bridge apart and start all over again.

"Don't worry," said the engineer when I mentioned this. "It's all figured out to a fraction of an inch."

"I shouldn't think there'd be much figuring," said a man in a gray overcoat. "Isn't it just a matter of dangling the wires to the level of the roadway?"

"Not exactly," said the engineer. "You see, that's just where we want them. You never put a cable where you want it, because then it'll go somewhere else. You put it where you don't want it."

We stared at him, and a man with a cap and curved pipe said he thought he could do that well himself. The engineer said he was sure of it; the main thing was to know the exact length of the cable. And how, the man inquired, resting an elbow on one of the jostling strands, did one find that out?

"We took the length of the span," the engineer said. "These big ones are 2,310 feet. And the height of the roadway—216."

"And the height of the towers, of course?"

"No. We had to find that out from the cable."

"Well!" said the man. "I'd have done it just the opposite!"

"That would be all right, too," nodded the engineer, "if your bridge didn't have to hold anything. We had to consider the load. On these long spans it's about 4,500 tons for each cable. From that we had to compute the cable tension."

"That's easy. Forty-five hundred tons."

The engineer shook his head. "The cable's not only carrying the load," he explained. "It's pulling against itself." He glanced round with brisk impatience for something to illustrate his point. "Say you stretch a string across a 20-foot space and hang a ten-pound weight on it. If it can sag only an inch the tension will be about 600 pounds. Let it sag a foot and the tension will go down to 50 pounds. If it can stand a pull of only ten pounds you'll have to let it down five feet before it'll hold. It all depends on the slope."

—General Electric Review

Strands of cable in place at the San Francisco anchorage

"Well then, what's the slope of the cable?"

The engineer smiled. "Since it hangs in a curve," he said, "it has a different slope at every point. And a different tension, too." He pulled out a notebook, riffled the pages, and swiftly wrote down a series of square-root signs, parentheses, and fractions, while the impatient rattle of an air-hammer came muffled out of the distance and the cobwebby catwalk swayed under us. "If it sagged only one foot in 20," he said as his pencil flew, "its greatest tension would be nearly 13,000 tons. The cable would have to be three feet nine inches in diameter, and it would weigh 1,184 tons more than the load!"

We shook our heads, and gazed out along the uneasy silver arc, wondering at the ways of cables.

"Then why not let it sag ten or even fifteen feet in twenty?" suggested the man with the pipe.

"At fifteen in twenty," said the engineer after a few flicks of his pencil, "the sag would be 1,725 feet. Add that to the height of the span and you get nearly 2,000 feet for the height of your towers!"

"Oh!" said the man with the pipe.

"Five in twenty would still run them up to 800. So we had to find the combination of tension and sag that would be least troublesome. We finally fixed the sag at 266 feet, a little over two in 20, which gave the cable a tension of 5,200 tons. That made the towers 502 feet high."

The man in the overcoat produced a memorandum book and rested it, open, against the cable. "I used to be pretty good in trigonometry," he said. He drew a triangle, frowned, then started over by drawing a circle. He moistened his lips and tapped his automatic pencil against the dull steel. "What do I take for the radius?" he asked. "Two-sixty-six, or—"

"Neither," said the engineer.

You can't, it seems, measure cables as you do straight lines or arcs of circles. They're parabolas, and when you start measuring parabolas you leave plane geometry and most of your friends behind and get up among the spiral nebulae of integral calculus.

The engineer made the calculation for us there on the windy catwalk, and at least it flashed out the cable length —2,392!

The man with the pipe heaved a deep sigh. "And I thought you hung cables like clotheslines!" he said. He gazed at the glistening curve that swung like a swallow's path from tower to tower. "Just 2,392 feet from there to there!" he murmured.

"Oh, no!" corrected the engineer. "Not yet. Steel stretches. The cable won't get its full length till the load is on it. We know how far steel stretches under a given tension. So we figured the tension at each of the 70 suspender ropes."

"And substracted the total stretchings from 2,392?"

"No," said the engineer, "there was a little more to it than that. If a 20-foot rope will stretch a foot, you can't make it 20 by starting with 19, because the 19-foot rope will stretch only nineteen-twentieths of a foot. That wouldn't be so bad, but when you shorten a cable you decrease its slope. That increases the tension and makes it stretch more. But as it stretches its slope increases, so that it stretches less and less. And of course that's going on at different rates in different parts of the cable—"

"You're not trying to tell me," broke in the man with the overcoat, "that any human being could figure that out!"

"Lots of them. We found that if we made the cable 2,388 feet long it would stretch four feet to 2,392."

—Mechanical Engineering

Looking down on one of the towers

The man in the overcoat murmured "Twenty-three eighty-eight!" wonderingly, and slapped a corrugated strand. "But you haven't told us how you measured off those 2,388 feet."

"Oh, we couldn't measure them off on the cable. We gave each wire the proper sag and that made it the right length."

"You let them sag a little less than 266—?"

"Not 266," the engineer interrupted. "You're thinking of the parabola, the shape the cable takes after it's loaded. When it's first strung up it takes a very different curve, called a catenary. So we calculated the sag of a catenary 2,388 feet long with a 2,310-foot span."

"I suppose that meant a lot more integrals?"

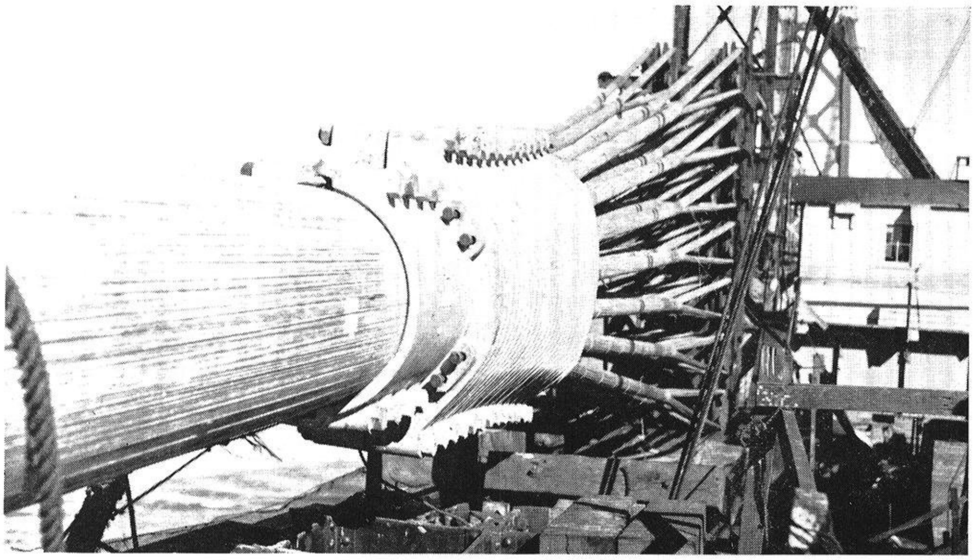
"Not at all. It was merely necessary to find, by successive trials, a number which, when divided by its own hyperbolic sine, would equal the cable-length divided by half the span, then multiply this by the hyperbolic cosine of half the span divided by the number. The result, when the original number was subtracted from it, yielded our answer—which was 235."

"Then," said the man with the pipe, "you gave the wires a sag of 235 feet, and that made them 2,388 feet long?" The engineer nodded. "And when the span's in place they'll stretch—"

"They'll first turn into a parabola with a sag of 256 feet. Then they'll stretch four feet, which will make them sag another ten, and just meet the bridge 216 feet above the water."

"About measuring that sag," said the man in the overcoat. "You couldn't have done it from above because there's nothing up there. Did you measure down to the water?"

"No. We set up a transit on one tower and aimed it at a point on the next. The points were calculated so that when the cable's vertex crossed the line of sight it would



—Mechanical Engineering

End of 28¾-inch suspension cable showing 7¼-ton splay casting which binds the 37 strands into conical shape

only swaying all the time, but they're stretching up and down. And they're being spread apart or drawn together by their bracing girders. The cable is rising and falling and shortening and lengthening, and so is the span under it, sometimes as much as nine feet a day. Every piece of metal in the bridge is changing its size and shape every minute day and night. The whole thing is constantly ly squirming around."

A broad-beamed barge, looking like half a walnut shell, came in sight through the chicken wire, inched along under our feet.

be 235 feet below the tower tops."

"Well, that was simple enough," said the man, with relief.

"Only," said the engineer, "that we had to allow for the shape of the earth."

"Of the **earth!**"

"Certainly. Those towers are nearly half a mile apart. If we had sighted straight across we'd have hit 1.28 inches too high."

"Well, that was the last of your problems, surely!"

"Almost. We still had to consider the temperature of the air. When the morning sun warms the east side of a tower, the steel expands and it leans to the west. In the afternoon it leans to the east, like a sunflower in reverse. The top sways six and a half inches in a day. That would throw our sights out two feet."

"But you couldn't stop the towers from bending!"

"Hardly. We pointed a collimator, or sort of telescope, straight down from the top of each tower, and when it was exactly on a mark at the bottom it meant the tower was vertical. We had telephones on the towers, and when we got word that both were vertical at the same time, we did our sighting."

Again we silently regarded the galloping strands. Somebody asked if that was why they were constantly in motion —was it that even now the tall towers were pulling at their ends?

"Partly," said the engineer. "But a good deal of it's in themselves. When the sun warms the upper wires in a strand, and the bay air cools the lower ones, the internal strains cause a complicated set of motions. And parts of them are always being warmed or cooled at different rates. It's no wonder they're never still."

"But all those close calculations," said the man in the overcoat, "are true only once in a while then?"

"Check," said the engineer. "There are no absolute dimensions in a big bridge like this. The towers are not

"What's the use of such fine calculations, then," the man protested, "when they aren't true the minute after you make them?"

"Oh, these squirmings and shiftings don't bother us," said the engineer. "They're all calculated in advance, too."

"You mean you can tell what this bucking steel bronco will be doing at any minute?"

"Sure," said the engineer. He dug his rubber heel into the wire netting and started down the springy catwalk. "That's all figured out."

But we didn't ask him how he did that. We were becoming a little dizzy up among those hyperbolic cosines.

TESTING THE HARDNESS OF METALS

The Brinell test has been used in testing metals ever since its introduction by the Swedish engineer, J. A. Brinell, in 1900. He measured the hardness of metal in the following manner: A 10-mm. steel ball is forced into a specimen under a standard load, usually 3,000 kilograms, and the diameter of the indentation after removing the load is measured. From the diameter, the surface of the portion of the indenting ball that was embedded in the specimen is calculated, the ratio of the load to the surface being defined as the Brinell number of the metal. By definition the Brinell number is equal to the average stress with which the material will resist further indentation.

Brinell and others after him found that the Brinell number of an iron or iron alloy specimen was roughly proportional to the tensile strength of that alloy. The Brinell number was also found to be a convenient indicator of variations in work-hardening and other metallurgical properties in a given type of metal.

These valuable characteristics, together with the fact that the Brinell test is simple to make and, in contrast to the tensile test, does not involve destruction of the material, have led to its widespread adoption as an inspection test in the automotive industries and as a research tool in metallurgical laboratories.—**Technical News Bulletin.**

Our ENGINEERS in the News—

Prexy:
WAYNE T. HUNZICKER

Being shy, modest, and unassuming must be marked qualities for leadership in student activities, for Wayne possesses these qualities which go with the presidency of Polygon. "Huntz" as he is known to his many friends, is also the reigning head of A. I. of Min. and Metallurgical Engineers — student branch. "Prexy" Hunzicker is general chairman of the coming St. Pat's parade and celebration, and is making elaborate preparations for it.


HUNZICKER

Born May 12, 1914, in Lake Mills, Wayne's early boyhood was spent in his father's services, and when the family moved to Madison he enrolled in Wisconsin High. When graduation rolled around, he had distinguished himself in track, football, and dramatics but, as most working engineers, he found little time to develop these activities here.

His graduation in June from the mining school will be followed by geo-physical work in oil developing at the newly discovered Franklin Field, Texas. Opportunity in copper mining in Arizona, or oil prospecting in the Bolivia wilds may lure "Huntz" as an aid.

Wayne is the sixth of the Hunzicker family to attend the university and the burden of a successful engineering career falls upon his shoulders, for he is the first member to attempt the engineering field. His favorite subjects are drawing, math., and mechanics, and Professor Washa his favorite instructor. He still remembers Professor Kahlenberg's philosophy-chemistry lectures regarding "Things they don't teach you on the hill," which haven't varied much from year to year.

Prom King:
WILLIAM PRYOR

Royalty invades this column. The engineering school pays homage to one of its members who has attained the highest social distinction the university can bestow on an individual. His Royal Highness, William Pryor, will lead the school in the year's outstanding social event—the Junior Prom.

Bill early marked his career as one of distinction by obtaining more honors than ever were bestowed upon a student at Shorewood High School in Milwaukee. Most numerable of them are: managing editor of the school paper, president of the science club, three-letter man on swimming team where he earned the title of champion back stroke of the state for 1932, and many other activities including dramatics and social life.

Bill has continued in his activities here at the university in a noteworthy manner. He was elected to Phi Eta Sigma, honorary freshman society. He has received his numerals as a member of the freshman swimming team. Bill is also a member of Tumas. Being a good engineer, he is a member of Polygon and belongs to the local chapter of A.S.C.E.

Bill believes that the engineering courses could be a lot more practical; that is why he stayed out of school last year and worked at the Allis Chalmers plant in Milwaukee. He also believes that the engineering courses are too heavy, that this fact makes it almost impossible for an engineer to get into outside activities to any great extent.


PRYOR

Bill is an active member of Sigma Nu social fraternity.

Actor:
JACK MEYER

Jack has the rare ability of mixing two professions, dramatics and chemical engineering, and coming out a success in both. He came to the university in September, 1935, from the Milwaukee Extension division, where he received his first two years of engineering training. Jack favors the chemical engineering profession because he thinks it is still in the embryo stage, developing and broadening, and offering many opportunities.


MEYER

He is a member of Haresfoot and the Wisconsin Players and has given much to both organizations. We can all remember him as vice-president Throttlebottom in the Haresfoot production, "Of Thee I Sing," of last season. Jack likes to play characterizations and plays them well. He started his career as a character actor early in life, playing many difficult roles while in high school. Jack will play the leading role, the part of George Radfern, in the University Theater's next production, "Laburnum Grove."

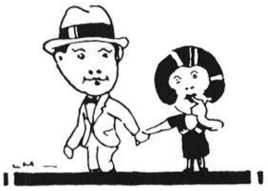
The best time Jack had while on the stage was during the last showing of "Of Thee I Sing," when everybody, as he said, "Chucked the rules." He has proven himself very versatile, appearing in many activities. He is a member of the dormitory quad council, and often plays the role of master of ceremonies. Whenever something is to be put across they call on Jack.

He is a bit in doubt about his future, not knowing whether it will be engineering or dramatics. As he said, "If I get a thousand dollars I'll head for New York and at least get dramatics out of my blood."

ON THE CAMPUS

HERE FOR HOLIDAYS

F. M. Dawson, dean of the College of Engineering at the University of Iowa, and formerly professor of hydraulics at Wisconsin was visiting here during the holidays. O. L. Kowalke of the Ch. E. department visited Mexico City with his wife during the Christmas recess. Leopold C. Finn, e'36, now in the Signal Corps, U. S. Army, was also in Madison for Christmas. Mr. and Mrs. O. W. Storey, ch'10, were here for New Year's Day.



PROFESSOR MEAD WINS NORMAN AWARD

At the next national meeting of the A.S.C.E. to be held in New York City, January 20-27, Daniel W. Mead, professor emeritus of the hydraulics department, will receive the Norman Medal for his paper, "Water Power Development of the St. Lawrence River." The award was established in 1872 by the late George H. Norman, member of A.S.C.E., for the best original paper considered an especially notable contribution to the engineering profession.

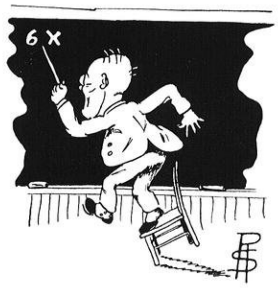
Professor Mead graduated from Cornell in 1884 with a degree of C.E. After graduation he served respectively with the United States Geological Survey, as city engineer of Rockford, Illinois, chief engineer and manager of the Rockford Construction Company, and as a consulting engineer on hydraulics and power plants. He has occupied the chair of hydraulic and sanitary engineering at the University of Wisconsin continually for 28 years as well as being assigned to the Red Cross Commission to China on flood protection of the Huai River in 1914. From 1913 to 1921 he acted as consulting engineer for the Miami Conservancy District, and in 1928 was appointed by the late President Coolidge to the Colorado River Board to pass on plans for the Boulder Canyon Project.

WITH DEEP REGRET—

We say goodbye to O. A. Hougen, professor of chemical engineering, who is leaving us to assume his new position as professor of chemical engineering at Armour Institute of Technology in Chicago. Professor Hougen will be sincerely missed by both the instructing staff and student body, and we feel that it will be a long time before his place in the engineering school will even be partially filled.

A graduate of the University of Washington in 1915, he came to Wisconsin two years later as an instructor. Here he added to his Ch.E. degree that of Ph.D. and gradually worked his way up to a position as associate professor in 1926. His activities have not been confined to teaching, however, for he is well known in engineering circles for his work and research throughout the entire engineering field. This is shown by the diversified positions which he has held in various concerns throughout the country. Probably the most important of these was as director of research for the United States Testing Company in 1934-35. Others are consulting engineer at Holeproof Hosiery Company, Phister-Vogel Leather Company, Burgess Laboratories, and National Oil Products Company. He also had one year of war service at the United States Chemical Plant No. 4 at Saltville, Virginia. Most important of his many publications is "Industrial Chemical Calculations," written in conjunction with K. M. Watson.

KESSLER TO TALK BEFORE WESTERN SOCIETY OF ENGINEERS



L. H. Kessler of the hydraulics department will talk to the Western Society of Engineers in Chicago on February 8. His subject will be "Results of Recent Investigation on the Theory of the Mechanism of the Activated Sludge Process." Assisting in the demonstrations to accompany the talk will be Clair N. Sawyer, assistant in the hydraulics department, and Gerard A. Rohlich, Wisconsin Alumni Foundation research fellow.

NEW HANDBOOK SERIES NOW AVAILABLE

In response to the long felt need for a single reference covering the fundamentals of engineering for quick review, John Wiley and Sons have published a new series of handbooks which are now available in the Engineering Library. The "Handbook of Engineering Fundamentals" is assigned first place in the series, since its object is to cover all the fundamental material common to all the branches of engineering. The rest of the series will be divided into the fields of mechanical engineering and communication and electronics. Volume II of the series is entitled "Mechanical Engineer's Handbook-Power," by Kent.

OCCASIONALLY a telephone wire must be run under a rug or carpet. The twisted wire formerly used made an unsightly ridge.

So Western Electric—manufacturing, distributing and purchasing unit of the Bell System—produces a flat cord only one-eighth inch thick, seven-eighths of an inch wide. (Like this). Within this tiny space are four conductors of insulated wire. Under the rug or carpet this cord is not seen, not even felt with bare feet.

Even to the smallest detail, the Bell System is constantly on the lookout for the better way to make telephone service more satisfactory to the customer.

College men and women find after 7 P. M. a convenient time for long distance calling. Moreover, most rates are lowest then.

BELL AMERICAN TELEPHONE & TELEGRAPH CO. BELL SYSTEM AND ASSOCIATED COMPANIES **TELEPHONE SYSTEM**

ALUMNI NOTES

Mechanicals

GROTH, ALVIN E., B.S. & M.S.'32, formerly of the Forest Products Laboratory, is now engaged as a design engineer at the Carnation Milk Co., Oconomowoc, Wis.

MATSEN, MAURICE, B.S.'31, M.S. '32, has taken leave of the Kimberly Clark Co. of Neenah, Wis., to accept a position as junior plant design engineer with the du Pont de Nemours, Wilmington, Del.

NORMAN, LORNE A., '33, has a position which requires him to do drafting, checking assembling, and designing with the W. S. Darley & Co., manufacturers of fire fighting equipment, located in Chicago.

MATTKA, FREDERICK A., '28, M.S. '35, is with the Charles E. Bedaux Co. of Illinois, Inc., at 435 N. Michigan Ave., Chicago. He was instructor in Steam and Gas during 1934-35 and instructor in engineering economics during 1935-36.

PHILLIPS, HARRY A., '22, athletic editor on the staff of **The Wisconsin Engineer** during his student days, is engaged in manufacturing refrigerating specialties under the name of H. A. Phillips & Co., at 155 N. Union Ave., Chicago.

RUMPF, H. E., '30, is employed in plant design work at the Carnation Milk Co., Oconomowoc, Wis.

RUTHERFORD, MARVIN H., '29, directly after graduation, accepted employment with the Chicago Transformer Corp. and has risen to the rank of mechanical engineer of the organization. During this period of time he has taken an active part in inventory control, production of metal stampings, tool and die manufacturing, and in the supervision of wage incentives.

STANEK, JEROME H., '36, corresponds that he is employed in the engineering department of the Johnson Service Co. of Milwaukee, Wis.

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Electricals

FRECK, MARTIN W., '34, has accepted a position with the Wisconsin Power and Light Co., working in the rate department.

HERTEL, ROLAND, '36, has been transferred from the Erie to the Schenectady works of General Electric Co.

MIEDANER, W. H., '36, is working in the Standards Department of Swift & Co. packing plant, South St. Paul, Minn.

RUTTER, R. H., '36, has a position with the Wisconsin Public Service Corp. at the High Falls hydro-electric plant, Crivitz, Wis.

SILVER, HAROLD S., '28, is in the Patent Department of Allis Chalmers Manufacturing Co., Milwaukee.

WOOLRICH, W. R. e'11, M.E.'23, head of the department of mechanical engineering at the University of Tennessee for 14 years, has accepted the position of dean of the College of Engineering, University of Texas. Mr. Woolrich was for a time in charge of the Agricultural Industrial Division of TVA.

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Miners

SIREN, J. E., '33, is a mining engineer at the Ironton Mine, Bessemer, Mich.

BRENNER. ROBERT W., '36, married Miss Catherine Ann Kelly on December 7, in Ironwood, Mich., where Mr. Brenner is employed as mining engineer for Pickens-Mather Co.

BEMIS, R. S., '29, M.S.'33, is superintendent of mine and mill operations for the Cerro-De Pasco Copper Corp., Mahr Tunnel, Peru, South America.

WOLTERS, EDWARD C., '28, has been superintendent of the Viroqua Camp of the Soil Conservation Service since last July.

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Civils

ANDERSON, ALBERT J., is also with the Wisconsin Highway Commission at La Crosse, Wis.

BERG, LOUIS L., '32, began work on December 1 with the Chicago Bridge & Iron Works, Chicago.

BUSH, WILLIAM L., '35, joined the staff of City Engineer Amundson of Baraboo on December 8.

HENRY, J. EVERETT, '36, has joined the staff of Engstrom & Wynn, contractors, at Wheeling, W. Va.

KUELLING, HERBERT J., '08, has been appointed director of WPA for District 5 at Stevens Point.

LIDICKER, WILLIAM Z., '27, after several months on the design of the Conchos Dam, has been transferred back to the St. Paul office of the U. S. Engineers as head of the design section.

LIDICKER, ROGER K., '33, was married to Marian Arlena Johnson of Milwaukee on October 10. After teaching for a year at Lewis Institute in Chicago, he has taken a position as private secretary to one of the executives of the Public Service Co. of Northern Illinois. Residence: 219 N. 2nd Ave., Maywood, Ill., Apt. 36.

VILLEMONTE, JAMES R., '35, has been with the new Wisconsin Code Authority since November with headquarters at La Crosse. He has been gathering data on the performance of highway construction machinery.

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Wisconsin Alumni at Cutler-Hammer Co., Milwaukee

ANDERSON, O. M., e'26, is an application engineer on drum controllers for electric motors.

BAIRD, J. T., e'38, has been working as a draftsman.

BALL, R. G., e'34, as engineer, works on resistor design and application in the development department.

COTTON, W. R., ch'34, is employed as a draftsman.

DOBBERPUHL, R., e'19, has the position of production engineer in charge of the Stores Department.

DRIES, JEROME F., m'32, as experimental engineer, tests magnetically operated brakes, clutches, and lifting magnets.

ERDMAN, EDWARD A., min'36, is engaged in metallurgical work.

FELDHAUSEN, CYRIL P., e'28, is an application engineer on electric controllers and drives for printing press and paper mill applications.

HEUSER, JOHN U., e'16, Sales Engineer, is manager of the Milwaukee Sales Office.

KNELL, KARL, c'34, is an industrial relations engineer in the Welfare Department.

LAABS, E. H., m'14, supervises printing press and paper mill applications.

LAMB, KENNETH E., e'23, works on applications of electric controllers for the U. S. Navy.

LILLQUIST, ARVID E., e'27, supervises work on magnetically operated clutches and brakes.

MILLERMASTER, RALPH A., e'27, in the capacity of development engineer, has charge of all development on electrical wiring devices, radio equipment and knife switches.

PAWLOWSKI, J. A., m'30, has the position of engineer in charge of all welding operations.

ROSECKY, JOSEPH J., e'33, tests magnetically operated contactors and relays in the engineer experimental department.

SCHMIDT, E. X., m'17, is development engineer in charge of gas equipment.

SCHMIDT, VERNON W., e'33, M.S. '35, does general test work in the engineer experimental department.

STIENKE, CARLYLE J., m'30, has a position as industrial engineer.

TIMM, HAROLD D., m'19, is production engineer in charge of the Stores Department.

WITH THE SOCIETIES

A.S.A.E.

Thursday, December 17, the ag engineers held their last meeting of the year 1936. Don Wiggins presided and Richard Witz gave a financial report, closing the year's accounts. He also passed around booklets describing, "What Ag Engineering Offers to the Young Man."

Willis Huffman's seminar report on the TVA was the first feature of the evening. He was followed by Lynn E. Norsman, who read another on "Rubber Tires vs. Steel" for farm machinery. The evening's closing subject was an entertaining moving picture entitled, "Mr. Miller Goes Into High Gear," which was presented by Mr. Keefe Taylor from the Madison branch of the Goodyear Rubber Company.

A.I.Ch.E.

At the December meeting of the American Institute of Chemical Engineers, Professor Hougen made his last appearance before the group. He spoke on the experiences of a group of untrained men trying to run a chemical engineering plant during the war, and pointed out the futility of the enterprise.

Leo Fuchs, the high standing freshman chemical last year, was presented with a certificate from the A.I.Ch.E.

The meeting ended with beer and pretzels and a general talk around.

PI TAU SIGMA

Late in November, representatives of Pi Tau Sigma, M. E. honorary society, convened in the Sunny South at the University of Texas for their nineteenth annual national convention. Sixteen universities were represented. The main business of the convention was the discussion of new ways to improve the individual chapters and the election of a national secretary-treasurer, who will hold office for three years. Feeling that he had ably discharged his duties for the last three years, the delegates reelected H. E. Degler, professor of mechanical engineering at the University of Texas.

Student pledges and Dean W. R. Woolrich U.W.'11, as an honorary member, of University of Texas, were initiated during the meeting.

Bill Gother, our representative from Wisconsin and president of the local chapter, was appointed chairman of the auditing committee for the coming year.

A.I.E.E.

The second meeting of the local branch of the American Institute of Electrical Engineers during this semester was held Thursday evening, December 10. The speaker was Norman H. Blume, of the Wisconsin Telephone Company, who gave an interesting address on the engineering problems involved in making telephone circuits suitable for carrying radio programs.

During the evening he mentioned the fact that the radio network programs come into a special switchboard in the telephone company plant and are designated by colors rather than numbers; what happened one time when a color blind operator was assigned to manage the switchboard was left to the audience to figure out.

Cocoa and cake finished off an enjoyable evening for a group of about 40 electricals.

The First Job Is The Hardest

[Compiled from Letters]

"The events which followed my recent letter to you show how inconsistent and contradictory life can be. As I recall, I stated in my letter that I hadn't had a nibble for work during the six weeks following my graduation. Well, five minutes after I posted that letter, I received a letter from the Jensen Company asking me to appear for an interview in answer to an advertisement I had put in the paper the previous Sunday. I secured the job during the interview. Then, when I returned home that same day, I was told that the N-C Bureau had an offer with a large manufacturing firm of this city to do stenography, tracing, and bookkeeping, for all of which I can qualify. Can you imagine that? Two jobs within twenty hours, and not a single one during the six weeks previous!

"I have been employed since March 15 as stenographer in the engineering department. It is surprising how important I have found my knowledge of shorthand. It was the means for my getting two jobs before I went to the university, and it is the chief requisite for my present job. The reason is, of course, that male stenographers are scarce; and after all I cannot blame a male for not wanting to be a stenographer. But if it makes the difference between having a job and not having a job, I'll be a male stenographer, and like it."—**N. L.**

Are You Wondering—

WHAT will the first job be like? The question is in the back of every engineering student's mind; faintly during the freshman year, but continually moving forward and demanding more attention until it becomes the first thought of the senior. To furnish at least a partial answer to the question, we are offering herewith abstracts from various letter received within the past two or three years. The men who wrote them were graduated during the Great Depression that began in 1930 and reached its nadir in 1934 so far as job-getting was concerned. It took energy and courage to find a job of any kind and men took what they could get and liked it. Their experiences may offer something of value to the men who follow in their footsteps.

He Found the Job He Liked

"I am happy to report that since May 2 I have been in the employ of the Metropolitan Water District as a recorder on a topographic survey party. My classification is the pretentious one of junior engineer, but my work is recording. I am in the distribution division, which is responsible for the location, design, and construction of about 210 miles of delivery line from the reservoir to the district cities.

"A long time and a big effort were required to get this job. However, this organization appealed to me so strongly that something more than a momentary desire to be salvaged from the ranks of the unemployed drove me to make a special effort. The organization is young and incomplete. The future in it looks good.

"In the nearly two years since I left Madison, I have kept myself partially busy as a clerk in a market and as messroom boy on a private yacht. I sailed a total of about 20,000 miles on various trips that took me to points along the coast between Skagway, Alaska, and Acapulco, Mexico. Viewed as a whole, they have been two quite interesting years; they were not entirely wasted."—**C. A. K.**

He Got on the Friant List

"I delayed writing until such time as I might be able to report something definite regarding my success in landing work, but I am getting nothing but vague promises and, after a month's delay, I am no better off. It seems that I am enveloped in a sort of doldrums, and waiting for the wind to start blowing is disheartening. I have put out every spare sail to catch any chance gust of wind.

"Last September, I had a personal interview with Mr. Blank of the XYZ Service, upon his request, and was told that I might expect to go to work the following week. Three weeks ago I received a letter from Mr. Blank telling me that he could place me subject to approval from the National Democratic Committee. So what! I have no objection to becoming a democrat, but tomorrow I may have to become a socialist to gain favor, and the following day I may have to change my creed again. Bad business that!

"Two weeks ago I received a letter from my congressman saying that he had slightly overlooked my letters of three months ago in which I had asked him what to do to get on the so-called 'Friant List.' Well, he has told me now. As a result I cruised about collecting the signatures of leading democrats of this vicinity. Dropped anchor in about fifteen ports. Being on the Friant List is more important than knowing your work. Yesterday I received a letter from Mr. Julian N. Friant informing me that he had requested that my name be put on the eligible list. Here you have the first step in the life of a democrat in the chrysalis."—**V. P.**

He Got the Job by Pestering

"I began work early this fall with Richard Roe, consulting engineer. I was fortunate in catching him at low tide in his business when he had completely reduced his staff. He began to be snowed under this fall with PWA plans and took me on for a tryout, inasmuch as I had been pestering him about twice a week all summer. I'm still on.

"This is a CWA job. It consists of laying 8,500 feet of 8-inch sanitary sewer, 700 feet of cast-iron force main, the construction of a pumping station, and installation of pumps and piping. I am in complete charge of the job, serving in the combined roles of engineer, superintendent, and inspector. The city is the contractor and has furnished two council members as foremen, neither of whom has had any construction experience.

"The boss sent me here to begin the work a couple of weeks ago on one day's notice, inasmuch as the city had obtained a grant for labor and wanted to start immediately. A few weeks before, the boss and I had made the scantiest preliminary survey for the PWA application. With this much foundation, I started. Not a stake was in the ground when the job started. I put the men to work digging a trench in the one place that I knew the sewer would be and then went to work to stake out the rest. I now have the situation well in hand. I never expected to have the job dumped into my lap this way; I thought I was being sent here as sewer inspector.

"The pump station extends 18 feet below ground. The upper 10 feet is clay, but the lower 8 feet is sand. The diggers failed to go down vertically and undercut the clay, so that when we got within a couple of feet of the bottom, the sand, drying out, began to slip. After trying various schemes, we finally put the forms for the concrete down in sections and threw the caved-in sand behind them. It sure had me worried. I didn't want anyone buried on my job. I worked in the pit with the men to get the forms in place, and it was enough to give us the jitters. I dreamed of cave-ins at night. We'd just about have everything ready to put a form in place when—swish, about a ton of sand would slide down. We'd stand back and speculate the possibility of the clay overhang crashing down on us; then, deciding that it still looked o.k., we'd dig in like a bunch of beavers to clear away the debris and get the form in before another slide came. After the forms were in place, chunks would slide down back of the forms and boom like a bass drum, just about scaring us to death."—
H. C. D.

They Tore Down All But the Third Floor

"A week ago last Saturday, I was made job engineer on the Van Buren job here in town and for nine days I have been working fourteen hours or more a day seven days a week. All last week we were on double shift.

"The plot is to take three stores and a seven-story hotel, tear them all apart, and put them together again to make a modern store two stores wide and a block long. We tore down everything but the third floor and the north wall, which was left standing four stories high, much to the dismay of the townspeople. As for the other buildings, the plot is to tear out the insides, jack up the roofs, and put a new building inside the framework. To add to the fun, the Van Buren store has to be open for business all during the remodelling. It's sort of like grabbing your britches with one hand, hoisting yourself into the air, putting on tight boots with the other hand, and trying to tighten your belt with your teeth.

"When I started I had a hard time getting over the surprise at having all those big mugs do whatever I told them to do and not tell me to go jump in the lake. They all seem to be great hulking brutes who chew tobacco and have no end of hair on their chests. My biggest trouble is remembering to say, 'Do this,' instead of, 'Don't you think you ought to do this.' They don't think anything; they have to be told every move to make.

"To be really good at the building business, all that a fellow has to know is his structures, masonry, substructures, surveying, geology, hydraulics, drawing, economics, public relations, contracts, social welfare, and medicine. In the past week, three of the steel workers managed to get themselves bunged up and we had to patch them up so that they could get to the doctor. When the doctor asked one of them what had happened, the fellow said that a piece of iron fell on his foot. The piece happened to be a three-ton beam. They had to jack it up to get it off of him, but he was back at work that afternoon. Later he tried to treat the foot himself by soaking it in horse liniment and is now in bed with a pretty ghastly foot.

"If you think a jig-saw puzzle is tough, you should try to figure out a 1500-piece terra cotta front. That's one of my personal headaches."—**C. E. V.**

Men on Construction Have Long Hours

"This job is a fairly large one and consists of building a bulkhead and breakwater about a quarter of a mile out into the lake. I will probably be here two or three months. For fourteen weeks the men on the job averaged twelve hours a day, and my job didn't end until about two hours after that. About a fourteen-hour day was the average; the maximum went as high as twenty! Six days a week, and plenty of weekly and monthly reports to do on Sunday. Not exactly a snap!

"We have been driving batter piles consisting of 16-inch I-beams to support a steel waler against which steel sheeting is set and then driven. The thing I use most out here is the course in substructures, but I am way beyond that course by now. I do a little surveying and compute some earthwork, but most of my time is spent in learning the business. When the job is finished, I will probably go back into the office on estimating."—**C. J. S.**

They Fight Fires by Night

"I believe that I told you I am locating engineer with the U. S. Forest Service. We are in the midst of the fire season, and all other work is considered secondary to fire fighting. We work in the day and fight fires day and night.

"It has been my lot to be transferred quite a bit. March 20, I was transferred here from Morehead, where I was very much at home after a year's residence. This is a small town situated in the mountains of eastern Kentucky and doesn't boast of any of the refinements of modern life. The people seem to be happy in spite of the crude manner of their existence. Although a native of the state, I had never been in the mountains until two years ago. As close as it is, there is a different type of people living here. There is a great difference in manners, customs, and speech within such a short distance. A philosopher would have a fertile field for thought, and plenty of time for thinking here."—**F. J. C.**

Steam and Gas Helped Him

"The outfit for which I am working is modernizing an old refinery which was hopelessly out-of-date. So far my work has had quite a bit of mechanical engineering connected with it. Apparently I gathered more from my steam and gas courses (that didn't show on my grades) than I suspected, as I have not had one bit of difficulty in doing the work required of me. The man for whom I am working is a civil engineer, but he admits that he has gone a long way in mechanical engineering since getting into the refinery business.

"So far I have found that if I resist a temptation to ask a question when things go a bit over my head, a little thought on the subject will clear matters up, and I can avoid showing unnecessary ignorance.

"So far the work has consisted of locating all the pipes that are always full, measuring their length, and computing the storage capacity of the plant; designing a muffler for an exhaust steam-line; designing a separator for the boiler blow-off; designing a clay-treating tower for light gas-oil; and supervising the surfacing of 500 feet of road. There has been enough work to keep me busy and chasing reference books."—**J. T. D.**

EDITORIALS

> ***"No book can be so good as to be profitable when negligently read."***
>
> —SENECA

BE CAREFUL Recently, the papers told how the clothes of one of our graduate students in mechanical engineering caught in a diesel engine on which he was working and whirled him around several times. Finally, his clothes ripped and he was thrown free, bruising his shoulder severely when he landed. He had one chance in a thousand that his head wouldn't hit the concrete floor as he was whirled around.

In this case, the protective covering was off the rotating part so that the test could be performed. As a part of the laboratory courses we take, we frequently use equipment, parts of which are distinctly dangerous; the big reason that such conditions are allowed to exist is that the experiment or test being run could not otherwise be completed satisfactorily. This absolute necessity of working on machinery which is dangerous should bring about a beneficial result. It teaches the student in the laboratory that he must learn to do his experimental work carefully and accurately, using caution and good judgment, so that he will not destroy equipment, or, more important, endanger his own life.

When we are graduated and are out working with some commercial organization, most of us will undoubtedly have to run tests, similar to those we do in the laboratory now, but under much less refined conditions. There will be no instructor to check the wiring used—the only way that we will know it was wrong even after we rechecked it is to have something go up in smoke as a result of a short circuit. No one will stand beside us to watch the way we start an engine and guide us if we are in error. A damaged piece of appartus will be the indicator that something was amiss. And on top of that, the actual working conditions may be bad. The machine to be tested probably will not be out in the middle of a light, airy room, but stuck back in some dark corner with no head room or space in which to move around. There, actual safety conditions will be something to worry about.

We are learning now, under infinitely better conditions than we will encounter after we are out of school, how to do tests and experimental work efficiently, accurately, and safely. Learn to do the work correctly now so that a careful and safe procedure will be a habit whenever you are called on to make experimental runs.

STUDENT "HONESTY" Cheating had begun long before that memorable prehistoric day when some caveman genius whittled out the first pair of bone cubes, fitted them with spots, and made a first tentative pass before his admiring clansmen. Down the march of years it has made much progress, taken on an infinite variety of forms and refinement and, all in all, kept easily abreast of civilization. Nevertheless, it still acknowledges one basic principle, that of taking unfair advantage of one's neighbors.

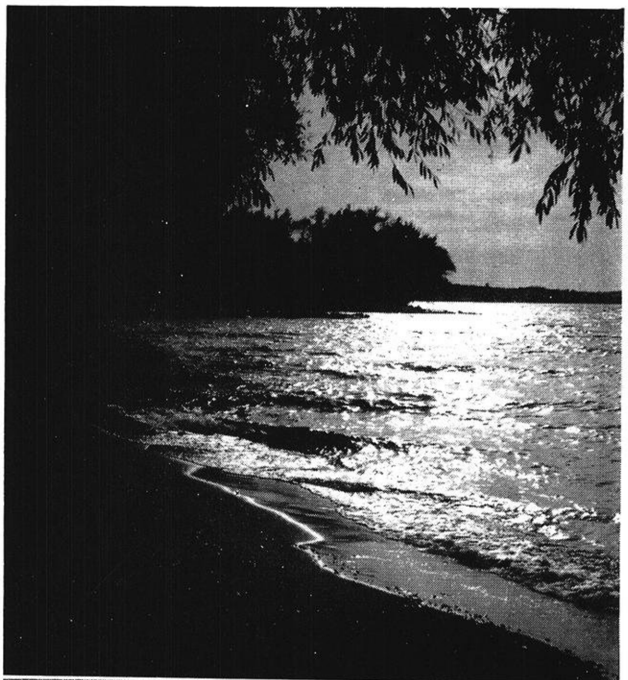
College is no exception. It is our estimation that a considerable portion of the student body of this university, and any other, cheats, cribs, sponges, or copies its way to a degree. Certainly the percentage of those who **never** cheat is small. Few cheat out of desperate necessity; most of those who chisel, and their—or our—name is legion, do so both because of intellectual laziness and the broad opportunities which the authorities in some instances provide for dishonesty.

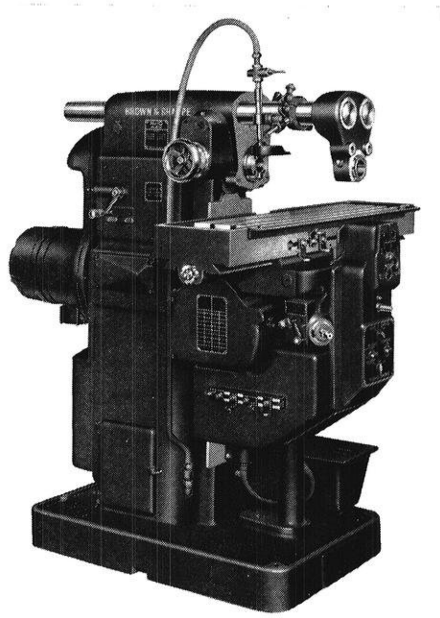
Our quarrel is not with the cheater—in his eyes he is justified, and preaching won't change that. There is a large distinction between cheating in examinations and sponging or copying other students' homework. The person who does the latter is merely cheating himself—he isn't getting his money's worth out of college. The man who practices it in exams is still cheating himself, but he thinks that there it is justified if he can "get away with it." For some generations the pupil-teacher relationship has been one of rivalry; there is in the hallowed custom of examinations an almost warlike code: "The instructor is out to trip us up; it's our job to outsmart him." And so goes the secret war.

The examiners have two defenses—the ancient proctor system and the newer "honor system." In our opinion an honor system is unsound. It relies on a man's honor to reveal his own or his neighbor's dishonesty but actually ends by putting those who live up to it at an even greater disadvantage than those who don't. If you see a neighbor cheating do **you** turn him in, even if to your advantage? You do not. This system forgets that an even older code places loyalty to one's comrades above any other loyalty. Such are the acknowledged duties of the proctor, supposedly an alert, disinterested outsider.

It has been our experience that proctors take too little interest in our proceedings, leaving an honor system without honor. We have sat through quizzes, watching others write with open texts beside them, seen page on page of crib notes, watched boys exchange corrections in each others' blue books, watched others get dishonest marks higher than our legitimate ones, not once or twice, but consistently. These conditions are most prevalent in courses where a large number of students are writing in the same room.

What inducement are we given to be honest? None, not even, through the indifference of examiners, a chance for an even break. To give all students this "even break," we suggest that our exam system be overhauled. Make proctoring more than a gesture, so that the exam grades, which seem to count so much, will give the comparisons they were intended to give.





BROWN & SHARPE

G-E *Campus News*

LIGHTNING STRIKES TWICE

LIGHTNING may strike not only twice but a dozen times in the same place over the same path within one second's time. This is one of the unusual facts that Karl B. McEachron, Research Engineer of General Electric's High-voltage Laboratory, has found out about lightning.

Even more unusual is the new theory that the brilliant lightning flash one observes during a storm is not a bolt from the sky, but a union of a cloud streamer with a similar one from the earth. The action of the air currents and of the falling drops of water separates the charges in the cloud. When the voltage in the cloud reaches a certain value, a streamer starts toward the earth, traveling in jumps at about one-tenth the speed of light. When this streamer is a few hundred feet away, streamers from four to eight feet long begin to form on the surface of the earth. When the streamer from the clouds unites with one from the earth, the flash of lightning occurs. The pressure generated during the passage of current makes the thunder.

General Electric conducts research in lightning so that its engineers can design transmission lines and protective equipment which will insure better continuity of service.

UNIVERSITY CLUB

DAVE PACKARD of Stanford and Otto Schwartz of Columbia played against each other in the Rose Bowl game of 1934, but now they are working side by side in the Schenectady Works of the General Electric Company. This seems unusual until it is pointed out that in the General Electric organization is one of the largest and most cosmopolitan university clubs in the world. Approximately 4500 college graduates, representing 237 American universities, colleges, and technical schools, are employed by the Company. In addition, there are 198 graduates from universities in 22 foreign countries.

Ten educational institutions have contributed more than 100 graduates each to the General Electric family. They are: Cornell, Iowa State, M.I.T., Penn. State, Pratt Institute, Purdue, Union College, U. of Colorado, U. of Michigan, and Yale. Fifteen other schools have provided more than 50 graduates each. They are: Case School, Georgia Tech., Kansas State, U. of Maine, U. of Minnesota, Ohio State, R.P.I., Syracuse, U. of California, U. of Illinois, U. of Kansas, U. of Nebraska, U. of Wisconsin, V.P.I., and Worcester Polytechnic.

DETECTING LIES

PAPA WASHINGTON needed no lie detector; George told the truth. But as a check on less truthful persons, Northwestern University's crime-detection laboratory has developed a lie detector. It makes simultaneous measurements of respiration, blood pressure, and perspiration. Emotional disturbances are reflected in these body functions. And since extremely sensitive recording instruments are needed to record changes in perspiration, the delicate photoelectric recorder developed by General Electric engineers is put to work.

For many years General Electric has made instruments for exacting applications. This same photoelectric recorder is used to obtain a continuous record of temperature in a wire-enameling oven. Electric gauging of ball-bearing diameters, of wire diameters, and of strip thickness is accomplished in rolling mills. These operations and hundreds of others are recorded by this instrument, and with a power consumption of only one thousandth of a microwatt.

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