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OF THE

LOUISIANA

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VOL. XXII, 1936

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PROCEEDINGS OF THE LOUISIANA ENGINEERING SOCIETY

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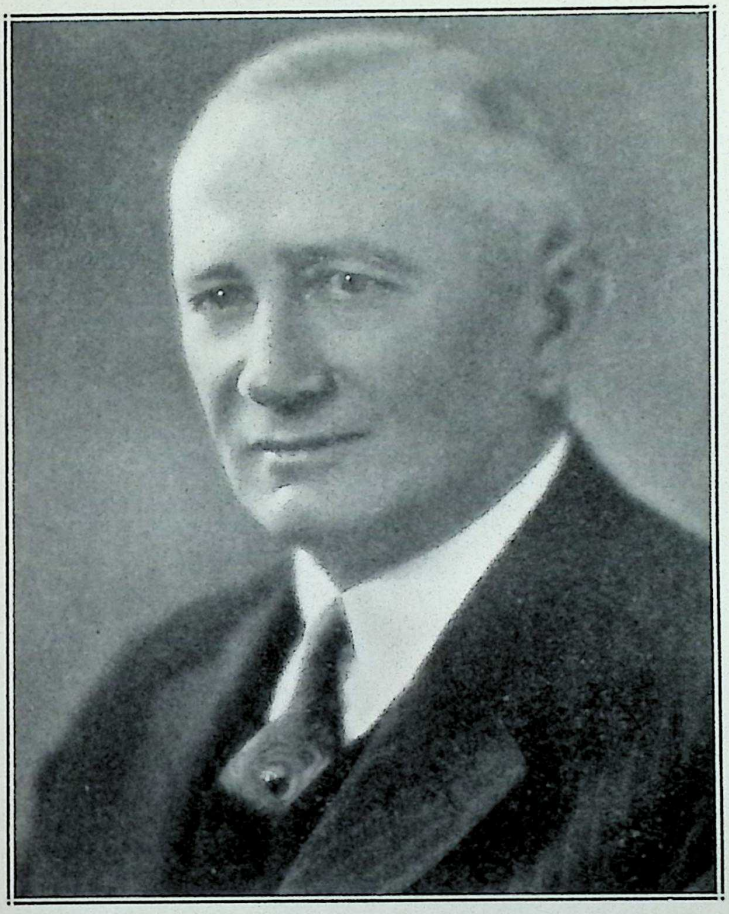

ALLEN S. HACKETT

PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

VOL. XXII. FEBRUARY, 1936 NO. 1

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EDITORIAL NOTES AND COMMENT

Our New President. Major Allan S. Hackett was born on May 30, 1880, in Shreveport, Louisiana. His early education was received in the public schools of Meridian, Mississippi. In 1903 he graduated from Tulane University with the degree of Bachelor of Engineering.

After graduation he was employed by the Southern Railway and Southern Pacific Railroad in Louisiana, Mississippi, and Texas on railroad location. His work with these railroads

also included construction and maintenance for about three years. Later he spent about ten years in the Republic of Honduras doing engineering and contracting work with Vaccaro Brothers, Cuyamel Fruit Company, and the United Fruit Company.

In 1916 he married Miss Madeline Bourne of Cleveland, Ohio. His family consists of five children—four daughters and a son.

During the world war he attended Officers' Training Camp and spent a year and a half over-seas as commanding officer of Company A, 23rd Engineers (Highway and Bridge). After the armistice he was commissioned Major in the Engineer Reserve Corps. In 1919 he returned to New Orleans to live, where he engaged in engineering and contracting for several years. His activities during the last few years have also included considerable consulting practice.

The Annual Meeting. The annual meeting has come and gone and what a delightful affair it was! Never in the history of the Society has an annual meeting been as pleasant, as substantial and effective as the one just passed. The whole meeting truly resolved itself into a "feast of reason and a flow of soul." Many were the distinguished speakers who graced the occasion and the messages they had were messages of real worth.

The excursions were both educational and entertaining. The social affairs were delightful in the extreme. It cannot be anything but a source of extreme gratification to those in charge of the annual meeting to witness the successful outcome of their efforts. The great number of out of town engineers who attended the annual meeting only added to this success.

Starting with registration Friday morning, January 24, there was something of interest going on every moment of the time. The culmination of the meeting was the most successful annual dinner the Society has ever had, Saturday night, January 25.

Those in charge of the annual meeting deserve only the highest commendation, both in their conception and in their execution of this meeting. The successful accomplishment of this meeting meant a great deal of hard work on the part of those in charge. Well did they do their work!

Other Officers for 1936. Professor Charles S. Williamson was elected Vice-President for 1936, and Mr. David W. Godat was elected on the Board of Direction to serve three years. Professor Arthur M. Hill and Walter B. Moses were elected Secretary and Treasurer, respectively. Prof. Claire W. Ricker and Mr. Bernard H. Grehan are the other elective members of the Board, who hold over for one and two years respectively.

Colonel Edward S. Bres as retiring President automatically becomes a member of the Board, taking the place thereon of the preceding retiring president, Professor A. L. Dunlap.

Honorary Membershhip for Dean Anderson. At the annual dinner honorary membership in the Louisiana Engineering Society was conferred on Dean Anderson of Tulane University. Amid great applause he was escorted to the speakers' table by Professor W. B. Gregory, who presented him for honorary membership with the following citation:

> "Gentleman of cultural poise and scholar of the first order.
>
> Teacher of the invisible realities as well as the immutable laws of the known world.
>
> Administrator of a great University, displaying wisdom, tact, and sympathetic human understanding.
>
> Influential force in nation-wide councils for the advancement of learning;—honored head of the society for the Promotion of Engineering Education.
>
> Friend of unwavering fidelity."

At the conclusion of this citation, Colonel Edward Sedley Bres, retiring President of the Society, conferred Honorary Membership on Dr. Anderson.

Frank A. Muth Dies. With extreme regret we have to record here the sudden and unexpected death of Frank A. Muth in Portland, Oregon, January 31, 1936. For almost thirteen years he served continuously as the Secretary of the Society, which office he resigned because of his promotion to the office of Superintendent of Lighthouses, 17th District, in Portland, Oregon. He had hardly started his new activities before his untimely death occurred. We extend our deep sympathy to his family. Resolutions are being prepared and will be published in a future issue of the Proceedings.

A Very Embarrassing Embarrassment of Very Rich Riches. Many, many times the editor of this journal has had to scratch his head in wonderment at where he was to obtain material to print. Very happily the case is not so unfortunate at present. The annual meeting has furnished us with a wealth of material so great that it is impossible to print it all in one number of the *Proceedings*. We shall therefore have the pleasure and profit of the annual meeting extended over a considerable period of time.

In the succeeding issues of the *Proceedings* we shall print the papers which were read at the annual meeting. Due to an unfortunate set of circumstances, entirely beyond control, the present issue of the *Proceedings* has been delayed. In order not to delay further and in order not to make these *Proceedings* more bulky, we are including in this issue only a small part of the total number of papers read. Every effort will be made to get out the succeeding issues on time.

PAPERS AND DISCUSSIONS

HISTORY OF CONSTRUCTION OF THE SEWERAGE, DRAINAGE AND WATER SYSTEMS FOR NEW ORLEANS, LA.

By ALFRED F. THEARD *

Read before the Society December 9, 1935.
Under the auspices of the American Society of Municipal Engineers

For the information of those who may not be quite familiar with the conditions in and around my native city, and to aid them in understanding the many difficult problems which the engineer had to solve during the progress of its development, I give a brief description of New Orleans and its environment.

The location of the great Metropolis of the South was fixed by nature as the point where a great natural system of inland waterways, serving half of a continent, connected with the ocean transportation of the world. This position, at the mouth of a tremendous area, destined to be one of the most important commercial centers of our country, was selected by Bienville in 1718 on the banks of the Mississippi River, some 110 miles from the Gulf of Mexico, as a protection to the city from tropical storms, and on a spot which was thought, at the time, to be a substantial foundation removed from alluvial lands.

The larger portion of New Orleans which lies on the east bank of the Mississippi River, has an area of about 39,000 acres with a flat surface, the greater portion of which is either at or below mean gulf level. It is entirely surrounded by levees, the crest of which is 7 to 24 feet above the natural surface.

The other portion of New Orleans, formerly known as Algiers, lies on the west bank of the river, and has an area of about 11,000 acres, with its surface slightly above mean gulf level.

* General Superintendent Sewerage and Water Board, New Orleans.

The nature of its soil is one of the most extraordinary combination of various formations found anywhere. Under a cover of river sand, deposited there by the floods of the river before the building of protection levees, the territory next to the river is a series of strata varying from blue clay to quicksand, with no fixed order of depth, class, or thickness. The balance of the territory on the east bank, which commences at a point from 5,000 to 6,000 feet from the river, was formerly a swamp with its surface practically level. It is made up of a large percentage of decayed vegetable matter or a mixture of peat and muck. Peat is partially decomposed vegetable matter, while muck has a considerable percentage of silt, clay and sand mixed with well decayed vegetable matter.

The subsidence of such soils is due to three causes: drying, decay and cultivation. Shrinkage, and the subsequent subsidence due to drying, affect mostly the top layer, but this extends in decreasing amounts, as deep as the soil is drained. After drainage, decay of the vegetable material in such soils is rather rapid and it is continuous. Complete decay of the vegetable matter causes some loss of weight and considerable loss in volume, thus gradually reducing the surface elevation of the soil. Cultivation increases the subsidence by indirectly increasing the action of drying and decay. That such subsidence has been in evidence, even before any drainage of any kind existed, is shown by the existence of two or more layers of stumps, underlying existing recent growth now at tide level, in areas which have not yet been drained, all of which have originally grown upon a surface once at tide level, but which has gradually subsided. The rate at which such soils subside is uncertain, but experiments conducted by eminent engineers for the United States Government show that the subsidence has been one to three feet during a period of about eighteen years, depending, of course, on special local conditions.

Besides, our city is subject to an average annual rainfall of about 56 inches, and all of its runoff, due to conditions just outlined above, must be pumped out.

You can readily conclude from the above brief outline of the local conditions that the tremendous advantages, which are

bound to work to the commercial advancement of New Orleans, are equalled by the most intricate problems which the engineer must solve for its sanitary development.

The building of structures with their foundations below the level of more rapid soil shrinkage, and some closer to or at the surface, illustrates the effect and irregularity of soil settlements formerly unnoticed, and the effect of this shrinkage and settlement on the utility and life of structures is one of the most serious of the problems confronting the engineer, both before and during their construction, and later for their maintenance.

Previous to 1880, we find very little evidence of any fruitful attempt from the engineering standpoint to develop New Orleans. Its death rate was 28.6 per thousand and its reputation was not the best, due to its unsanitary conditions, lack of drainage, sewerage, and an adequate water supply, and its danger of yellow fever epidemics.

At or about that time, an effort was made to start its sanitary improvement. The old waterworks company began the installation of filters, and the municipal authorities granted a franchise to a private corporation for the installation of a system of sanitary sewers. A little later a serious movement was started for the building of a drainage system which culminated in 1893 in the organizing of a force under guidance of the City Engineer, to make a complete topographical survey of the City of New Orleans and to gather the data necessary to the formulation of a complete modern system of drainage.

It was the first topographical survey of the city, and it gave valuable information. It was made under the direction of the City Engineer, Mr. Linus W. Brown, and an advisory committee of eminent engineers of high reputation, Messrs. B. M. Harrod, Henry B. Richardson, and Rudolf Hering, and it gave to the city the foundation for the projecting of all of its future sanitary works, all or the greater portion of which are now an accomplished fact.

Up to that time, it was deemed sufficient to adopt makeshifts, one after another, to accomplish some immediate ends and to benefit small disconnected sections.

The result had naturally been a somewhat incoherent and crude system of drains and canals, insufficient in size, depth, and slope; a disposal of the water through main channels and outfalls objectionably located; inefficient methods of pumping; in fact, a bad system, based on erroneous information or no information at all.

It was evident that New Orleans was steadily advancing in size and importance, and that means had to be made available, in proportion to its growth, to better its streets, its railway service, its lighting and water supply, its pavements, its sewerage, its drainage, and its general sanitary condition. This had to be based on well digested plans, designed to provide for future development. This first topographical survey supplied the initial information.

It was my good fortune to be connected with this preliminary work of importance as chief draftsman, and to have continued uninterruptedly my professional connection with the formulating of plans, and construction of the sanitary systems of New Orleans during these forty years.

This has made the building of these great public improvements practically my life's work. As my personal efforts and professional services have been devoted to my employers, I am going to review, briefly, the progress of the construction work completed to date by the Sewerage and Water Board. This is the agency which, through its distinguished officers has had official charge of the expenditure of the funds dedicated to the construction of modern drainage, sewerage and water systems for New Orleans.

The original body, the Drainage Commission of New Orleans, was created by legislative enactment in 1896, and, with a limited bond issue, was authorized to build a drainage systeh for the city. Subsequently, the city petitioned for and obtained the creation of the Sewerage and Water Board, providing it with a continuing tax for the construction and extension of the drainage, sewerage and water system, with an authorized bond issue of some twelve million dollars.

This new body absorbed the Drainage Commission and subsequently found itself in a position to increase its bond indebtedness to thirty million dollars.

It continued to advance the construction of the sanitary improvements, and today, with a total expenditure of some sixty-three million dollars, due to its good methods of administration of its finances, the city has over 754 miles of water mains, reaching about 99 per cent of the premises of the city with domestic supply and fire protection; over 652 miles of sewers, reaching about 96 per cent of the premises of the city with a sanitary sewerage system; and over 920 miles of drainage canals and pipe lines giving drainage, proportionate in its perfection to the development of the areas served, to the entire area within levees, about 50,000 acres, with a population of over 490,000.

In the solution of these sanitary problems, it became evident to the engineers that a separate system of storm and sanitary sewers would be economical and desirable.

The storm waters must be handled through very large arteries, due to the extraordinary tropical rainfalls (sometimes 3 to 9 inches in 24 hours, and once 14 inches in 18 hours) and the size of the territory served, and pumped into tide level outlets north of the city with a lift of from 5 to 15 feet.

Sewerage could be handled through comparatively small conduits and must be discharged at a point below the center of the city into the Mississippi River against a head varying from 35 to 100 feet including friction in the discharge mains.

This was an important factor in the design of the storm and sanitary sewers.

First, as to the sanitary sewers:

In the design of its sewerage system, no startling or novel departures have been employed or attempted by New Orleans. Well known and accepted principles, such as have stood the test of years of practical use and operation, have been the basis; the interests at issue and the financial investments being too large to trust to untried methods, however correct and adaptable in theory.

Fixing the territory to be covered in the plan, the present and future population, the probable varying densities of such population in different portions of the city, the probable amount of sewage, both from house sewage and ground water, to be taken care of, these important factors were combined and reduced to a convenient form for the determination of the general plan and the size of sewers required for different areas.

It is impossible in this paper to go into a full detailed description of the sanitary sewer system; suffice it to recite its important features.

For all large areas or 2,000 acres or more, it was assumed to have 62½ per cent. of the total run-off of house sewage and full run-off of ground water, which is about 1,000,000 gallons per square mile of seepage. Areas of 200 acres or less are assumed to have full run-off of both house sewage and ground water. Population is estimated at 50 per acre for ordinary residential areas, and up to 115 per acre in dense business sections.

The unit of the system is an eight-inch pipe (probably 87 per cent. of the total mileage of the system) increasing in size to the largest circular main built of brick, and having an inside diameter of 7 feet.

Where natural conditions contribute so little to grades, it was decided to fix a minimum slope of one foot in 450 feet for an eight-inch sewer and the bulk of the sewer system is designed to that grade.

With an initial velocity of 2 feet per second in the laterals, the velocity is gradually accelerated, increasing with the size of the sewer, until it reaches over 3.5 feet per second in the largest mains.

Recognizing the importance of flushing, flush tanks are usually not left to automatic flushing, but are flushed several times in quick succession two or three times a year. House flow and ground water take care of this pretty well.

The question of transportation of sewage in such flat graded sewers, and for such long distances to its ultimate point of disposal, necessitated the construction of intermediate pumping stations, eleven in number. For these intermediate lift

stations, which must be in operation twenty-four hours each day, the question of attendance, screening of sewage, removal of screenings, had to be met or eliminated. A design for a centrifugal pump was worked out by the mechanical engineer of the Sewerage and Water Board, which can pass any object which enters it, will pass a 12-inch ball or any amount of water carrying flexible trash, rags, etc., without obstruction or decrease in efficiency. These stations were equipped with this type of centrifugal pump, and are automatically operated without cost of attendance, or nuisance of screening, or removing of screenings, and their operation is entirely successful to activate the gravity flow. The final point of disposal is into the river below the center of the city where, when mixed with even the minimum discharge of about 200,000 cubic feet per second of the Mississippi River, the sewage, thus amply diluted, borne down stream from the city, will never be dangerous or offensive.

Of its water supply the following description can be given:

There is a river low lift pumping station to force water from the river through the two double 48-inch pipes, 4,000 feet long, to deliver it to the Purification Plant in times of very low water in the river.

The first step in purification is the removal of the heavier particles which will settle out promptly by passage at a very low velosity through grit chambers; next lime and sulphate of iron are added and automatically proportioned to the amount of water being treated, as it is passed, at a sufficient velocity to prevent deposit and promote effective mixing, through about a mile of mixing passages.

Leaving the mixing passages with the necessary reactions completed, the water passes into and through the coagulating reservoirs, where nearly all of the suspended matter and bacteria, originally carried, and much of the carbonates of lime and magnesia originally in solution, as well as the coagulating chemicals, are deposited. Overflowing from the coagulating reservoirs, the water passes to the filters, which are of the rapid gravity sand type, and with the assistance of the ammonia and chlorine treatment, which remove the last traces

of turbidity, the objectionable bacteria are 99.9 per cent. eliminated.

This process has, continuously, since 1909, purified the water of a very muddy stream containing an average of 650 parts per million of very fine suspended matter, and 2,500 bacteria per cubic centimeter, giving to New Orleans a softened supply of clear water showing an average of only 1.5 per cent. of bacteria per cubic centimeter, and complying fully with the rigid tests of the United Etates Public Health Service as to its sanitary quality.

After filtration, the water is delivered to the distribution system by direct pressure pumps, or sent to the clear water storage reservoirs by low lift pumps for future delivery to the distribution system. Seventy pounds pressure is maintained at the Waterworks Pumping Station and usually not less than 60 pounds pressure is shown at remote points on the distribution system.

The former capacity of the Water Purification Plant was 40,000,000 gallons per day, but this has been increased to 112,000,000 gallons per day to afford a reserve capacity and to meet future demands.

Existing overhead power lines, 102,000 linear feet; underground power lines, 164,970 linear feet. Capacity of waterworks station, 27,000 K. V. A. Interchange capacity, 11,000 K. V. A.

There are ten drainage stations equipped with pumps varying in type from centrifugal to screw pumps, with horizontal or vertical shaft, of different makes and capacity, some submerged and others not, with a total pumping capacity of 27,000 cubic feet per second, all electrically operated, mostly from the Waterworks Pumping and Power Station, where there are now available 35,000 horse power of electric generators.

The unit of the drainage system was fixed at a 10-inch pipe with a slope, when obtainable, of one foot in three hundred feet, to take care of the run-off of about one-third of an acre, and at the rate of run-off was fixed at 20 to 80 per cent of the rainfall for suburban and improved areas, respectively.

In our spongy soil, the rate of run-off varies materially in proportion to the condition of prolonged drouth or rain which precedes any rainfall, especially in the unimproved sections, and this factor is an essential one to be considered in fixing the ultimate size of the large arteries built to serve each area.

A minimum slope of one foot in 2,500 feet was fixed for all large canals.

It is important to show you just how a steady progress was made in the design of the drainage canals and connections and to explain why a gradual change was made from brick conduits to reinforced concrete structures and from vitrified clay pipes to concrete and reinforced concrete pipes.

The first contract for the construction of a portion of the drainage system was let in 1897 for a central electric power station, three pumping stations, and several miles of lined and covered canals.

This central power station I believe was the first important structure of its kind built on a pile and concrete foundation in New Orleans. Some twenty-two hundred piles 50 to 65 feet long were driven about 3′0 centers and a monolithic concrete slab 4′ 0″ thick 140′ x 180′ was poured over the piling.

This contract included the construction of large and small drainage canals.

Subsequent lettings included more pumping stations and additional canals, pipe lines and connections, until we secured the very fine, though uncompleted, system of today.

Originally, specifications for sides of canals provided for brick retaining walls and bottom to be constructed of concrete made of portland cement, sand and shells of specified thickness, upon which the retaining walls should be built after the concrete had been allowed to set for at least four days. The portion between the walls was covered with a polished surface ¾″ thick, composed of portland cement and sharp sand in the proportion of one to one.

Contracts were awarded in 1902 for additional pumping stations and canals. Specifications provided that all lined and covered conduits should be covered, at the option of the engineer, with beams and arches, or with slab construction of a

combined use of concrete and steel in the shape of expanded sheets or rods. Tests were to be made to determine the satisfactory strength of the slabs at a time not less than 28 days after their completion, bottom to be as previously described, of concrete with one to one surface finish.

It was during the progress of this work that we decided to cover our drainage canals with reinforced concrete slabs, and finally abandoned the I-beam and brick arch construction.

We experimented, of course, on the method of pouring these reinforced slabs as well as on the kind of reinforcement used. We made some use of expanded metal, but were partial from the very start to deformed steel bars.

Subsequently, about 1904, we built the first reinforced concrete lined and covered canal, and this, I believe, was the first monolithic reinforced concrete structure of its kind built in New Orleans.

I have mentioned already the special formation of our soil and endeavored to explain why we must overcome so many difficulties during the progress of our construction work.

Quicksand, in New Orleans, is composed of the very finest particles of rounded sand which will flow freely through the smallest openings whenever there is an excess of water (and the least pressure) to carry them. The alluvial formation of the soil, by overflow from the Mississippi River, accounts for the extreme fineness of all of this sand, all of the coarser particles having been sorted out and deposited by the river long before it reached New Orleans.

In the sponge-like soils, subject to an absorption of a large percentage of ground or seepage water, such quicksand creates unusual difficulties, the more so when a trench is excavated in an undrained area. But it is so even in areas which, due to open canals and improvements, have had the moisture line reduced.

I remember that in the central area, where improvements had already lowered the moisture line, we were called upon to install a large reinforced concrete canal, some 12 to 25 feet wide, with all of its branches and connections. As our work was progressing about one mile from the river, we happened to

cross a vein or stratum of quicksand, just about the period of the year when the Mississippi River was at its highest stage. This vein of quicksand down in the trench was approximately 20 feet below the level of the water in the river. No pumping could keep the water out of the trench. It was finally decided to concentrate the flow through a small barrel head connected to the trough carrying this flow of water some distance away. By careful attention, the reinforced concrete bottom was poured around this barrel head and after full set this was plugged and the hole was concreted over, leaving the water to continue flowing where it did before. This work, executed 20 years ago, was effective for there has been no further trouble at this point.

Often, when sheeting or sheet piling is driven to protect the trenches, signs of sloughing below our bottom rangers develop. We pump out and fill the pit with a cheap grade of concrete. But one of the most troublesome questions to solve has been to prevent settlement or subsidence over the back-filled trench after the work is done.

The original design of the storm sewers provided a substantial space between the back of the sidewalls and the sheet-piling. This space had to be backfilled after completion of the work. While the specifications provided for careful backfilling, we have reached the conclusion that the tamping or ramming of local clay back filling is utterly futile, and the flooding of such backfilling, to compact it, is worse than futile.

The volume occupied by a given amount of local clay will vary with the amount of water which it contains, and puddling with water only increases the amount of subsequent shrinkage as the added water gradually escapes. The roots and stumps or peaty matter in our soil in large quantities are subject to even greater shrinkage than the wet clay, and they decay and gradually revert from organic to inorganic matter with great shrinkage of volume. With this special problem in mind at the time that it was my good fortune to be placed in charge of drainage construction work, a new method of construction was designed eliminating the space back of the canal walls.

This new section has many advantages. It is true that the wooden sheeting left in the trench must be abandoned, but the

width of excavated trench is reduced, and this eliminates completely the chance of any subsidence due to back filling.

This has been found so satisfactory, that no suggestions have as yet been advanced for a change in methods of construction. That is the cause of the new section.

You will note that no change has been made in the construction of the large drainage canals because nearly all our large covered canals have been or are being built in former open canals where the driving of sheet piling for back form is not practical.

The present section is that of a reinforced concrete canal 28′ 6″ wide. It is the widest reinforced lined and covered canal in our system.

Vitrified clay pipe had been in use for all subsidiary drains up to the year 1917. At or about that time, the concrete pipe manufacturers asked to be given a chance to compete, provided tests made of concrete pipe would prove satisfactory.

As an enthusiastic partisan of all concrete products, I was very glad to have our office get the opportunity to conduct these tests.

The results were eminently satisfactory, so much so that the specifications were prepared, fixing the requirements for concrete pipe, and these were included in the city specifications, giving the city the right to select either vitrified clay or concrete pipe for all city contract work.

Since then, concrete has been given the preference for large pipes.

But while concrete was rapidly improving and gaining support, the manufacturers of vitrified clay pipe made such wonderful improvement in the manufacture of this class of pipe that it stands, certainly, today, as a more than serious competitor with concrete pipe, due to its smoothness, its strength, and its general true cast.

In soils such as have been described above, there are certain serious objections to the construction of reinforced concrete structures in the trench. However carefully conducted the work may be, the position of the reinforced metal is more

or less uncertain, and this may vitally affect the strength of the structure. The very fact that a sewer or large conduit is built in the trench, makes it difficult to assure proper inspection. The presence of light defects in the concrete itself may lead to serious results. This difficulty is more serious when the trench is in ground of a soft, treacherous nature, with veins of quicksand appearing where least expected and rendering the maintenance of an open trench almost impossible.

For this reason alone, if not for any other, it has been my opinion that, when such can be secured, precast reinforced concrete structures are more desirable in our soils.

With the ideas expressed above and the natural difficulties encountered in endeavoring to maintain the alignment of the open canals which must necessarily serve as drainage arteries in the suburban areas until such time as the improvement of such areas justify the expense of constructing lined and covered canals, it became rather an important question how the banks of these canals could be supported or how to prevent sloughing of the side slopes.

A partial solution was found in building a wood lined channel, offering a V-shaped channel for the delivery of the daily flow and the run-off from small storms.

This was so constructed as to form a beam holding th base of each side slope and preventing initial slides. Bu these structures get old, and they called for expensive maintenance as they grew older before the time was opportune to replace them by permanent work.

Here again it became incumbent upon the engineer to devise some other method to serve as a part of a future permanent structure while serving indefinitely as part of a temporary channel for storm water.

It was then decided to build reinforced concrete tongue and groove sheet piling. This was successfully accomplished, and this sheet piling is now being driven so as to form the sides of a permanent reinforced concrete channel called upon to act as a carrier of a large flow between our main pumping stations.

It is rather soon to express an opinion on the success of this type of construction, but it seems to have all the elements

that will make it the best adapted to our conditions. Its proven success will result in changing the type of construction of our large canals, and allow for an increase in their ultimate width, if the development and population of our city and its improved areas justify it.

With these unusual difficulties confronting us on every side, the best and most economical forms of development in many directions for most other cities are, for New Orleans, most costly and disappointing in their results. The ultimate price which we must pay to develop and maintain a great city on a soil which was not, by a few thousand years of natural development, ready for such use, will necessarily be large and increasing, as we utilize more and more the tide level areas, where the effect of soil shrinkage will be at its maximum.

Our climate conditions are known to all. We live within the temperate zone, and while we occasionally have a low record, the thermometer has very seldom been below freezing during our short winter (sixty to ninety days), and during nine or ten months of the year, it hovers around 65 degrees Fahrenheit. This, coupled with the fact that our permanent structures are underground, renders the question of providing expansion joints negligible.

Such a view was taken by the engineer in charge when our first reinforced concrete canal was built twenty years ago, and the question has never been considered since, as, even when nature provides small cracks in the concrete, they are considered of no consequence, there being no intention of making our drainage canals waterproof. The effort to obtain imperviousness in our structures is, in my opinion, more desirable in sanitary sewers.

This is probably the only drainage system of its kind in the world. Some claim has been made that Holland with its dikes, and surrounded by the sea, was placed in a position similar to that of New Orleans, but I believe this is not quite true, because its soil formation is somewhat different; its most modern deposits consisting of alluvial wind-blown sands and peat, and its moisture line being very near, and never more than 4 feet below, the surface.

Soil conditions outside New Orleans are not very different from those found in the city, but we have had less experience with them. We know, for instance, that a white sand stratum can be found under the surface, at a varying depth of one to fifteen feet, on a line say three miles south of the present shore line of Lake Pontchartrain, and extending in a northeasterly direction across the city until it meets the present shore line. We know that mixed with this white sand, (which, after screening, can be used as a concrete sand), were found sea shells, of various sizes and description, a further evidence that this was, in prehistoric times, the shore line of the lake.

With all, the construction of our great sanitary systems has progressed and New Orleans is fast taking its rank with the large modern cities. Its death rate has been reduced to 16.00 per thousand; its commercial development has been phenomenal; its population has increased to over 490,000, or nearly 100 per cent. in 40 years, and its splendid location and port facilities have advanced it to the rank of second port of the United States. This, in no small measure, is due to the public spirited devotion of its citizens, its true American spirit, and the arduous work of the engineering profession.

DISCUSSION

MR. HAMMETT: What sewerage or drainage waters do you discharge into Bayou Bienvenu?

MR. THEARD: Strictly the drainage, but only a part of it; only the first storm wash. After it is formed we pump it right down into Bayou Bienvenu. The balance is pumped out into Lake Pontchartrain. What we pump there is perfectly clear water.

MR. BRES: We notice that some of the paved streets are gradually sinking. For instance, Palmyra, General Pershing and Walnut streets. Will these streets and other streets continue to fail or has this condition now become stable?

MR. THEARD: These streets were paved several years ago and I think that it is due to lowering of the moisture line and the natural subsidence of the soil.

MR. BRES: Why is there an additional subsidence on the new paved streets which have been gravelled for years and in which catch basins and drainage have been in continued use?

MR. THEARD: It depends on the conditions before the subsidence.

MR. BRES: On some of the streets where there was gravel, since the streets were paved, all the sidewalks are sinking.

MR. THEARD: I don't like to "pass the buck" to anybody, but we have had supervision of drainage only since 1903, that is after we went to the legislature. We were ordered to have supervision of all subsidence and drainage. It was then that we took possession of drainage outlets. Before then there was drainage in a few sections of the city.

MR. BRES: How much can we expect the ground to subside?

MR. THEARD: Three feet in 18 years. That is my own experience.

MR. BILLINGSLY: I can understand now why we have to have another contour map made.

MR. THEARD: Some parts of the city were supposed to be the same elevation as the level of the gulf and the lake. Now we have elevations four feet below that. I have found elevations 17 and 17.5 Cairo Datum. You can imagine how hard it was for us to devise a drainage system for New Orleans. The lake front, with an elevation of between 17 and 19, and bring it back within 3 and 4 miles. We had to prepare a special intake to provide adequate gravity flow to our lake station back of the City Park.

MR. DERICKSON: Mr. Theard, does the subsidence of three feet which you mention cause objectionable sag in the minor lines? Does the pipe line go down and form a reverse hump or sag or does the grade maintain itself in the pipe?

MR. THEARD: Yes, it is generally uniform, but the subsidence is generally in the former swamp areas. It varies in accordance with soil formation to a depth of about 12 feet. You can find evidence of subsidence of that character. That has been confirmed, I think, by experiments made by the United States engineers. We confirmed it by our own observations.

MR. STEINMAYER: About two years ago the newspapers carried an article quoting Dr. Cline, and to the best of my recollection, he stated that no area of the City of New Orleans was below sea level.

MR. THEARD: We found the same condition at Citrus as we found at Lake View. We found a subsidence of nearly five feet. We found an elevation of about three to five feet below gulf level. We do not know whether it was due to a particular soil formation or not, but as a rule we found a number of places back of the Ridge with elevation of 17 and 18½ C. D. instead of 21 and 21½ C. D. twenty years ago.

MR. DUSENBURY: Is Broad Street at sea level?

MR. THEARD: Broad Street was apparently at 20 Cairo datum. This was below gulf level.

MR. DUSENBURY: Does that difference prevail all the way?

MR. THEARD: Yes.

MR. DUSENBURY: That section has not subsided very much has it, Mr. Theard?

MR. THEARD: I don't think that section has subsided at all.

MR. DUSENBURY: Will the lines that have subsided tie into the lines that have not subsided?

MR. THEARD: When the original drainage plan was formulated, we developed an idea to take advantage of the existing conditions by using the gravity flow. That was practical at Broad Street. At Broad and Canal Streets the elevation at that time was slightly below twenty. It is that yet. In fact we were 21 feet below elevation 41 C. D., which is the high water of the river.

MR. BRES: Didn't I hear you say that some parts of Lakeview had subsided to below sea level?

MR. THEARD: At Lakeview is that sand stratum. It is not that of which I spoke. It was at pumping station No. 7. The engineers did not agree with us at that time. The specifications provided for driving piling through the sand. We allowed the contractor to screen that sand and use it for concrete. When this

stratum passes Paris Avenue it is at the surface, then it deepens again and goes right through to Little Woods. In other words, my idea and the idea of others is that that was the original lake front. Between that and the actual lake front, I found a large number of piles or trees about 12 feet under the ground. There were many stumps that had been cut off probably in some prehistoric time.

MR. BRES: Will the present program take care of drainage in Lakeview?

MR. THEARD: Yes. We expect to have an answer as to when it will begin within the next few days. Under the rules of the Sewerage and Water Board, we have to advertise bids for work over a thirty-day period and that would bring the letting of the contract up to the 31st of March.

MR. BILLINGSLEY: Some years ago some of the stations were put out because of heavy rain. I think it would be interesting, Mr. Theard, if you would explain why.

MR. THEARD: Tomorrow at 12:15, we are going to let bids for the furnishing of underground cables.

If the bids are satisfactory, this contract will be let. We rejected bids last year because the bids were too high. We have about 102,000 lineal feet of underground lines and about 160,000 feet of overhead lines now. In the meantime, in order to avoid interruptions, we have completed an interchange arrangement with the New Orleans Public Service. We can interchange power in case of an accident. On the 26th of November we had an interruption of the water service when the water was cut out of our homes for 72 minutes. It was not because we do not have an emergency hook-up. It took nearly half an hour before we could shut off the valves and put the new current on and operate the lines to give service. If we had done it without wiping off the lines we would have had an explosion. It was said that during that time the whole city was without fire protection. There were 14,000,000 gallons of water in the pipes. They were not moving because there was no pressure to move them. There was no lack of fire protection at that time. The engines could have

pumped out of those lines for seven hours before the water would have gone down.

MR. GREVENBERG: Are the drainage stations all served by underground electric cables?

MR. THEARD: Yes.

MR. GREVENBERG: In this interchange with the Public Service will you be able to make an interchange at the main pumping plant and individually at each of the plants there?

MR. THEARD: The interchange is at the station D, the power is distributed to the other stations.

MR. GREVENBERG: Can you make it interchange at more than one point and if so wouldn't it be advisable to make the interchange at more than one point?

MR. THEARD: It may be but it would cost a great deal of money. It can be done, however.

MR. EARHART: Mr. Theard answered the question I was about to ask. I am glad he brought up the question of the supply of water in case of fire. The report was a mistake. There was enough water for the engines to draw from and they can draw the water at any time. In case of an interchange with regard to the breaking of the pump, I am going to ask the Board to appropriate some money for that interchange. The workmen should be complimented on their work at the time of the break down. They worked very quickly under the conditions.

MR. GREGORY: We have all listened to the very find paper of Mr. Theard and I hope that it will be published with all of its figures in the Louisiana Engineering Society *Proceedings*. I am sure that this hope is expressed by all of us here. I want to tell you about the two pumps that have been presented to Tulane University within the past year. The Sewerage and Water Board saw fit to have made a model of the drainage pumps, the largest of which are 14 feet in diameter and handle 1,000 cubic feet each. The model of this pump, designed under Mr. Baldwin Wood, is now in the laboratory of Tulane University ready to be tested. The model is beautifully built and as well designed as a model could be made. We are going to give

it a complete test. Each of these pumps has a motor to drive it arranged as a dynamometer. We expect that future engineers turned out by Tulane University will be familiar with the pumps and other machinery used by the City of New Orleans for drainage. Scores of graduates of Tulane University have contributed to the splendid work that Mr. Theard has told us about tonight.

MR. ROBERT: It must be a source of considerable satisfaction and pride to a man like Mr. Theard to have started with a proposition as he started with it, and see that brain child of his grow and grow into what it is today. We owe Mr. Theard a vote of thanks. And we of the Engineering Society owe the Municipal Engineers a vote of thanks for bringing Mr. Theard here.

Another good test of your blood pressure is to have a friend borrow your money to buy himself something you can't afford.—Illinois State Register.

Conditions are rapidly improving, it is true, but there's still a detour sign at the entrance to Easy Street.—Atlanta Journal.

As we understand it, the French want America to swallow their defaulting with good grace, and use their wines for a chaser.—Greensboro (Ga.) Herald-Journal.

So live that if everybody followed your example the blackmailers would starve.—Springfield Union.

If you know how to spend less than you get, you have the philosopher's stone.—Benjamin Franklin.

Talent develops itself in solitude; character, in the stream of life.—Goethe.

Our doubts are traitors, and make us lose the good we oft might win, by fearing to attempt.—Shakespeare.

We shouldn't be surprised if France sends us a bill for storage on our money she's keeping.—Atlanta Journal.

THE MISSISSIPPI RIVER FLOOD CONTROL PROJECT IN LOUISIANA, AND ITS PRESENT STATUS

By JOHN KLORER *

Read at the Annual Meeting, January 24, 1936.

Notwithstanding an unusual amount of publicity given to the Flood Control Project of the Mississippi River, there are nevertheless many intelligent persons, including engineers, who have only a hazy conception as to what the flood control problem comprises, and as to what is being done toward solving it.

The work being done constitutes one of the major activities in the field of public works in this country. It is being executed under the direction of the U. S. Engineer Department. Local communities represented by State Levee Boards, participate only to the extent of furnishing rights-of-way required by the U. S. Government. Consequently, it would have been in my opinion better by far to have had a paper on this subject presented by one of the U. S. Engineers, not only from the standpoint of hearing authoritative statements made by someone in charge of the work, but also from the standpoint of relieving me from an embarrassing position of apparently reporting on the work of other engineers. My protests were overruled by your program committee, and with the consent and approval of General Ferguson, the President of the Mississippi River Commission, and Colonel Carruth, the District Engineer in charge of Flood Control Work for the Second New Orleans District, I am making this presentation.

The great flood of 1927 focussed the attention of the engineers in charge of the Mississippi River flood control work on the important fact that they had greatly underestimated the magnitude of the future floods which governed the height of the levees that they were building. The determination of a new estimated future flood was necessarily the first step to be taken in the planning of future work.

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* Chief Engineer, State Board of Engineers.

It is true that in the past consideration of this subject of the ultimate high water to be expected, the total of possible contributions of floods from the tributary streams, as determined by the past performances of these respective tributaries, had been footed up, and this total was not only impressive but to some of us, fearful. Nevertheless the thought prevailed—the wish being father to the thought—that a combination of a main stream flood condition with abnormal tributary effects, both in their number and in their volume of discharge, such as occurred in April, 1927, was such a remote contingency that it was impracticable to provide against it, particularly in the face of comparatively limited appropriations for flood control and with due regard to considerations of economical justification of expenditures.

This thought still maintains, though to a lesser degree, in the present plan of flood control. For example, the sum total of the maximum discharge of the upper Mississippi River as measured at Thebes, Ill., 46 miles above Cairo in 1903, and of the maximum discharge of the Ohio River as measured at Metropolis, Ill., 36 miles above Cairo in 1913, amounting to 2,500,000 cubic feet per second, is discounted to 2,250,000 second feet for the future maximum flood flow at Cairo. This quantity compares with 1,800,000 cubic feet per second, the estimated discharge of a confined 1927 flood at that point, or equivalent to a 25% increase, which the U. S. Weather Bureau states is a factor of increase that is relatively high for a drainage area of 894,700 square miles.

As we progress further down stream the magnitude of the flood provided for in the present flood control plan increases, and as expressed in terms of discharge is placed at 2,850,000 second feet at the latitude of Arkansas City, Ark., and at 3,000,000 second feet at the latitude of Red River Landing, or Angola, La. These figures are estimated to present a 25% and a 20% increase, respectively, over those of 1927.

The problem presented in its simplest terms was this: With a levee system capable of carrying between levees only about three-fourths to two-thirds of these future discharges, what should be done to provide for the additional discharge of approximately 900,000 second feet?

It was doubtful from the beginning that the long-observed practice of revising levees grades upward to meet the increased flood heights could be resorted to in meeting the new condition. At Arkansas City, the computed maximum gage reading at that point for the confined 1927 flood was 69.0 feet—or 11 feet higher than the previous highest water. At Vicksburg, the computed maximum gage reading for the confined 1927 flood was 62.7 or 7.9 feet higher than the previous highest water. At Red River Landing, the estimated confined 1927 flood would read 61.5 or 6.2 feet above the previous highest water. At Carrollton, the estimated confined 1927 flood would read 24.6 or 3.3 feet higher than the previous highest.

These increases in flood heights were equal to or in excess of the accumulated increases in flood heights that had taken place in the forty-year period beginning with the memorable flood of 1882 and terminating with the previous highest flood of 1922. Moreover, if provision was to be made for a flood 25% or 20% in excess of the 1927 flood and which was to be confined between levees, these increases in flood heights must be further supplemented by an additional four or five feet.

The prospect of taking care of future floods by levees alone did not look encouraging. The yardage contents involved were stupendous; for it must be remembered that the contents in a levee section increases as the square of the height, and to raise a 20-foot levee to a new height of 30 feet means the placement of more yardage than is present in the existing levee. There was in addition a well-grounded opinion among the farmers and planters that high levees while keeping the river off the adjacent land, did not keep the seepage from appearing in the fields with the consequent damage and sometimes loss of growing crops. This condition prevails even under present levee heights, for several thousand feet back of the levee, the ground being so saturated that it does not respond to the usual efforts made to facilitate drainage by ditching. Higher levees holding out higher waters would aggravate this condition.

There were engineering objections also to further increasing the height of the levee. In this connection, it may not be amiss to digress for a few moments to point out the limitations

of levees as applied to flood protection. An earthen levee is one structure not built to conform to the usual requirements that the analysis of the forces at play would seem to dictate. In this respect, it is unlike a concrete or masonry dam. In the latter instance provisions against settlement of the structure; provision against any underflow taking place; and provision for adequate width of base to prevent overturning, cover almost all the requirements that safety demands.

But in the case of an earthen levee, while it is true we have a structure, the integrity of which is not affected by any settlement of the foundation—a structure which is incorporated in the foundation upon which it rests by clearing, exploring and preparing the surface of that foundation,—a structure that opposes the lateral pressure of the water it holds out by its weight and does this with a factor of safety of more than 15 to 18—yet levees fail. They fail on account of a disintegration that takes place in the cohesion of the materials constituting the levee which is brought about by the infiltration or absorption of water, and there is no factor so potent in bringing about this disintegration as is a greater head of water against the levee. There is, therefore, a certain practical height which it is not considered good judgment to exceed in levee building.

The development of the present levee cross-section is the result of a "cut and try" method to find such section as will contain the slope of saturation within the land side slopes of the embankment. The earlier levee cross-sections provided for an 8-foot crown and side slopes of three on one. With levees higher than 16 feet, and during protracted high-water periods, the lower portion of the land side slope would become soft and wet for nearly one-half of its slant height. If the material in the embankment was other than stiff clay, it would not stand in this wet condition on a slope of one on three and the lower part of the slope would slough off, taking a flatter angle of repose, but generally leaving a ruptured surface which presented a steeper slope than that which originally sloughed off. When this occurs it is then only a question of a few hours before a second slough takes place and a levee failure is imminent

unless this particular section is given the usual treatment of blanketing the river slope with additional earth so as to build riverwards the section of levee threatened and thereby advance the saturation line in the same direction, i. e., away from the land side slope.

Experience and observation prove that there are three factors that are mainly responsible for a greater or lesser degree of seepage or wetness in levee sections having the same dimensions. One is the duration of the extreme flood stages, another is the height or head of water against the levee, and the third factor is the class of material of which the levee is built.

This is a convenient place to mention that the present standard levee section being built under the Adopted Plan of Flood Control is no longer defined as one having a specified width of crown, with slopes of a special ratio of vertical to horizontal measurement, as was customary in the past, and which practice justified the criticism that the "Standard Section" took no cognizance of a standard, or less than standard, material. The present standard section is one having an increasingly flatter landside slope as the height of the levee increases, and having an even still flatter slope than the above condition imposes, depending on whether the material of which the levee is built is clay or loam or sand. As an illustration, taking a levee 25 feet in height, the theoretical saturation line causes a variation in the land slope of the embankment from 1 on 5.24 for clay material, to a slope of 1 on 7.05 for sandy material. In this standard section the land side slope of the embankment is a function, so to speak, of the saturation line—a much more intelligent procedure than observing the arbitrary formula previously used.

Recognizing the limitations of earthen levees for flood protection purposes as set forth above, together with the fact that a considerable mileage of the up-state levees already exceeded 25 feet in height, engineers familiar with the problem readily concurred in the conclusion that some means must be found to take care of the excess water of a super-flood other than by increasing the heights of the levees. From this basic and fundamental requirement there was evolved a plan that has since

become known under the various titles of: The Army Plan; The Jadwin Plan; The Adopted Plan.

The Adopted Plan.

That part of the Adopted Plan that applies to the portion of the Mississippi Valley, lying north of the mouth of the Arkansas River, is of lesser interest to the people of Louisiana and a discussion thereof can well be omitted for that reason as well as for the reason of time limitation. For that portion of the valley lying south of the mouth of the Arkansas River, the Adopted Plan provides for the Mississippi River levees to be improved by enlarging their cross-section, and by adding about 3 feet to their height and for passing between levee lines such flood-flow as can safely be passed by this means. The surplus or remainder is to be passed through diversion floodways on the west side of the river, selected on that side for topographical reasons. One of these floodways, called the Boeuf Floodway, begins a short distance below the mouth of the Arkansas River and extends to the back-water area at the mouth of the Red River, a distance of about 150 miles. The other floodway is known as the Atchafalaya Floodway and extends from Old River to the tide level lands below Morgan City, a distance of 120 miles. The diversion of surplus flood waters from the main river through these two floodways is supplemented by a controlled spillway to serve a similar purpose known as the Bonnet Carre Spillway, located 27 miles above New Orleans, and which has a discharge capacity of 275,000 cubic feet per second into the tide level waters of Lake Pontchartrain.

The Adopted Plan provides that the surplus waters of the flood enter the Diversion Floodways only at extremely high stages and by overtopping a comparatively long length of low levee constituting the head or entrance of the floodway. This length, 35 miles in extent in the case of the Boeuf Floodway and 29 miles in the case of the Atchafalaya Floodway, is designedly kept from being improved in order that it be relatively weaker than the rest of the levee line, thereby receiving the name of "fuse plug levee." The withdrawal of surplus water through the Bonnet Carre Spillway is brought about in

a different manner, there being in that instance a humanly controlled entrance device or opening that regulates the quantity of discharge.

As stated above, the Boeuf Floodway begins just below the mouth of the Arkansas. In this vicinity the Adopted Plan provides for a flood flow of 1,950,000 cubic feet per second to pass down the Mississippi River at a gage reading of 62.5 on the Arkansas City gage. It might be said incidentally that this quantity is nearly 200,000 cubic feet per second more than was passed at that point in 1922, which was the highest flood previous to 1927. All waters in excess of the 1,950,000 cubic feet per second (and in the project flood amount to 900,000 cubic feet per second) will pass over the crest of the fuse plug levee, thereby bringing about its blow-out or failure, and will pass on down into the Boeuf Basin, being restrained from creating a general flooded condition in that Basin, by the Boeuf Floodway Guide levees. These waters finally reach the backwater area at the mouth of the Red River, but only to find this area already partly occupied by the inflow from the Mississippi River at Red River Landing of such waters as are in excess of the carrying capacity of the Atchafalaya River and of the Mississippi River below Red River Landing.

The addition of tributary run-off south of Arkansas City, after allowing for deductions for floodway storage and for river-basin storage, gives a discharge of 3,000,000 cubic feet per second as the total quantity to be taken care of at the head of the Atchafalaya Basin, sometimes referred to as the latitude of Red River Landing. At this locality the Adopted Plan provides for the passage of 1,500,000 second feet down the Mississippi River at a reading on the Red River Landing or Angola gage of 59.5. The remaining 1,500,000 second feet is to be taken down the Atchafalaya Basin in the following manner:

The Atchafalaya River between its leveed banks is to take care of 500,000 cubic feet per second, and two floodways with fuse plug entrances, one eight miles long on the west side and one twenty-one miles long on the east side of the Atchafalaya levee system, will take care of the remaining 1,000,000 cubic feet per second required to meet the superflood conditions.

These double floodways in the Atchafalaya Basin merge into one floodway below the end of the levee system on the Atchafalaya River, and conduct the surplus flood waters through the area of numerous lakes, bayous and rivers that traverse the Atchafalaya swamp from Krotz Springs to Morgan City.

The Adopted Plan apparently ignores the serious situation created by bringing to the vicinity of Morgan City a flood volume far in excess of the discharge capacity of the natural channel through Berwick Bay and leaving this volume of water to find its way to the gulf the best way it can.

It is believed that the above outline gives a fairly good idea of the Adopted Plan of the Flood Control Act. The plan permitted flexibility in its execution to meet special conditions and it is only fair to state that the U. S. Engineers were generous in their interpretation of the provisions of the act, when they consistently could do so. As an illustration, one of the most annoying problems confronting communities in the Atchafalaya Basin was the prospect of having their drainage canals interrupted by a continuous line of levee in the floodway. This was successfully solved by the U. S. Engineer authorities requiring land side pits for floodway levee construction to be excavated in accordance with dimensions and grades to serve drainage purposes, with the result that these communities have better drainage facilities now than they formerly enjoyed.

In so far as this portion of the valley in which we are directly interested is concerned, we find the Adopted Plan has been advanced well towards completion and almost within schedule time. The Bonnet Carre Spillway has been completed; 75% of the Atchafalaya Basin Floodway levees are under construction or under contract and the bank revetment work is probably equally well advanced. The only item of major importance that has not progressed is the construction of the Boeuf Floodway. Here the work of the United States was halted by court action brought by Mr. R. Foster Kincaid, owner of land in the Boeuf Floodway, restraining the United States from building the Boeuf Floodway levees before first making settlement with him for flowage rights or damages. The long observed custom of not holding any governmental

authority, state or nation, responsible for Mississippi River flood damages, was assumed by the United States Government as justification for the Flood Control Act not providing for payments of damages to property located in the floodway. The case was a test case, and apparently the United States Supreme Court leans to the view that flowage rights or damages will have to be paid for, but did not so express itself, rendering its decision against Kincaid on the point that he could not insist on receiving payment for damages in advance of sustaining those damages. The case is a very much involved one with fine distinctions interesting to the legal fraternity, and is too lengthy to go into at this time. It is admitted by all parties that this litigation has had the effect of stopping all work in the Boeuf Floodway.

It is desired now to invite attention to certain proposed modifications to the Flood Control Act of 1928 as recommended by the Msisissippi River Commission and as approved and submitted by Major General E. M. Markham, Chief of Engineers, in a letter to the Committee on Flood Control of the House last February. I quote the summary of these recommendations from the letter above referred to as follows:

"(a) A complete revision of the floodway plans between the Arkansas and the Red Rivers to reduce area sumberged in extreme flood, by eliminating the Boeuf Floodway and substituting therefore a floodway on the east side of Macon Ridge, with a controlled inlet in the vicinity of Eudora, and a back protection levee extending from this floodway north to the Arkansas River.

"(b) A revision of the floodway plans in the Atchafalaya Basin to provide for additional protection of the valuable lands at the head of the basin east of the Atchafalaya River, by a floodway with a controlled inlet above Morganza.

"(c) The protection of the developed lands at the southern end of the Atchafalaya Basin by an extension of the protecting levees and the construction of a new outlet to the gulf.

"(d) Acquisition of flowage rights in floodways at reasonable costs with a limitation based on total 1934 assessed value.

"(e) The adjustment of drainage works at Federal cost as made necessary by levee construction.

"(f) A 6-year program of work to increase the flood-carrying capacity of the river channel between the Arkansas and the Red in the middle section of the river, and of the Atchafalaya River in the southern section, and a continuation of bank stabilization.

"(g) Flood-control works in the St. Francis and the Yazoo Basins to protect against the recurring floods of tributaries to which these areas are now exposed.

"(h) The construction of roads on levees, to facilitate their better upkeep and to provide accessibility in flood emergency. This in addition to road adjustments agreed upon in connection with floodways."

It was urged that these recommendations might have been incorporated in a bill and enacted during the past session of Congress, but the Flood Control Committee of the House, where the bill originated, became hopelessly divided over some of its details and the session closed without it having been reported out of the committee. Senator John Overton has just introduced a bill embodying these recommendations and hopes to have it passed in the Senate at the present session of Congress.

At the hearings conducted by the Flood Control Committee of the House on these proposed modifications, considerable opposition developed against the substitution of the Eudora Floodway for the Boeuf Floodway by property owners in the parishes through which the Eudora Floodway passes, to-wit: East Carroll, Madison, Tensas and Concordia. At first it appeared that the dissatisfaction arose on account of the proposed basis of payment for flowage rights, namely, one and one-half times the assessed value, but it appears that this was not the only objection. The anticipated curtailment of parish

revenues due to the reductions in assessments on account of revised values to be given to lands in the floodway area, was represented as affecting the ability of the parishes to meet interest payments on the School District Bonds, Drainage District Bonds, and other obligations issued by these parishes. The presence of the floodway through these parishes was considered by the protestants as a deterrent to any future development of the parishes. *So strongly did they feel over this proposed project that influential and representative citizens and landowners in the various parishes expressed themselves as being satisfied* to take a chance on the occasional levee failures and overflows with the levee system as presently existing, rather than live in this district with a river levee in front of them and a floodway levee behind them. They were not willing to believe that the solution of the problem necessarily rested with a Diversion Floodway and urged that the reduction in flood heights be obtained by means of reservoirs to be constructed on the Arkansas and White Rivers and by the fullest development of cutoffs on the Mississippi River between the Arkansas River and the mouth of the Red River. The Chief of Engineers was requested by the Flood Control Committee to advise it as to the possible reduction in flood heights that might be expected from these two methods. He stated that the Mississippi River Commission had made a study of available reservoir sites in the valleys of the Arkansas and White Rivers and had found thirteen sites suitable for the purpose on each of the two tributaries, or twenty-six potential reservoirs in all; that the estimated cost of constructing these reservoirs was $126,719,000 as against $103,000,000, the estimated cost of the Eudora Floodway; that for a 1927 flood their effect would be to reduce the outflow at Arkansas City by 330,000 second feet and this was estimated to correspond to a reduction in stage of four feet. The estimated high water elevation of a confined 1927 flood is 68.9 on the gage at Arkansas City and of the superflood, if confined, 73.1. Consequently, after allowing for the reduction in flood height attributable to the 26 reservoirs, a confined 1927 flood would be 2.4 feet higher than the 62.5 ultimate height of water proposed to be carried down the main river at that point, and the project flood would be 6.6 feet higher. So that this excess height represents the reduction

in flood height that must be accomplished by cut-offs, plus reservoirs, in order to obviate the necessity for the Euroda Floodway.

The Chief of Engineers, while admitting certain reductions obtainable by means of cut-offs, would not commit himself as to what the quantitive effect would be on *crest stages,* nor did he give any estimate of the costs of making the cut-offs.

This reference to "cut-offs" brings to our notice the most impressive, audacious and gratifying feature of the entire flood control plan. Impressive, because it upsets the policy and theory of many, many years; audacious, because it challenges the right or custom of the river to select its own path down the valley and lays down its future course with chain and transit; gratifying, because it justifies the judgment of many engineers who labored hard and long for an Experimental River Hydraulic Laboratory with a view to substituting the application of scientifically observed results for tradition and folk-lore ideas that previously ruled in dealing with the river.

It was an accepted fact from time immemorial that the result of a cut-off was to introduce abnormal slopes both upstream and downstream, and that when a cut-off occurred, the river immediately set to work to readjust the flood slopes back to normal by caving the banks upstream and downstream in an attempt to recover the lost length of river. A cut-off was considered such a disturbing factor in maintaining the regimen of the river that it must be stopped from occurring by all means. A classic instance was the threatened cut-off at Cowpen Neck, just above Natchez, which was fought year after year for the past forty years, and millions were spent to hold the bank revetment in Giles Bend to prevent such a cut-off occurring. The justification for these expenditures was the preservation of Natchez as a river city, which distinction it was alleged it would lose if the cut-off occurred and a sand bar formed on its water front. Not only that, but the anticipated bank caving following such a cut-off would destroy the town of Vidalia across from Natchez on the Louisiana side of the river. The important fact overlooked by members of the old school of thought was the difference between a cut-off located by design at a certain spot and with a predetermined direction, as compared with a cut-off allowed to take

place anywhere on the long frontage of a protruding neck of land. Had the river been permitted to make the cut-off where indications pointed that it naturally would, it is possible that the dire consequences predicted might have resulted.

Cowpen Neck Cut-Off was made by dredges at a selected location and on a selected course in the spring of 1933; the 1935 freshet enlarged its cross-section. It is now carrying 30% of the river flow with the Natchez gage reading 50 feet, about 6 feet lower than the highest stage, and there is no tendency evident either of Natchez losing its river frontage or of the town of Vidalia caving into the river.

General Ferguson, President of the Mississippi River Commission, deserves much credit for the initiative, energy and courage displayed in making the cut-offs, but it is safe to say that the U. S. Waterways Experiment Station at Vicksburg was a powerful ally in creating the confidence required to take such a decisive step as lopping off 100 miles of river in a total length of 370 miles.

The study of cut-offs was undertaken by the laboratory as a part of a river stabilization plan and it was hoped that the results of the study might show that the Mississippi River Commission could be relieved of a high maintenance expense on the existing bank revetment in the bends without having to incur the equivalent expenditures on revetments or on other works in new locations as a result of the cut-offs. The indications are that this objective has been attained. In connection with the studies made, unexpected results developed as regards the behavior of flood-slopes. For example, it was noted that the influence of the cut-off, in lowering the flood plane, was confined to that portion of the river lying upstream from the cut-off. The up-stream lowering effect tapers out in a distance anywhere between 50 and 100 miles. Contrary to prevailing opinion, no piling-up effect takes place downstream from the cut-off. This fact is corroborated in the results of several hundred sets of observations.

The laboratory experiments also indicate that taking a flood equivalent to that portion of the project flood that is to be passed down the Mississippi River, i. e., 1,950,000 second feet at Arkansas City, and following the operation of four cut-offs, viz: at

Leland Neck, Tarpley Neck, Linwood Neck and Ashbrook Neck, (all in the vicinity of the Greenville Bends and comprised between river miles 445 Below Cairo and 488 Below Cairo) the accumulated total of lowering was 10.44 feet at mile 443. The reduction tapers upstream to 3.60 feet at mile 414 Below Cairo and tapers down-stream to 0 feet at mile 488 Below Cairo.

These are the laboratory results that give hope to the citizens living in the Eudora Floodway that the necessity for a floodway may be obviated and the flood taken down the main river by means of cut-offs combined with the lowering to be accomplished by the twenty-six reservoirs previously referred to. But it must be remembered that these striking reductions in the flood-flow line are obtainable only where such unusual conditions prevail as exist in the Greenville Bends. Here the river bends sinuously back and forth for a length of 35 miles to accomplish an airline distance of 9 miles. The lowering of the flow-line as shown above increases the discharge capacity materially of that part of the river above referred to. It makes it possible for the river to carry much more water between the river levees than the 1,-950,000 second feet provided for in the project,—that is to say, it makes it possible to do so, for a short distance. But the elimination of the Boeuf Floodway, or of the Eudora Floodway, requires an increase in discharge capacity not only for the 80 miles between the mouth of the Arkansas River and Greenville, but also for that part of the river extending some 290 miles further to the latitude of Red River Landing, in which length the possible cut-off locations are not as numerous, nor as favorably situated to give results anything like those obtained in the locality known as the Greenville Bends.

The crux of the cut-off's effect is set forth in the laboratory report as follows: "Investigations conducted on the ten cut-offs described in this report lead generally to the conclusion that a lowering of stages will result in immediate up-stream reaches, while, immediately below, except as lowered by the next cut-off downstream, the same stage will be preserved as before.

To provide for increase discharge therefore a considerable increase in levee heights would be necessary downstream before any advantage could be taken of the additional capacity that the

cut-offs would give in the short stretch of river affected by them. To translate this statement into quantitative terms, it is noted that the profile developed in the laboratory for passing a flood of 2,473,000 cubic feet per second (which represents the magnitude of the confined 1927 flood) with and without the ten cut-offs, shows a maximum lowering of 9.36 feet at river mile 443 (37 miles above Greenville), but lowering of only 1 to 5 feet, and reaffirms the correctness of engineering judgment in providing for a Diversion Floodway.

Whether or not this floodway will be constructed, depends on the attitude of the present Congress on a question that concerns not only the landowners in Northeast Louisiana but those in Southeast Arkansas as well as those in the Delta section of Mississippi from Rosedale, Miss., south for a distance by river of approximately 160 miles. Unquestionably the people living in the Louisiana area are in the unfortunate position of being the victims of a topographical situation of which the people in Arkansas and Mississippi are the beneficiaries. Congress may take the people of the Fifth Louisiana Levee District at their word in their statement that rather would they be occasionally overflowed than consent to the construction of the Eudora Floodway, and thereby save $103,000,000. Or Congress may decide that the interests of the adjacent states are of sufficient importance to order the condemnation of the right-of-way for the floodway and proceed with the work in spite of local opposition. It will be a difficult decision to make on account of the question of equity involved, as this equity will not be entirely satisfied with the provision for just compensation for damages and losses sustained, and also on account of the human equation entering into the question to a very large degree.

No description of the Flood Control Work executed in the lower end of the valley would be complete without some reference being made to the seventeen million cubic yards of dredging operations conducted in the Atchafalaya River discharge into a well defined route to Grand Lake. Some of these dredging cuts are through a tenacious Red River yellow clay formation that extends across the floodway, and the removal of which to the

proper depth, will facilitate the rapid movement of Atchafalaya River water to Berwick Bay.

In the early nineties it was feared that the Atchafalaya River was increasing too rapidly and should be throttled. Two submerged sill dams were placed near its head to limit the diversion of water from the Mississippi River going that way to the gulf. At that time the end of the levee system was not far below the town of Melville, 32 miles below its head. Under this condition, and no doubt assisted by the effect of crevasses, velocities during high flood stages of approximately 46 feet on the Simmesport gage varied from 7 to 7.5 feet per second. With the subsequent extensions to the levee system of about 24 miles, the more recent high waters with gage readings of 50 at Simmesport and with no crevasses seldom yield velocities greater than 5.0 to 5.5 feet per second. The increase in discharge has not been commensurate with the increase in cross-section, and, therefore, something should be done to steepen the hydraulic gradient down the Atchafalaya River. The dredging being done and to be done from Whiskey Bay to Grand Lake will assist in creating a drawdown effect extending perhaps as far upstream as the head of the Atchafalaya with a consequent increase in velocity and discharge. The proposed improvement of the channel capacity of the Atchafalaya River will have far-reaching possibilities. It will, for one thing, assist in lowering the back-water in the area at the mouth of Old River with the accompanying benefits to some of the lands now submerged by back water during ordinary floods. It may eventually result in creating a river of sufficient discharge capacity to eliminate the necessity for the West Atchafalaya Floodway entirely.

In conclusion, I wish to say that the day for the completion of flood control on the Mississippi River is in sight. That day will mark the end of a conflict between man and the river that has been going on ever since the white settlers came in the valley. In the last half century the puny efforts of the individual having proven to be pitifully inadequate and unsuccessful, it was necessary to combine the organized efforts of communities and commonwealths to fight the floods of the river. As time went on and as progress towards a greater degree of safety than that pre-

viously enjoyed seemed about to be accomplished, there would occur a greater flood than any previous flood to wipe out the margin of safety so eagerly sought, and so nearly obtained, and a new start had to be made, in the face of difficulties more formidable than those previously experienced. This occurred again and again. But in 1928 a new order of things began—National recognition of a National obligation was obtained, the valley states no longer would be expected to protect themselves from the run-off of the vast territory comprising thirty-one states and lying tween the Alleghenies and the Rockies. Ample funds were made available by Congress; ample and competent engineering talent was supplied by the United States, and instructions given to put the big job through. The foremost contracting firms in the country were assembled to exercise their wits and talents in developing a new technique for handling earth. This they have done eminently well. In the execution of the Flood Control Works of the Mississippi they have achieved a record of 124,000,000 cubic yards of earthwork constructed in one year, a construction performance that will serve as "high water mark" so to speak for future construction work many years to come. It will be recalled that the highest record achieved on the Panama Canal was 4,000,000 cubic yards of excavation a month. The highest monthly yardage of earthwork constructed on the Mississippi River Flood Control Project was 14,281,000 cubic yards in August, 1933. In this great accomplishment we may well doff our cap to the contractors as well as to the engineers.

DISCUSSION

By Lieut. Col. John H. Carruth *

During the past three and a half years, that is to say, during the incumbency of General Ferguson as President of the Mississippi River Commission, there has been carried on by the Vicksburg and Second New Orleans Engineering Districts, under his direction, a comprehensive and intensive program of channel stabilization of the lower Mississippi River, and this work is still in progress.

* District Engineer, Second New Orleans District.

The channel stabilization program may be broadly divided into two parts, namely, contraction works and corrective dredging. The contraction works are sand dykes which are being constructed at selected points for the purpose of causing a deepening of the channel and stabilizing the channel at the increased depth. The corrective dredging has consisted of dredging over shoal stretches of the river for the purpose of creating and maintaining adequate channels through these stretches; and dredging to produce cut-offs. These cut-offs have been referred to in length by Mr. Klorer in his address. Their ultimate value in increasing the flood discharge capacity of the river, and thereby lowering flood stages, has not yet been completely established and will not be until the program of General Ferguson is completed. There is, however, no question as to their value in improving navigation by eliminating long and tortuous bends which are difficult to keep open to navigation, by improvement of channel conditions, and by the shortening of shipping distances on the river.

The cut-off program of General Ferguson now includes twelve cut-offs, of which five are located in the Second New Orleans District and seven in the Vicksburg District. One of these, Yucatan, is a natural cut-off, which occurred in the latter part of 1929; the other eleven have been made by dredging. All have been completed with the exception of two, namely, Rodney Cut-Off in the Second New Orleans District and Sarah Island Cut-Off in the Vicksburg District. These two are under construction. The cost of the twelve cut-offs has averaged approximately $1,000,000.00 each, but they have more than paid for themselves because they have resulted in the elimination of the need for about forty-five miles of bank revetment for which the maintenance cost for the next fifty years would be approximately $45,000,000.00.

It is interesting to note that the average length of each of these twelve cut-offs is 3⅓ miles each and the average river distance through the bend which the cut-off replaces is 11⅔ miles, from which the average saving in river distance is 8⅓ miles per cut-off. The twelve cut-offs are included in a stretch of approximately 300 miles, and upon completion of the two

still under construction the total river distance will be shortened by them 100.6 miles.

The following is a tabulation of the twelve cut-offs and of pertinent data on each:

Name	Opened	Distance in Miles: Across Neck	Around Bend	Net Shortening
1. Glasscock	Mar. 26, 1933	4.8	15.6	10.8
2. Giles	Mar. 25, 1933	2.9	14.0	11.1
3. Rodney		4.1	9.9	5.8
4. Yucatan	Fall of 1929	2.6	12.2	9.6
5. Diamond Point	Jan. 8, 1933	2.6	14.6	12.0
6. Marshall	Mar. 12, 1934	3.1	7.3	4.2
7. Willow Point	Apr. 8, 1934	4.7	12.4	7.7
8. Sarah Island		3.2	8.5	5.3
9. Worthington	Dec. 25, 1933	3.8	8.1	4.3
10. Leland	July 8, 1933	1.4	11.2	9.8
11. Tarpley	Apr. 21, 1935	3.6	12.2	8.6
12. Ashbrook	Nov. 19, 1935	1.9	13.3	11.4

MEMBERSHIP LIST

C. M. : Charter Member
H. M. : Honorary Member
L. M. : Life Member
N. R. : Non-Resident Member
R. A. : Resident Associate Member
R. Aff. : Resident Affiliate Member
N. R. Aff. : Non-Resident Affiliate Member
J. : Junior Member
N. R. J. : Non-Resident Junior Member

JAMES R. ADAMS, (N. R.), (1911), Assistant State Engineer, Lake Providence, La.

FELIX L. ALCUS, (1922), President, Felix L. Alcus, Inc., 632 S. Peters St., New Orleans.

LEWIS SCHERCK ALCUS, (1922), 7902 Plum St., New Orleans.

LESTER F. ALEXANDER, (1915), Engineer and Contractor, 834 Audubon Bldg., New Orleans.

DOUGLAS S. ANDERSON, (H. M.), (Jan. 1, 1909), Professor of Electrical Engineering and Dean of the College of Engineering, Tulane University, New Orleans.

SAM VERNON APPLEWHITE, (1927), Engineer, with J. W. Billingsley, 702 Interstate Bank Bldg., New Orleans.

JEROME C. BAEHR, (J.), (1930), Junior Engineer, U. S. Engineer Office, 522 Lowerline St., New Orleans.

A. F. BARCLAY, (1908), Chief Engineer Public Belt Railroad 5670 Rosemary Place, New Orleans.

MALCOLM H. BARNES, (J.), (1933), Engineer, 5528 Hurst St., New Orleans.

WADE BARNETT, (1910), Civil Engineer, Sewerage and Water Board, 6117 Loyola Ave., New Orleans.

RAYMOND P. BASSICH, (R. Aff.), (1923), Manager, New Orleans Blue Print & Supply Co., Inc., 826 Union St., New Orleans.

CHARLES DREWRY BATSON, (N. R.), (1928), Manager, Republic Creosoting Company, Mobile, Ala.

R. H. BAUMBACH, (R. Aff.), (1911), Manager Eugene Dietzgen Co., 318 Camp St., New Orleans.

CECIL N. BEAN, (1922), care of Capt. H. C. Koch, Orleans Parkway, New Orleans.

DANIEL M. BEARD, (1926), 4323 Carondelet St., New Orleans.

JAMES D. BECK, (1916), Consulting Engineer, 2331 Constance St., New Orleans.

BEN H. BELL, (1920), Operating and Electrical Engineer, New Orleans Public Service Inc., 4604 S. Derbigny St., New Orleans.

CHARLES A. BENDER, JR., (R. A.), (1933), Lubrication Engineer, Gulf Refining Co., 1729 Marengo St., New Orleans.

MERRILL BERNARD, (N. R.), (1917), 2619 Woodley Place, Washington, D. C.

F. N. BILLINGSLEY, (1915), Consulting Engineer, Billingsley Engineering Company, 702 Interstate Bank Bldg., New Orleans.

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C. M. BOWMAN, (N. R. Associate), (1935), Engineer, 221 Royal St., Baton Rouge, La.

SHIRLEY C. BRASELMAN, (1919), Vice-President, American Creosote Works, 1305 Dublin St., New Orleans.

EDWARD S. BRES, (1925), Scott & Bres, Contracting Engineers, 311 Maritime Bldg., New Orleans.

JAMES P. BRODTMAN, (R. Aff.), (1932), Gulf States Creosoting Co., 901 United Fruit Bldg., New Orleans.

A. J. BROUSSEAU, (1935), Engineer, Jefferson Lake Oil Co., 1931 S. Dupre St., New Orleans.

LAWRENCE C. BRUNE, (J.), (1933), Engineer, Federal Land Bank, 2546 Conti St., New Orleans.

LOUIS M. BUJA, (1922), Construction and Civil Engineer, 7820 Spruce St., New Orleans.

JACOB THOMPSON BULLEN, (N. R.), (1925), Parish E. R. A. Engineer, Webster Parish, Minden, La., 913 Dalzell St., Shreveport, La.

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SOLIS SEIFERTH, (1927), Architect, Secretary-Treasurer, Weiss, Dreyfous and Seiferth, Inc., 600 Maison Blanche Bldg., New Orleans.

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ARTHUR M. SHAW, (Nov. 14, 1910), Engineer-Examiner, P. W. A., 1529 Jefferson Ave., New Orleans.

HERBERT M. SHILSTONE, (1932), Consulting Chemist, 1662 Valmont St., New Orleans.

HERBERT M. SHILSTONE, JR., (J.), (1933), Testing Engineer, Shilstone Testing Laboratory, 301 M. and M. Bldg., Houston, Texas.

ARTHUR F. SHUEY, (N. R.), (1928), Roseland Box Co., Roseland, La.

HARRY H. SHUTTS, (N. R.), (1935), Member of firm, F. Shutts and Sons, 915 Cleveland St., Lake Charles La.

JOHN A. SIBSLEE, (N. R.), (1915), Petroleum Engineer, 1923 So. Wheeling St., Tulsa, Okla.

WALTER S. SIMPSON, (J.), (1933), Engineer, 19 Audubon Place, New Orleans.

HENRY F. SIRGO, (J.), (1932), with Todd Dry Dock, Engineering and Repair Co., Inc., Engineering Division, 1215 St. Anthony St., New Orleans.

LESTER C. SMITH, (1920), Vice-President, Doullut & Ewin, Inc., 901 Queen & Crescent Bldg., New Orleans.

T. BAKER SMITH, (N. R.), (1919), Civil Engineer, Houma, La.

JOHN Y. SNYDER, (N. R.), (1918), Engineer, 902 Delaware St., Shreveport, La.

W. HOBSON SPAAR, (1934), Office Engineer, State Board of Engineers, 5705 Willow St., New Orleans.

LEROY AUGUSTUS STAPLES, (1931), Structural Engineer, with Geo. P. Rice, Consulting Engineer, 5101 Pitt St., New Orleans.

DAVID STAYER, (J.), (1933), with R. C. A. Victor Co., 219 White Horse Pike, Audubon, N. J.

JOHN J. STEADHAM, (N. R. Aff.), (1912), Supervisor, Bridges and Buildings, N. O. & N. E. R. R. and N. O. T. Co., 308 Newman St., Hattiesburg, Miss.

REINHARD A. STEINMAYER, (1925), Associate Professor of Geology, Tulane University, 7933 Oak St., New Orleans.

F. W. STEVENS, (L. M.), (Oct. 14, 1909), Manager, New Orleans District Sales Office, Allis-Chalmers Mfg. Co., 1124 Canal Bank Bldg., New Orleans.

LAWTON T. STEVENS, (R. Aff.), (1931), Sales Engineering, 588 Walnut St., New Orleans.

DAVID WHYTE STEWART, (1920), Chief Engineer, Market Street Station, New Orleans Public Service Inc., Market and So. Peters Sts., New Orleans.

H. H. STOCKMANN, (J.), (1935), Engineer, 5665 Ada Place, New Orleans.

BRUNO STOLLEY, (N. R. Associate Mem.), (1933), with Shell Petroleum Corp., Houston, Texas, 630 Napoleon Ave., New Orleans.

HERBERT C. SWAN, (1923), Assistant Engineer, Sewerage and Water Board, 6316 Magazine St., New Orleans.

IRA W. SYLVESTER, (L. M.), Mar. 25, 1901), Consulting Engineer, Rapides Bank Bldg., Alexandria, La.

PAUL EDWARD TERROY, (R. Aff.), (1934), Chief Inspector for Hartford Steam Boiler, Inspection and Insurance Co., 205 Fairway Drive, New Orleans.

ALFRED F. THEARD, (Jan. 1, 1898), (C. M. and H. M.), Drainage Engineer, Sewerage and Water Board Bldg., New Orleans.

S. A. THEARD, (N. R.), (1920), Engineer and District Sales Manager, Oyster Shell Products Corp., Inc., Morgan City, La.

J. FRASER THOMSON, (J.), (1933), Assistant Professor of Mathematics, Tulane University, 135 S. Genois St., New Orleans.

STEWART TICKNOR, (N. R.), (1922), Civil Engineer, 155 Royal St., Baton Rouge, La.

JAMES M. TODD, (1923), Consulting Mechanical and Electrical Engineer, 315-317 Balter Bldg., New Orleans.

LOUIS M. TOGNONI, (J.), (1933), Graduate Student, Tulane University, 4609 Arts St., New Orleans.

JAMES F. TOMPKINS, (N. R.), (1932), Engineer, Tennessee Coal, Iron & R. R. Co., Carnegie Steel Co., Box 159, Houston, Texas.

NELSON W. TREMBLAY, (J.), (1933), M. & E. Engineer, Lago Oil & Transport Co., Box 817, San Nicholas Aruba, Netherland West Indies.

J. H. TREPAGNIER, (J.), (1933), Engineer, 1424 Henry Clay Ave., New Orleans.

SID E. TROUARD, JR., (J.), (1928), Assistant Electrolysis Engineer, New Orleans Public Service Inc., 317 Baronne St., New Orleans.

WILDAY TUDURY, (J.), (1933), 2522 Palmer Ave., New Orleans.

W. O. TURNER, (1931), Chief Engineer, Louisiana Power & Light Co., 142 Delaronde St., Algiers, La.

THOMAS H. TUTWILER, (L. M.), (April 2, 1898), Retired, 1488 Vinton Ave., Memphis, Tenn.

LUCIEN T. VIVIEN, JR., (1926), Construction Engineer, with Gulf Refining Co., Maison Blanche Bldg., New Orleans.

WM. VON PHUL, (N. R.), (July 1, 1908), President, Ford, Bacon and Davis, Inc., 39 Broadway, New York, N. Y.

ALVIN A. VOSS, (N. R. J.), (1929), Civil Engineer with U. S. Coast and Geodetic Survey, Chief Draftsman Resettlement Administration, Box 195, Milton, Fla.

FRANK H. WADDILL, (L. M.), (April 2, 1898), Consulting Civil Engineer, 407 Tulane-Newcomb Bldg., New Orleans.

GEORGE D. WADDILL, (1911), Assistant Engineer, U. S. Engnieer Office, 7433 Maple St., New Orleans.

RICHARD E. WAGNER, (J.), (1933), Engineer, 1818 So. Gayoso St., New Orleans.

J. D. WALKER, (Jan. 8, 1908), Engineer for Craven & Lang, Carondelet Bldg., New Orleans.

WILLIAM WALLACE, (R. Aff.), (1931), General Contractor, 131 No. Jefferson Davis Parkway, New Orleans.

STEPHEN J. WALLBILLICH, (1926), Engineer, 1415 Adams St., New Orleans.

PHILIP A. WEBER, (N. R. J.), (1933), U. S. Coast and Geodetic Survey, Washington, D. C.

LEO S. WEIL, (1918), Consulting Engineer; President, Engineering Sales Co., Inc., 425 So. Peters St., New Orleans.

LEON C. WEISS, (1918), Weiss, Dreyfous & Seiferth, Architects, 600 Maison Blanche Bldg., New Orleans.

HORACE C. WELMAN, (J.), (1934), Draftsman for Air Reduction Sales Company, U. S. Industrial Alcohol Co., Baltimore, Md.

W. S. WHITE, (L. M.), (Jan. 1, 1898), Box 44, Sulphur, La.

CHARLES WIGGIN, JR., (1927), Mechanical Sales Engineer, Walter Castenedo, Inc., 329 Balter Bldg., New Orleans.

BEN WILLARD, (L. M.), (Jan. 1, 1900), Retired, 1710 Audubon St., New Orleans.

ELMER WILLIAMS, (1927), Resident Engineer, P. W. A., Buder Bldg., St. Louis, Mo., 7200 So. Claiborne Ave., New Orleans.

W. HORACE WILLIAMS, (1908), President and General Manager, W. Horace Williams Co., Inc., Engineer and General Contractor, Southern Bldg., 833 Howard Ave., New Orleans.

C. S. WILLIAMSON, JR., (1916), Head of School of Chemical Engineering, Tulane University, New Orleans.

ARMAND L. WILLOZ, (1922), Engineer, Orleans Levee Board, 4439 So. Miro St., New Orelans.

VICTOR L. WILLOZ, (L. M.), (Jan. 1, 1900), Distribution Engineer, New Orleans Public Service Inc., 317 Baronne St., New Orleans.

J. NORMAN WILSON, (1911), Assistant Engineer, Mechanical Engineering Department, Sewerage and Water Board, 2425 Audubon St., New Orleans.

JOHN W. WILSON, (J.), (1933), Engineer, 7916 Oak St., New Orleans.

A. R. WINGATE, JR., (1924), Jones and Laughlin Steel Corp., 1525 Exposition Blvd., New Orleans.

WALTER E. WINSHIP, (1921), President, Chalmette Petroleum Corporation, 1213 Pere Marquette Bldg., New Orleans.

CARROLL L. WOOD, JR., (J.), Engineer, 819 Calhoun St., New Orleans.

A. A. WOODS, (N. R.), (1914), Chief Engineer, Maintenance of Way and Structures, Southern Railway System, Lines West, 307 East Fourth St., Cincinnati, Ohio.

D. F. WOODS, (N. R.), (1922), Lutcher, La.

CHARLES J. WYLER, (1919), Principal Assistant Engineer, A. M. Lockett & Co., Ltd., 530 Jackson Ave., New Orleans.

HENRY L. ZANDER, (L. M.), (March 5, 1898), Civil Engineer, 821 No. Rampart St., New Orleans.

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Hagstette, E. J., Jr.
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Fordoche
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Gretna
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Hotard, A. E.

Hammond
Loustalot, L. A.
Mentz, H. A.

Houma
Seashore, P. T.
Smith, T. B.

Jackson
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Elberson, S. W.

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Barnett, Wade
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Baumbach, R. H.
Bean, C. N.
Beard, D. M.
Beck, J. D.
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Duval, A. C.
Earl, G. G.
Earl, R.
Eastwood, J. T.
Egan, J. T.
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Engelhardt, H. G.
Ernst, T. E.
Estorge, T. L.
Ewing, J. P.
Favrot, C. A.
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Godchaux, J.
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Grehan, B. H.
Grevenberg, F B.
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Guillot, A. H.
Haase, J. A. III
Hackett, A. H.
Hadden, C. F.
Hamilton, F. P.
Hammett, G. R.
Hanemann, E. J.
Harris, A. J.
Haulard, M. V.
Hay, W. W.
Herpich, R.
Hess, W. T.
Hiers, L. H.
Hill, A. M.
Hogg, W. T.
Hoffman, W. H.
Hoots, P. F.
Hottinger, S. E., Jr.
Hughes, E. F.
Hyatt, E. C.
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Jahncke, E. L.
Jahncke, P. F., Sr.
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Joachim, J. W.
Johnson, W.
Jones, C. L.
Kammer, K. P.
Kerr, C. M.
Kirst, L. R.
Klorer, J.
Koch, W. E.
Kohnke, R. B.
Kohn, L. I.
Krauss, G. C.
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Kuhn, R. J.
Lane, H. J.
Lamphier, E. S.
Lawes, G. W.
Leake, W. S.
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Legeai, R. F.
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Lockett, A. M.
Lockett, R. P.
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Lorio, J. A.
Macdonald, F. M.
Mall, I. O.
Malochee, H. J.
Marks, A. E.
Massimini, S. V.
Mayer, J. K.
McCarroll, T. M.
McLean, G. J.
McLean, H. L.
McLean, L. C. H.
McNiven, J. A.
Melancon, O. O.
Mendow, F. R.
Meunch, C.
Meyers, H. J.
Montgomery, J. W.
Montz, A. S.
Moodie, D.
Morden, E. B.
Moses, W. B.
Muller, J. F., Jr.
Myers, H. B., Jr.
Naberschnig, E. M., Jr.
Nairne, C. L.
Naquin, A. A.
Negrotto, A. J.
Nelson, B. S.
Newman, L. L.
Newton, W. T.
Nielsen, J. C., Jr.
Norton, M. M.
Oakes, W. F.
Old, H. N.
Olsen, O. K.
O'Neill, J. H.
Oster, W. P.
Pareti, P.
Paterson, A. B.
Phillips, P. F.
Peirce, C. J., Jr.
Porter, J. L.
Prouet, R. C.
Quinlan, P. H.
Rackerby, G. C.
Rainville, W. S., Jr.
Reed, L. C.
Reinhard, J.
Rhodes, G. L.
Rhodes, W. H.
Rice, G. P.
Ricker, C. W.
Riess, J.
Rittenberg, C. L.
Robert, J. M.
Robert, J. M., Jr.
Roberts, T. H.
Rodriguez, E. J. H.
Roessle, E. G.
Salzer, H. S.
Samuel, P. T.
Sarre, A. J.
Scales, W. H.
Schmidt, R. McC.
Seaver, G. A.
Seiferth, S.
Shaw, A. M.
Shilstone, H. M.
Simpson, W. S.
Sirgo, H. F.
Smith, L. C.
Spaar, W. H.
Staples, L. A.
Steinmayer, R. A.
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Stevens, L. T.
Stewart, B. W.
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Stolley, B.
Swan, H. C.
Terroy, T. E.
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Thomson, J. F.
Todd, J. M.
Tognoni, L. M.
Trepagnier, J. H.
Trouard, S. E., Jr.
Tudury, W.
Vivien, L. T., Jr.
Waddill, F. H.
Waddill, G. D.
Wagner, R. E.
Walker, J. D.
Wallace, W.
Wallbillich, S. J.
Weil, L. S.
Weiss, L. C.
Wiggin, C., Jr.
Willard, B.
Williams, E.
Williams, W. H
Williamson, C. S., Jr.
Willoz, A. L.
Willoz, V. L.
Wilson, J. N.
Wilson, J. W.
Wingate, A. R., Jr.
Winship, W. E.
Wood, C. L., Jr.
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Zander, H. L.

Norco
Creighton, W. H.

Roseland
Shuey, A. F.

Shreveport
Bullen, J. T.
Clanton, H. M.
Howze, J. B., Jr.
Scheib, J. G.
Seiler, R. F.
Snyder, J. Y.

Sterlington
Rodhigue, E. A.

Sulphur
White, W. S.

Thibodaux
Chenet, T. T.

MARYLAND

Baltimore
Welman, H. C.

MASSACHUSETTS

Cambridge
Cooley, H. B.

MICHIGAN

Detroit
McGehee, H. H.

MINNESOTA

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Monteiro, C. R.

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Ocean Springs
Holloway, W.

Hattiesburg
Steadham, J. J.

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Stayer, D.

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Black, A. L., Jr.
Davis, G. H.
Mann, R. H.
McInerney, J.
Von Phul, W.

Brooklyn
Reynolds, F. L.

NICARAGUA

Puerto Cabezas
Scott, H. D.

OHIO

Cincinnati
Woods, A. A.

OKLAHOMA

Tulsa
Sibslee, J. A.

OREGON

Portland
Muth, F. A.

TENNESSEE

Knoxville
Cooper, A. J., Jr.
Okey, C. W.

Memphis
Tutwiler, T. H.

TEXAS

Galveston
Davis, A. B., Jr.

Houston
Eblen, W. F.
Shilstone, H. M., Jr.
Tompkins, J. F.

WEST INDIES

Netherland
Tremblay, N. W.

MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY

Regular Meeting of the Board of Direction, December 9, 1936.

Members present: President Bres, Dunlap, Grehan, Hackett, Hoots, Moses, Ricker, Hill.

The meeting was called to order by President Bres. A letter was read from the U. S. Naval Reserve, offering a lecture on training of recruits. The Secretary was requested to reply that only technical papers could be used before the Society.

A letter from Mr. G. W. Lawes was read applying for the position of Secretary. This letter was referred to the Nominating Committee.

It was suggested that a mimeograph letter be sent out to members in arrears with 1934 dues.

The report from the Committee on Administrative Improvements was read. The Secretary was directed to send a copy to each of the officers of the Society.

It was motioned and seconded that this report be considered at the next meeting. The Secretary was directed to write a letter of thanks to Mr. Dusenbury.

The letter of resignation of Mr. R. M. O'Brien was read and accepted with regret by the Board.

There being no further business the meeting adjourned.

ARTHUR M. HILL, Acting Secretary.

Regular Meeting of the Society, December 9, 1935.

The meeting was called to order by President Bres in the Hunt Room of the St. Charles Hotel, seventy-nine members and guests present.

Col. Bres called attention to the fact that Soil and Foundation Work may be eliminated unless approval from Washington be given. The American Engineering Council may be able to help on this.

Announcement was made of the election of Douglas S. Anderson, Acting President of Tulane University, as an honorary member of the Society.

Mr. John H. O'Neill, Chairman of the Nominating Committee, read the report of nominations as follows:

Allen S. Hackett	President
C. S. Williamson, Jr.	Vice President
Walter B. Moses	Treasurer
Arthur M. Hill	Secretary
David W. Godat	Director for Three-Year Term

President Bres called attention to the fact that these nominations constitute the official ballot.

Since this meeting was a joint meeting with the American Society of Municipal Engineers, the meeting was turned over to Mr. F. N. Billingsley, President.

Mr. Alfred F. Theard delivered an interesting illustrated address on "Sewerage, Water and Drainage in New Orleans, Their History and Construction."

A lively discussion followed. After a rising vote of thanks to the speaker the meeting adjourned to the usual collation.

ARTHUR M. HILL, Acting Secretary.

Minutes of the Meeting of the Board of Direction, January 24, 1936.

The meeting of the Board took place on Friday morning, January 24. Present: Hacket, Moses, Hoots, Ricker, Dunlap, Hill. Ballots for the election were opened. No further business was transacted. The meeting adjourned.

ARTHUR M. HILL, Acting Secretary.

Minutes of the General Meeting, January 24, 1936

The meeting was called to order at 11 a. m. by President Bres, 203 members and guests present.

Acting President Anderson of Tulane made a short address of welcome.

The report of the President was reviewed and approved.

The report of the Secretary was briefly reviewed and approved.

Mr. H. J. Malochee gave a short paper on the beginnings of the Society, in connection with his work as Historian.

Two of the District Representatives were introduced, Mr. Berny Oakland and Mr. T. Baker Smith.

The tellers reported a total of 79 votes cast, with the following officers elected: Allen S. Hackett, President; C. S. Williamson, Jr., Vice President; Walter B. Moses, Treasurer; Arthur M. Hill, Secretary; David W. Godat, new member of the Board, to serve three years.

Mr. Hackett was escorted to the chair by Prof. W. B. Gregory and Mr. John Klorer. After a brief address by President Hackett the meeting adjourned.

ARTHUR M. HILL, Acting Secretary.

Minutes of the Board Meeting of February 3, 1936

Present: Hackett, Bres, Godat, Moses, Williamson, Ricker, Hill.

The meeting was called to order by President Hackett and the minutes of the previous meeting read.

The Secretary was directed to check names of delinquent dues letters with attendance.

A letter of resignation of Mr. Paul Andry was read. The Secretary was directed to suggest non-resident membership to Mr. Andry, since he is no longer located in New Orleans.

The Secretary was directed to transfer members to next higher grades, in accordance with the Constitution.

A letter requesting reinstatement was read from Mr. John Bernhard. The Board directed that he be reinstated as a resident member.

A committee for drawing up a resolution upon the death of Frank A. Muth was adopted, as follows:

E. S. Lanphier, Chairman.
J. M. Robert,
E. S. Bres.

Mr. L. P. Elberson was suggested as a Contact Representative of the 7th District, to replace Mr. Bernard, who no longer resides in the state

The Secretary asked that the routine for admission of members b simplified, and this matter was referred to Committee on Profession: Advancement.

The question of a clock in the library was discussed, and suggestions were made along this line.

The formation of a Committee on Public Relations was discussed. Prof. D. S. Elliott was selected as chairman of this committee.

The formation of a Committee on Student Affairs was also suggested.

A follow-up plan was devised for non-members who attended the Annual Meeting, in order to interest them in the affairs of the Society.

The Secretary was instructed to write to the speakers at the meeting, to ask how many extra copies of the Proceedings they desired.

Action on the Report for Administrative Improvement was delayed until the next meeting, so that the new members of the Board would have an opportunity to study it.

It was voted that Mrs. Alexander be retained this year to take notes on the discussions at the regular meeting.

A letter from Mr. Todd, suggesting an annual award in the form of a medal, was read. Acting on this matter was referred to a committee, to be appointed.

Mr. Todd submitted a detailed report of the Annual Meeting, which will be taken up for discussion at the next Board Meeting.

It was decided to omit attendance prizes at the meeting of February 17.

There being no further business the meeting adjourned.

A. M. HILL, Secretary.

ANNUAL REPORTS

ANNUAL REPORT OF THE BOARD OF DIRECTION

Year 1936

New Orleans, La., January 2, 1936.

To the Members of the Louisiana Engineering Society:

Founded January 15, 1898, the Louisiana Engineering Society now enters its thirty-ninth year.

It is one of the oldest State Technical Societies of the nation, and has achieved a record of accomplishment of which we can feel justly proud. Its efforts have helped in keeping engineering apace with other professions, in increasing the prestige of the profession, and in making it a factor in civic affairs.

The activities of the Society are more widespread than many members realize. With a view, therefore, of informing the membership of the Society's activities in detail, and at the same time, inviting constructive criticism a review of the year's work is here given. It is particularly desired to impress the fact that all policies have been decided upon by the Board of Direction as a whole rather than by any one individual.

The development during the year is reflected in the present condition of Society affairs which can be measured by membership, finances, library, meetings and kindred activities, a report on which is here given.

Membership: The membership has increased from 319 to 339. The increase in the number of non-resident members and of reinstatements has been gratifying. Many members for years incorrectly carried in lower grades, have been transferred to proper grades in accordance with provisions of the Constitution.

Finances: It has been the effort this year to budget expenditures within anticipated current revenues; to make all entertainments self-supporting and to pay all indebtedness for the current year prior to the end of the year. The Budget Committee report was adopted at the February meeting of the Board. The estimated expenditures amounted to $2,686.00, and the anticipated revenues amounted to $2,857.00. Expenditures for account of entertainment budget have been exceeded by $36.34, and of the library budget by $75.76. However, these are felt justifiable, especially so in the case of the Library when the relative value to the membership is considered. The Annual Library Budget of $500.00 was unexpended for years and, subsequently, the major portion thereof was returned to the General Fund and devoted to other activities.

Meetings: Ten regular meetings and one special meeting of the Board of Direction were held for the transaction of business. Of the ten regular meetings of the Society, nine were held in New Orleans. An innovation of the year was a meeting held outside of the City of New Orleans, the first of its kind in the history of the Society. This meeting was held in Baton Rouge in May, and was the result of the successful co-operation of the Entertainment Committee and the Technical Papers Committee with the non-resident members of the Society and others living in Baton Rouge. The features of this meeting were: the dinner to the members with the Louisiana State University as host, a series of Technical addresses, and a concert by the University band. This meeting was one of the most representative meetings in the history of the Society, including outstanding engineers from all branches of the profession and all sections of the State. 152 members and guests attended. This new development has met with favorable comment from within and without the Society in that it has contributed much to making the Society statewide as its name implies, and causing the non-resident member to feel that he is an integral part of the organization.

Over last year the average attendance at meetings has increased by 15%, or from 89 to 103. The largest attendance numbered 156, and the smallest, 61 members and guests. The discussion of Technical papers presented at the meetings is of much value in bringing out various phases of the topic and the publication of discussions is of interest, especially, to members who are unable to attend. For this reason a stenographer has again been employed to record discussions, which are published with the papers in the Proceedings. Additional discussion by letter is invited.

Library: A number of new books and publications have been added to the library. A questionnaire has been sent the membership asking for suggestions. The method of cataloging has been revised and a more accurate check is kept of borrowed books. Additional comforts have been added to make the library and rooms more attractive. Members are again advised that they may borrow books which will be mailed without cost.

It has been the purpose of your officers and Board of Direction during the past year, to advance the interests of the Society and the engineering profession by:

1. The development of the internal organization of the Society.
2. Promoting the closer co-ordination of the various branches of the profession.
3. Holding meetings in different sections of the State to decentralize and make more widespread the Society activities.
4. Broadening of the program of the Annual Meeting.

These objectives have been carried on through the routine, and added activities of the Society and, as related are, briefly:

A. The development of the interior organization:

1. Through encouraged use of the club room and library.
2. Improvement of the library through survey of needs and addition of books.
3. New method of indexing borrowed books.
4. Appointment of a Historian and the writing of a concise history of the Society.
5. Register kept of members and guests visiting rooms.
6. Record of members and guests attending meetings followed up by questionnaire card to improve attendance.
7. Prizes awarded during collation and informal "get together."
8. Hitherto inactive members appointed to Committees with gratifying increased interest.
9. Young members given Committee duties.

B. Co-ordination of Branches of Profession:

1. Appointment of Professional Advancement Committee.
2. Technical program for some monthly meetings assigned to local Sections of National Societies.
3. Annual Meeting of Society:
   (a) In charge of Committee composed of representatives of each local Section.
   (b) Technical program includes papers for each branch recommended by each local Section.
   (c) Local Sections and Student Chapters to have Special Conferences.
   (d) All members of profession whether or not members of Society urged to participate in annual meeting.
   (e) Local Sections invited to use "Proceedings" as medium of contact between members.
   (f) Professional Advancement Committee consulted in connection with amendments to Constitution and By-Laws.

C. Decentralization:

1. By-Laws amended to provide for at least one meeting each year in city other than New Orleans.
2. Appointment of District Representatives.

D. Annual Meeting:

1. Broadened to a two-day meeting, to include:
   (a) Presentation of technical papers and discussions.
   (b) Visits to industries, plants and engineering construction.
   (c) Widespread participation by all members of profession and students.
   (d) Program prepared by Committee composed of engineers from all branches of profession.

The routine activities and Committee work have been continued. These include:

Proceedings: This official publication of the Society has been improved by several new features which have proved of value. The issues have contained more reading matter and have included the discussions of the papers presented. With a view to further improvement a questionnaire was mailed and published in the "Proceedings" requesting members to submit suggestions. These suggestions were submitted to a Special Committee whose report was received and accepted by your Board.

Awards: The Annual merit awards to students and graduates of engineering of Louisiana State and Tulane Universities have been continued. Scholarships were awarded to Arthur Porter, Tulane University, and A. P. Siess, Louisiana State University. Junior memberships in the Society were awarded J. H. Trepagnier, Tulane, and A. F. Blumer, Louisiana State.

Employment: The Employment Committee received application from 93 engineers and placed 38 of this number. In addition the Society was represented on the local Council of Engineers, which conferred with the Emergency Relief Administration in an effort to increase salaries and make possible additional positions for engineers. Some results were accomplished in this work.

Legislation: Activity in the enactment of changes in registration laws affecting engineers has been withheld until the next regular session of the State Legislature. Due to the effort of the Committee Act 15, 3rd extra session of 1934, was amended to repeal and eliminate that section which required the payment of a license based on the gross revenues of engineers. The repeal of this law will effect substantial annual savings to the profession.

Constitution and By-Laws: To enable the Society to expand its activities, and for simplification, several articles of the Constitution were amended during the year. The most important of these are: Article V, amended to provide for regular meetings outside of New Orleans. Article II, Section 8, amending the provisions for Honorary Membership;

and Article VIII, Section 13, providing for Junior members on Standing Committee.

Technical Papers: The technical papers presented at the nine regular meetings deserve the greatest praise. The program included subjects on every branch of the profession and was prepared and published in the "Proceedings" several months in advance. Each local section of a national society sponsored at least one of these meetings. These joint meetings were held with Sections of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Chemical Engineers, the American Institute of Electrical Engineers and the American Society of Municipal Engineers. In accordance with previous practice, members of the Society, who delivered addresses before the Society had their dues remitted.

Entertainment: The program of entertainment was more varied than heretofore. Included under its activities were the Annual meeting, a Smoker, arrangements for the opening of the Highway Bridge over Bonnet Carre Spillway, the Baton Rouge meeting, the annual Golf Tournament at the Colonial Country Club; the opening of the Bonnet Carre Spillway and the formation of the Motorcade going to it. In addition the Committee formulated plans for increasing interest and attendance at the collation following meetings by awarding prizes. These prizes were secured without cost to the Society. Outings were arranged for, but weather conditions and conflicting interests interferred.

History: For a number of years the need of an accurate record of events and activities or history of the Society has been apparent. The Board approved the recommendation of the President of the appointment of Mr. G. W. Lawes as historian and Mr. Leonard Kirst as co-historian. Due to ill health Mr. Lawes was unable to continue with the work and Mr. Henry J. Malochee has been appointed in his stead. The history has been started and is satisfactorily progressing. The work requires much detail and personal effort. Several months will be required for completion. The members are invited to offer suggestions to the Historian.

The Ladies' Auxiliary: The Ladies' Auxiliary of the Louisiana Engineering Societies under the leadership of Mrs. Douglas Anderson, has been active in furthering the ideals of the auxiliary and the aims of this Society. To Mrs. Anderson, her officers and members, we wish to express our grateful appreciation.

American Engineering Council: On April 8, 1935, your Board accepted election to the American Engineering Council. The annual membership dues of the Council have been reduced from one dollar per member, or $339.00 for the Society, to a flat payment of $25.00. The Council at this time is of especially valuable service to the Society. Direct information is furnished regarding the rapidly changing conditions and regulations

of the various Public Works subdivisions. Additionally it gives representation in Washington to the Society and keeps it in contact with all matters of national importance to the profession. The membership of the Society has been more than warranted by the contact and immediate favorable results obtained in securing the continuance of the Soil and Foundation Survey.

Soil and Foundation Survey: An outstanding accomplishment which has developed interest and elicited inquiries throughout the United States was the inauguration of the Soil and Foundation Survey. This survey was initiated by the Society as a project to be financed by the Federal Emergency Relief Administration for the purpose of providing employment for engineers and accomplishing a project of constructive value. Tulane University has donated office space and equipment. When the FERA was succeeded by the Works Progress Administration it became necessary to have the project sponsored by a public board. The Board of State Engineers very courteously co-operated by becoming the sponsor. The survey is being carried on under the direction of a board composed of Prof. Donald Derickson, Chairman, representing Tulane University; Ringgold Brousseau, Chief Engineer, WPA for Louisiana; John H. O'Neill, American Society of Civil Engineers, and Edward S. Bres, Louisiana Engineering Society. All of these engineers are members of the Society, as is F. Petrie Hamilton, the engineer in charge of the undertaking for the Federal Government.

A total of $37,000.00 has been allocated for the survey. Work has been provided for 14 engineers, 3 draftsmen and 4 office assistants. 105 projects have been investigated and reports are now in preparation. When completed the results will be printed in book form and made available in a limited number. This work is of monumental value to engineers, architects and the construction industry of the State and will reflect to the Society.

District Representatives: To make the activities of the Society more far reaching in the State the Board approved the appointment of the following District Representatives:

3rd District.....T. Baker Smith, Houma, La.
4th District.....J. T. Bullen, Shreveport, La.
5th District.....Berny Oakland, Monroe, La.
6th District.....Harry B. Henderlite, Baton Rouge, La.
7th District.....Merrill Bernard, Crowley, La.
8th District.....Ira W. Sylvester, Alexandria, Ia.

These representatives are the direct representatives of the President, assist the members when possible, and advise the society of any activities in which it can be of assistance.

Secretary: In November, 1935, Frank A. Muth, Secretary of the Society since 1923, was transferred to Portland, Oregon. This caused the loss of an officer whom we had come to look upon as an institution and whose loss we sincerely regret. In his stead Arthur M. Hill has been appointed Acting Secretary.

Honorary Membership: In accordance with the Constitution as amended, Douglas S. Anderson, Acting President of Tulane University and President of the Society for Promotion of Engineering Education, was elected an honorary member.

During the year the Society acted as co-host to the Electro Chemical Engineers during their meeting in New Orleans. Official recognition has been accorded the profession and the Society through invitations to participate in the Diamond Jubilee of Louisiana State University, the Centennial Celebration of Tulane University, the opening of the Highway Bridge and Spillway of the Bonnet Carre Spillway, the New Orleans Public Belt (Huey P. Long) Railroad Bridge over the Mississippi River, and the National Rivers and Harbors Congress.

Members of the Society have been accorded National recognition in these instances: John F. Coleman, President American Engineering Council, and recently elected Honorary Member, American Society of Civil Engineers; Professor Douglas S. Anderson, President, Society Promotion Engineering Education; John H. O'Neill, Chairman, Conference State Sanitary Engineers of United States; James M. Todd, Director, American Society of Mechanical Engineers, and Edward S. Bres, Representative, Fifth Region, American Engineering Council.

It has been the aim of this administration to make the Society a truly State Society and to weld together the activities of the various branches of national Societies and members of the profession towards a unity of thought and action in professional advancement. Any success which has been attained has been due to the untiring work of the Committees and the loyal support of the membership, and to them we extend our grateful thanks.

Respectfully submitted,

EDWARD S. BRES, President.
ALLEN S. HACKETT, Vice-President.
ARTHUR M. HILL, Acting Secretary.
WALTER B. MOSES, Treasurer.
PAUL F. HOOTS.
CLAIRE W. RICKER.
BERNARD H. GREHAN.
A. LEE DUNLAP.
Board of Direction.

ANNUAL REPORT OF THE SECRETARY

Year 1935

New Orleans, La., Jan. 2, 1936.

To the Board of Direction,
Louisiana Engineering Society.

Gentlemen: As Secretary of the Society, I herewith submit the following report for the year 1935:

During the past year the Board of Direction has held 9 regular meetings and 1 special meeting, making a total of 10 meetings. The Society has held 10 regular meetings. Several of the meetings were joint meetings held with local chapters of A. S. C. E., A. S. M. E., A. I. Ch. E. and A. S. Mun. E.

The following technical exercises were held:

February 11. "Erection Methods of Main River Bridge, New Orleans Public Belt Railroad Bridge," by Mr. C. W. Doerr.

March 11. "Design and Operating Devices of the 1450 Pound Steam Plant, Deepwater Station," by Mr. H. G. Hiebler.

April 8. "Mapping Louisiana From the Air," by Capt. J. P. Dean.

May 13. "Petroleum Products and Their Manufacture," by Mr. W. J. Rathborne; "The Steam Plant at Baton Rouge," by Mr. T. E. Crossan; "Manufacture of Sulphuric Acid," by Mr. W. J. Daspit; "Manufacturing Processes of Timber and Boxes," by Mr. J. A. Moore.

June 10. "Practical Gulf Coast Geology," by Prof. R. A. Steinmeyer.

September 9. "Navigation Problems in Louisiana," by Major Henry Hutchins.

October 14. "Recent Advances in the Production and Refining of Petroleum," by Dr. W. J. Sweeney.

November 11. "Taking Boulder Dam to Market," by Mr. E. T. Gunter.

December 9. "Sewerage, Water and Drainage in New Orleans, Their History and Construction," by Mr. Alfred F. Theard.

The membership has shown a steady increase during the year with a net increase of 19 members.

Tabulation of Membership.

GRADE	On Roll Jan. 1, 1935	Elected	Reinstated	Transferred to	Transferred from	Dropped	Died	On Roll Jan. 1, 1936
Honorary Members	4	1	....	1	....	....	....	—
Life Members	17	3	....	....	....	....	....	—
Resident Members	147	5	5	2	2	....	1	—
Non-Resident Members	50	....	....	....	....	1	....	—
Associate Members	1	1	....	....	....	....	....	—
Non-Res. Associate Members	1	....	....	....	....	....	....	—
Affiliate Members	17	....	....	....	1	....	....	—
Non-Res. Affiliate Members	3	1	....	....	....	....	....	—
Junior Members	63	3	2	....	....	....	....	—
Non-Res. Junior Members	16	1	....	....	....	....	....	—
Totals	319	15	7	3	3	1	1	339

It is with regret that the death of Mr. Joseph P. Beranger is recorded.

CONSOLIDATED FINANCIAL STATEMENT

January 1, 1936.

Assets:

Cash in bank:

Checking account balance	$ 741.41

Accounts Receivable:

Membership dues for 1935	684.00
Advertisers	74.36
Investments	4,208.76
Frozen Funds	4,924.42
	$10,632.95

Liabilities:

1935 Dues paid in advance	$ 5.00

Reserves:

General Reserve Fund	10,459.35
Proceedings Reserve Fund	168.60
	$10,632.95

Cash Account 1935.

Receipts:

1934 and prior years dues	$ 305.00
1935 Dues	1,688.50
1936 Dues	4.00
Advertisers	462.01
Entrance Fees	54.00
A. I. E. E., A. S. M. E., A. S. C. E. Contributions	50.00
N. O. Security Gold Note Liquidation	360.00
Louisiana Savings Bank & Trust Co	100.00
	$ 3,023.51
Add 1935 Balance	477.35
	$ 3,500.86

Disbursements:

Cost of Proceedings	$ 1,001.59
Smoker, Entertainment, Outing	136.34
2 Scholarships	165.00
Printing and Postage	227.01
Secretary	600.00
Assistant to Treasurer	20.00
Gavel and Present for President	30.65
Library Expenses	225.76
Bond for Treasurer	10.00
Porterage	48.00
Refreshments	190.63
American Engineering Council	25.00
Stenographer	10.00

Not in the Budget:

Legislation Expense	13.12
General Expense	53.23
Exchange on Checks	3.12
	$ 2,759.45

Receipts	$ 3,500.86
Disbursements	2,759.45
Cash Balance	$ 741.41

Proceedings Fund.

Revenues:

Allotted	$ 1,050.00

Expenses:

Salary Editor	$300.00	
Salary Assistant to Editor	180.00	
Printing and Mailing	521.59	
		1,001.59
Balance		$ 58.41

Library Fund.

Allotted	$ 150.00
Expenditures	225.76
Deficit	$ 75.76

Investments.*

2—$100 1st Liberty Loan	$ 200.00
1—$ 50 1st Liberty Loan	50.00
5—$ 50 1917 Liberty Loan	250.00
Greater N. O. Homestead	1,208.76
Union Homestead	500.00
Standard Homestead	500.00
Italian Homestead	500.00
Security Homestead	500.00
Columbia Homestead	500.00
Deferred Account Canal Bank Savings	403.69
National Bank of Commerce Savings	685.14
Deferred Account Interstate Savings	1,630.59
Deferred Account Interstate Checking	2,205.00
	$ 9,133.18

Deep appreciation is expressed to the officers and members for their co-operation and to Mr. Frank A. Muth, past Secretary, for the untiring assistance rendered by him in the transfer of the records of the Society.

Respectfully submitted,

ARTHUR M. HILL, Secretary.

* From Treasurer's Report.

ACTIVITIES OF LOCAL SECTIONS

President,
F. P. HAMILTON
1st Vice-President,
CLIFFORD H. STEM
2nd Vice-President,
H. A. SAWYER
Secretary,
CHAS. M. KERR,
5831 S. Robertson Street
Treasurer,
A. J. NEGROTTO
501 S. Rendon Street



STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

Annual Meeting at
New Orleans in May

Special Meetings at
call of President

The Annual Meeting of The Section will be held at the home of Mr. and Mrs. Ole K. Olsen, 508 Millaudon St., Wednesday evening, April 15th. The synonym for Olsen is Goodtime so you had better attend. There will be good things to eat and drink. No cover charge—your annual dues pay for entertainment. There will be a technical address of interest. Officers for the current year will be elected.

The Spring Meeting of the Society will be held in Hot Springs, April 22nd, 23rd and 24th, and a pleasant and interesting time is anticipated.

It is noted with pleasure, in a recent report of the Am. Soc. C. E. on Student Chapters, that the Tulane Student Chapter is placed among 12 of the 113 chapters receiving a letter of commendation from the President to the Chapter.

In our last news page we mentioned the transfer of Mr. Frank A. Muth to Portland, Oregon, with a deserved promotion in his line of duty. It is with sadness that we now record the death of Mr. Muth, who for so many years had been associated with Louisiana engineering.

THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

LOUISIANA-MISSISSIPPI SECTION

Officers and Members

C. S. Williamson, Jr., Chairman, Tulane University, New Orleans, La.
W. R. Stryker, Vice-Chairman, Southport Mills, New Orleans, La.
E. A. Gastrock, Secretary-Treasurer, Celotex Co., Marrero, La.
H. A. Levey, Director, American Products Co., New Orleans, La.
J. J. Ganucheau, Director, Southern Cotton Oil Co., Gretna, La.

E. Bache, Bogalusa Paper Co., Bogalusa, La.
R. M. Boehm, Masonite Corp., Laurel, Miss.
M. W. Boyer, Standard Oil Co., Baton Rouge, La.
C. E. Coates, Louisiana State University, Baton Rouge, La.
J. T. Cox, Jr., Himalaya Refinery, Tallieu, La.
C. B. Dicks, Jr., Tulane University, New Orleans, La.
H. S. Foote, Bay Chemical Co., Weeks, La.
H. H. Hewetson, Standard Oil Co., Baton Rouge, La.
G. K. Hickin, Freeport Sulphur Co., Port Sulphur, La.
P. M. Horton, Louisiana State University, Baton Rouge, La.
A. G. Keller, Bunkie, La.
W. B. Logan, Newport Co., Lake Charles, La.
G. P. Meade, Colonial Sugars, Gramercy, La.
H. J. Molaison, Jefferson Lake Oil Co., Barba, La.
E. S. Rothrock, Louisiana Chemical Co., Baton Rouge, La.
W. R. Schuler, Mathieson Alkali Works, Lake Charles, La.
J. H. Thickens, Masonite Corp., Laurel, Miss.
E. Wander, Bay Chemical Co., Weeks, La.

Regular meetings are held on the first Friday in February, May, October and December in the Richardson Chemistry Building, Tulane University, New Orleans, La.

PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

VOL. XXII. APRIL, 1936 NO. 2

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EDITORIAL NOTES AND COMMENT

Engineering Education as Training for Citizenship *. In the minds of the foremost thinkers of the country there exists a very strong feeling that the engineer and the scientist must take a leading part in our future economic development.

Indeed, the part which the engineer has taken in the past is quite small compared to the demands which must be made on him in the future. In addition to his contribution to the com-

* Condensed from a Radio Address, January 22, 1936.

forts and convenience of mankind, of necessity there will be added to the responsibilities of the engineer the disentanglement of civilization from the economic snarl in which we find ourselves so tightly enmeshed today.

We live in an engineering and scientific age. There is scarcely a moment of our daily lives that is not touched by some engineering development. The clothes we wear, the food we eat, the houses we live in, the equipment for our play, the motion pictures for our entertainment, the automobile which serves us—to mention only a few—are all the results of engineering development. The list could be made almost endless.

To date the engineer has been content to produce only the *material* benefits of civilization. He has not as yet assumed economic leadership. This is the engineer's responsibility of the future.

As an example, the engineer has produced automobiles which run 80 to 100 miles an hour. But these same automobiles kill yearly more people than does any single disease. These automobiles are *built* as safe as technical skill can make them. But the conditions surrounding their operation are neither a political nor wholly a police responsibility. The problem of highway and traffic safety is almost completely an engineering problem, capable of logical—perhaps expensive—solution. All automobile traffic should be controlled by an engineering department, with its own police powers. The police department should be completely relieved of an engineering problem which is inherently not its responsibility.

Let us take just a moment to indulge in a bit of digressive heresy. It is our firm belief that the final solution of the problem will be in the direction of safety *with* speed—*not* in a reduction of speed. An arbitrary speed limit does not necessarily mean safety. Ever since man first substituted the four longer and swifter legs of a horse for his own inadequate two, his appetite for speed has been insatiable. The automobile was devised as an attempt to appease that appetite. Speed is an almost fundamental human desire. It can not be curbed by police dictum. It *must* be made safe. To do so is an engineering responsibility.

The engineer has built great sewer, water, and light systems, permitting a high concentration of population in cities; but up to this time he has not been called upon to eliminate the slums and tenements which have been an unnecessary parasitical growth accompanying these great works. This must be another of the future citizenship duties of the engineer.

The education of the engineer is unique in that it is ideal training for citizenship. There are three fundamentals that are unceasingly stressed throughout the engineer's educational period. They are: first, logical analysis and logical sequence of thought; second, fearlessness, positiveness, and accuracy of action; and third, imagination. These are the qualities above all others that will be required of the leaders in our future economic development.

Let us consider these three fundamentals of engineering education. The first of these is logical analysis and logical sequence of thought. Clearly it will be conceded by all that engineering education could not even begin without initiating the development of these qualities. To think straight and to think in an orderly manner is fundamental to the engineer. In an economic leader that quality is certainly not only desirable but quite necessary—but that is not all which is desirable.

The second fundamental which is most particularly stressed in engineering education is fearlessness, positiveness, and accuracy of action. The engineer is essentially a man of action. Action there must be, but action alone is not sufficient. The action must be accurate, positive, and fearless. Accurate? Certainly! The misplacement of a decimal point is *not* a slight misjudgement of position. It is a one thousand or more per cent. inaccuracy. If later translated into metal, stone, or other material, it might result in the sinking of a ship, the dropping of a Mississippi River bridge into the water, the explosion of a high pressure boiler, the crumbling of an Empire State building, or some other disaster with its attendant loss of life. The engineer must be right the *first* time—there might not be a second time.

Along with accuracy his action must be positive and it must be fearless; positive in that it must be thought out in advance.

No starting out on a line of action, the termination of which is nebulous. No start with the hope that he will not come out in a blind alley. The engineer must know where he is going before he starts. And his action must be fearless, of course. That quality must be inherent in any leader. It needs neither reiteration nor justification nor discussion. It is just not in the make-up or in the education of the high grade engineer to sacrifice fearless, accurate, and positive action to expediency. We pass on.

Imagination was mentioned. There may be some doubt on the part of the public that imagination is a vital, necessary, or even a desirable portion of the equipment of the engineer. The general thought is that the engineer deals with brick, rubber, stone, steel—the material things of life—and that he, therefore, has no imagination and needs none. Imagination is supposed to be that nebulous, gossamer scintillation of intellectual activity which is given only to poets, writers, business men, lawyers, economists, and thinkers. But the engineer, dealing only with material things, needs no imagination. How far from the truth—oh! how *very* far!

Think for a moment and you will realize that before an engineer can do anything at all, he must imagine. Imagination is his first approach to any activity. You are completely surrounded by the evidences of it. Consider for a moment the giant turbines which light a great city or drive a monster ship across the sea. Consider the monster ship itself. Consider the boilers that feed these giant turbines with high pressure steam. Consider a Chrysler building or an Empire State building, teeming with its human ants. Consider our own great bridge across the Mississippi, just completed. Consider the hugh printing presses which bring you the Sunday paper on Saturday afternoon. Consider our great air-liners carrying passengers quickly to and fro over land and sea. We have spoken of the wonderful design and construction of the present day automobile, with its availability to you at ridiculously low cost. Consider it. Consider the giant telescopes which bring the very heavens so much closer to the earth. And at the other end of the scale, consider the microscope, making nothing big enough to be something so that you can see it. Consider the instruments that will measure to the two-

millionth part of an inch. Consider the hypodermic needle, a tube of flawless steel with a perfect hole hardly big enough to be seen with the naked eye.

And in the realm of synthetic chemical engineering, consider the many materials which are a part of your daily life. Glass, celluloid, rubber, bakelite, brick, celotex, paper—to mention only a few.

Consider all of these structures and materials along with countless others. You have daily contact with them. Their existence is a fact. How could all of these things—or any one of them—actually exist in fact if they had not previously existed in the imagination of the engineer. A bridge, a turbine, a skyscraper must be imagined before it can be built. It must exist as a pure figment of the brain before it can exist in steel or stone. A giant locomotive is truly a poem in steel!

Engineering education is fundamental education. It is training in those intellectual and spiritual qualities which are most necessary in a good citizen and an able leader.

It is training such as to make him a potential source of valuable public service and great economic leadership. This service and leadership is citizenship in its highest form.

The engineer has heretofore refrained from this type of service, having been content with the exercise of his technical skill. The time is fast approaching, however, when his peculiar type of education and training must be brought to bear on some of our yet unsolved social and economic problems.

Society Scholarships for Engineering Students. Again we call your attention to the fact that each year the Louisiana Engineering Society awards one scholarship to Tulane University, one scholarship at Louisiana State University, to worthy students who wish to pursue the study of engineering. It is always desirable that these scholarships go to the children of members of the Society if possible. The Board of Directors has drawn up definite rules for awarding these scholarships, and those rules are printed below for the guidance of the members. Here they are:

1. The announcement of the Scholarship Award shall be set up and carried in the *Proceedings*.

2. The cards sent out by the Secretary for the notice of the April meeting shall include a statement relative to the Scholarship Award and request members to make recommendations or nominations. The April issue of the *Proceedings* shall also carry an article on the Award.

3. The Scholarships shall be set up as honor awards to the children of the members of the Society or to other worthy students who are financially unable to begin or continue their engineering studies. Awards shall be made, preferably, to a dependent of a member of the Society or of an engineer.

4. The Scholarships shall be awarded in the Colleges of Engineering for undergraduate study only. The scholarships awarded to a student in Tulane University will be $125.00 per annum, and to a student in Louisiana State University, $40.00 per annum.

5. The Award shall be made for one year and may be renewed annually until the undergraduate course of study has been completed, provided proper scholastic grades have been maintained with the regulations set up by the universities for the annual renewal of scholarships.

6. An Awards Committee consisting of three members of the Society shall be appointed annually by the President.

7. Applications for Scholarship appointments shall be made to the Awards Committee. In the event that no award is made by the Awards Committee, the Dean of the College in question shall be requested to nominate a candidate for the scholarship.

8. All applications shall be referred to the dean of the College of Engineering of the proper university. The dean shall rate the applications and submit the entire list to the Awards Committee together with all available information and such recommendations as he may deem fit.

9. The President shall make the award on the recommendation of the Awards Committee.

Annual Meeting Papers. We continue in this issue the publication of papers presented at the Annual Meeting. Such a wealth of material was offered at the Annual Meeting that it

has become impossible to publish it all in one number. Therefore, the policy has been adopted of dividing these papers up and publishing a number of them in each of several successive issues. With all of the good material in this issue, there is still more to come.

New Members. The following members have recently been elected:

Mr. Claude J. Kelly, Vice-President of the New Orleans Cement Products Company.

Prof. Powell H. Humphries, Assistant Professor of Electrical Engineering, Tulane University.

Dr. Leo J. Lassalle, Dean, College of Engineering, Louisiana State University.

OBITUARY

FRANK AMENDE MUTH

Frank Amende Muth, Superintendent of Lighthouses, Seventeenth District, Portland, Oregon, died January 31, 1936.

Mr. Muth was born in Kirksville, Ky., January 27, 1887, the son of Edward Godfrey and Elizabeth (Tevis) Muth. He attended the University of Missouri, and received the degree of B.S. in Civil Engineering in 1910.

He began his professional career with the U. S. Engineers of the War Department and with the U. S. Reclamation Service for short periods. He entered the Lighthouse Service July 1, 1911, as an Engineering Aid in the Third Lighthouse District, Staten Island, N. Y.; promoted and transferred as Assistant Superintendent, Eighth Lighthouse District, New Orleans, December 28, 1914, and was promoted and transferred as Superintendent, Seventeenth Lighthouse District, November 29, 1935.

Mr. Muth was granted six months leave of absence by the Lighthouse Service from June 14 to December 8, 1924, to perform the work of revising the building code of the City of New Orleans. He served many years as a member of the Board of State Examiners for Civil Engineers practicing in this state.

Mr. Muth was elected a member of the Louisiana Engineering Society October 1, 1915. He was elected Secretary of the Society on January 20, 1923, in which office he served continuously nearly thirteen years until his departure from New Orleans in November, 1935.

Mr. Muth was a member of the American Society of Civil Engineers and a past president of the Louisiana Section of that society. He served as Secretary of the Louisiana Section for many years prior to April 25, 1925, when he was elected Vice-President of the Local Station, and then President from April, 1927, to April, 1928.

He was married on July 16, 1913, to Miss Allie Lewis Frank, and is survived by his widow, two sons and a daughter.

> NOW WHEREAS, Frank Amende Muth was recognized by his fellow members as an efficient and loyal worker for the Society, which he served for so many years, and

as he enjoyed such a large and intimate acquaintance with the members of the Society, and in view of the high qualities of his character and integrity, both personal and professional,

BE IT RESOLVED that, in recognition of the loss of such a true friend and member, these remarks be spread upon the minutes of the Society and a copy be sent to Mrs. Muth.

Committee: E. S. LANPHIER,
J. M. ROBERT,
E. S. BRES.

PAPERS AND DISCUSSIONS

MOVING A FIVE-STORY BRICK AND CONCRETE BUILDING A DISTANCE OF 162 FEET IN ONE HOUR AND FIFTY-EIGHT MINUTES

By C. Glenn, Cappel *

Read at Meeting of the Society February 17, 1936.

The job of designing methods and accomplishing this work was turned over to us by Dr. Leon C. Weiss, head of the architectural firm of Weiss, Dreyfous & Seiferth, because we are engineering contractors and such a job being neither strictly architectural nor engineering could best be handled by engineering contractors.

The problem which confronted us was the removal, intact, of a five-story building to a new location 162 feet distant.

1. We first had to determine the feasibility of accomplishing the desired result, so we made a careful examination of the building.

2. It was a five-story and basement reinforced concrete structure about 58′ wide and 105′ long. The floor system is what is known as tile and joist construction, 4″ or 5″ concrete joists being separated by rows of terra cotta tile with a thin slab of concrete over all. The exterior walls are brick faced with tile backing, and the interior partitions of various usual materials.

The building is supported generally on four rows of columns —one row in each outer wall, and two spaced 9′ 4″ apart down the center, thus leaving a span of 22′ 10″ to the outside row of columns on either side. The columns are spaced 12′ 10″ along the major axis of the building. There are two exceptions to the column spacing—one of the front and center columns was offset about three feet towards the near wall (incidentally this column carried the heaviest load of any column in the building).

* Vice-President, W. Horace Williams Co.

Then there is an intermediate column between the other two columns in the front wall.

The existence of the basement was both a hindrance and a help. It facilitated the installation of the cradle, but offered special problems in support.

We decided that we could do the job.

3. Our first step was to compute the loads on each column. To you, who have never done this, it might appear a colossal undertaking, but you, who have done building design, will know that there is no mystery about it. You know the weights of the various materials, you compute the quantities and there you have the loads. All you have to do is start at the top and work your way down. A building structure is designed from the top down and built from the bottom up.

4. Now in moving, the heaviest load would pass over all points, therefore, the new foundations had to be designed for the heaviest load.

A pile foundation in New Orleans is a different proposition entirely from a pile foundation in any place where a firm subsoil condition exists, or where rock is within reach. Contrary to usual assumption, piles generally in New Orleans depend mostly on end bearing to develop their resistance, and develop skin friction only incidentally.

The sub surface structure usually provides strata of varying thickness ranging from a few inches to 10, 15 or more feet in thickness. These strata are usually composed of a mixture of sand and finely ground shell.

Your foundation is only as good as the strata upon which it rests. The function of the pile is merely to transmit the load from the unstable top soil to a more stable stratum.

Had the top soil been capable of sustaining the load of the moving building we would not have been confronted with the problem of designing a pile foundation which had to support varying loads applied quickly. Piles settle under load in New Orleans, so we had to try to design the new footings so that they would settle uniformly under the unequal loading. A certain amount of continuity was desirable, but not too much.

6. The uncertainty of the action of the piles under a quick load really took the design of these footings out of the realm of science and put it on a basis of experience and judgment. We added 15% to the piles which presently supported the building—made the footing continuous and reinforced it partially for negative movement. I cannot here go into a discussion of all the considerations governing the design of these footings. It would require too much time. Just bear this in mind—we made them safe, in our judgment.

7. The footings supporting the structure in its original position were individual footings with the proper number of piles under each column. We had to provide some means of stabilizing these footings under the moving variable load.

The basement slab was poured directly on top of the footings, and tied down to them to resist hydrostatic pressure.

8. The possibility of grant concentration of load due to inequalities, obstructions under rollers, settlement or any of the many things that might occur, coming on the edge of one of these footings causing a tendency to tip or over load some particular pile or two necessitated the use of a sill. This we provided in the form of a continuous 18″ 47# I.

9. The run or travel beams in the basement consisted of 18″ 54# I clamped to the concrete column stubs and supported by columns also of 18″ I section spaced 4′ 3¼″ on centers and resting on the sill beams. The run beams in the new footings were 2 channels back to back grouted into the footing. Continuity was provided by extending the 18″ I run beams into the new footings.

10. The type of roller which would be best suited to the purpose gave us considerable concern. A roller made of double extra heavy pipe filled with concrete travelling on both tracks at each column line was finally discarded in favor of a spool turned out of 7″ shafting to a diameter of 6″ on a 7⅛″ face leaving ½″ flanges on either end of the 9″ spool, which included the safety provided by the flanges and the elimination of the tendency of a roller supported at two points to change its direction of travel should the tracks get out of exact level.

11. The cradle was our next concern. It consisted of a 24″ 79# I clamped on either side of each row of columns within about 20″ of the bottom of the first floor. On top of these 24″ beams 12″ I clamps were to be grouted in to the columns and up to the floor slab which at the columns formed a capital. Two 8″ I's set directly under each column and resting on shelf angles riveted to the webs of the 24″ I's and resting on the lower flanges completed the cradle structure proper.

12. The pulling arrangements were a matter of considerable moment. First came calculations as to the amount of pull required. As far as I could see then, and the same is true now, there are so many variables affecting such a calculation that a whole lot more will have to be learned about it before one can make such calculations safely without using a very unengineering-like factor of safety.

The formula is P d = W 2 c — in which P is the pull, "d" the diameter of the roller in inches, W the weight and "c" a constant factor representing the lever arm on which the weight acts, induced by the "bite" of the roller into the tracks. In this case the value of "c" is supposed to be .02 approximately. This would give us a required pull of

$$P \frac{10{,}000{,}000\# \times 2 \times .02}{6''} = 66{,}667\#$$

Due to probable imperfections in track conditions, obstructions to rollers—such as dust on tracks, etc., and flange bind, we decided to design for a pull of 600,000#. Having four lines of tracks (double) we designed the bracing to transmit the load without appreciable deflection to each—in other words, 150,000# to each line of columns.

The rigid and comparatively brittle type of construction of the building made it imperative that the pull be uniformly applied to the four lines of columns so that there would be no tendency to distort the structure and so cause ruptures in the rigid frame.

It was determined to pull from one point located one-third forward from the rear and on the center line of the major axis.

Thus the horizontal bracing of the cradle received its load two-thirds as push and one-third as pull.

The motive power was a 10 x 12 steam hoist with three drums, only two of which were used. Two 8-sheave blocks were used anchored to a cross head in the far end of the new footings. Two 4-sheave blocks were anchored about midway of the new footings as a precaution in case any difficulty was experienced in starting. Thus we had sixteen parts of ¾" cable on the main blocks and eight parts on the auxiliary blocks.

With plans made the work proceeded. From borings it was determined that a satisfactory stratum could be reached at about 45′, so the piles were seated in this stratum. Piles were carefully checked to determine if any were unseated by upheaval caused by the compression of the soil. Any found so were reset. A No. 1 Vulcan Hammer was used, giving an average of about 25 to 30 blows to the last foot—which resistance was perfectly satisfactory.

Due to the congested condition at the site, ready mixed concrete was used. The steel framing had to be detailed correctly and the fabrication performed accurately. I wish to compliment Mr. Gondron of the Jones & Laughlin Steel Corporation for his unstinted efforts and co-operation along this line.

While the new foundations were being built the basement was cleared out and the steel work set.

The cradle was first set, the collars and needles placed and grouted in. Then the run beams or tracks were clamped in temporary position and the columns and sills put in.

The spools were then set in their proper position and 640 steel wedges 4″ and 8″ long were driven tight under the sills, after which the sills were concreted into place.

We now had the weight on the cradle and travelling structure. Working on alternate columns we cut away half of the concrete columns and placed and grouted in one of the two 8″ I's. After the grout had properly set (we used Incor quick setting cement) the remaining half of the columns were cut away and the other 8″ I's placed.

The weight of the building was now free on the travelling structure. No preceptible movement was observed when all columns were cut free, evidently we had taken the load fully with the wedges.

We were now ready to move after about six weeks of preparation.

With the use of compressed air, water and thin steel blades, we cleaned off the tracks and around the rollers.

In order to check the movement as it progressed, we set cross arms on the front and rear corners so that a transit set in the rear of the building could check the lateral and vertical movement at the same time. For a check of accuracy a level was set to check the elevation of the two front corners.

Everything was ready to move and it was planned to do the moving the afternoon of June 4th, 1935. A preliminary pull was made the afternoon before so as to be sure there would be no hitches the next day.

According to our calculations it took a 615,000# pull to start, which was the full capacity of the pulling rig. We only moved the building about 10″ that afternoon. It was then found that in spite of all our precautions some dust had lodged in front of each roller, it was mashed into thin flakes after the passage of the rollers. If we ever move another building using this method, we will certainly take utmost precautions to prevent dust or obstructions of any kind, no matter how small, from accumulating in front of the rollers.

Rollers were spaced properly ahead.

In order that every detail might be observed men were stationed at posts along each track and Mr. Grenier and myself gave our closest attention to every detail.

When we gave the signal to go a 338,000# pull moved the building to its final resting place 162′ distant in an actual moving time of twenty minutes, total elapsed time being one hour fifty-eight minutes.

During its travel the building moved sideways to the limit of the spool flanges in both directions. The rollers had to be

skewed to correct this motion and prevent undue pressure on the spool flanges.

As the building moved forward onto the new foundation, the front end lowered ⅛″, when it was entirely on the new foundation it leveled off ⅛″ below its original elevation. At the end of 24 hours, after it reached its final position, it had settled uniformly ¼″, 48 hours later another ¼″, and ten days later it came to rest level and ⅞″ below its original elevation.

After the building was clear of the old position, the steel underpinning in the old basement rose ¼″.

The flanges on most of the spools showed signs of coming in contact with the edges of the track beams with considerable force as some of them were badly scarred. The top flanges of the 18″ run beams were bent downward slightly, the center 2½″ seeming to take most of the load. The tracks had been aligned to an accuracy of 1-64″.

Some obstructions on the track must have thrown undue load on the cradle beam on one side near the rear, as cross stress lines appeared in the last 40′ of one line of 24″ I's.

Four hundred thirty-two spools were always under the building. This gives a load of about 4000# per lin. in., based on the 6″ flange of the 18″ run beams.

After the building arrived at its final location the travel, or temporary footing was promptly cut away to prevent any unequal settlement.

Rollers were well greased and then along with the cradle concreted in. The building now stands on cradle and rollers.

The entire movement was accomplished without causing a single crack in either masonry or plaster, and without unsettling a single door or window.

The execution of the work was under the direction of one of our Vice-Presidents, Mr. J. L. V. Grenier. The fidelity with which the most minute details were carried out by Mr. Grenier and the men under him was, of course, essential to the success achieved.

Discussion

C. J. WIGGIN, JR.: I would like to ask three questions. Would you take the job again? What was the amount in money saved by moving instead of demolishing and rebuilding? How large a building can be moved?

MR. CAPPEL: The answer to the first is "yes." The savings amounted to about $200,000.00. The foundations are the problems in moving buildings, not so much the size.

MR. SCALES: I would suggest that engineers who are interested in the subject of moving buildings might find some interesting data in some of the issues of *Engineering News Record.* I have in mind particularly the Telephone Building in Indianapolis, and the Telephone Building in Dallas. The latter buliding was picked up and turned around ninety degrees. In neither of these buildings however were there foundation problems, as bed rock was available in each case.

MR. NAQUIN: What was the method of machining the ways?

MR. CAPPEL: A buffer and straight edge were used to true up the ways.

MR. MULLER: How did abrasion upon rollers and sides of flanges show up?

MR. CAPPEL: Flanges of the beams were bent downward, and rollers were badly scored.

MR. GODAT: How was block attached to cradle?

MR. CAPPEL: Plate girders 48 inches wide were attached to the horizontal members. The plane of this 48-inch girder was horizontal, and in the center was bored a six-inch diameter hole to attach pulled tackle. The cross bracing of the cradle was designed to send the strain to this central point.

MR. MEYERS: How was the load on the offset column taken care of?

The load was transferred to 24″ 79# I-beams, clamped to each side of the column, and on top of these, 12″ I clamps grouted into the concrete column.

MR. TODD: This has been a most enjoyable talk and diecussion, and while it is possible that larger buildings than the one shown here to-night have been moved, I doubt if any have presented the serious foundation problem present in this case.

THE MANUFACTURE OF LARGE MACHINERY

By W. M. WHITE *

Delivered Saturday, January 25, 1936, at the Annual Meeting of the Society.

The manufacture of large machinery is characterized by the provisions which must be made to care for the effects of the properties of large masses of materials.

Temperature changes which are of negligible value in the manufacture of general machinery are disturbing factors in the working of large metal parts for large machines. The distortion of large machine parts due to deflection caused by their own weight, due to flow of the material of the part under stresses requisite to the machining of the part, due to the removal of a hard surface in machining, or due to the removal of a section under initial strain produced in the cooling of the part, must be cared for in the machining operations.

The economical production of large machines requires that the surface to be machined shall be a minimum. In consequence, individual parts of large machines are made as large as is consistent with casting, handling, and shipping.

In large machinery the dividing up of any part merely for the purpose of manufacturing usually increases the total weight due to the flanges and bolts for providing the means for joining the parts, and in consequence the cost is increased.

The patterns for the manufacture of large castings are frequently made of the skeleton type, thereby avoiding core boxes particularly where the cores are sufficiently large for the molders to work within the pattern.

In large machines of different types, the castings will be of different composition and in the economical operation of the iron foundries, the rapid and frequent tests of the molten material is requisite in order that the melting cupola may be continued in operation, but the issuing mix be changed to meet the many requirements for the variety of large castings for the day's pouring.

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* Chief Engineer, Hydraulic Department, Allis-Chalmers Co., Milwaukee, Wis.

In a plant for the manufacture of large machinery, the forge shop is required to maintain a stock of large billets from which to forge various parts for machining. If these forgings are heated too rapidly, temperature stresses are set up, sometimes so great as to actually rupture the material. The billets can be heated only at the proper date considering the rate of flow of heat in the quality of material in the billet. Large castings and particularly steel castings are frequently given a rest period after the first machining in order that the casting may take its permanent set before final machining.

Heat treatment of materials has now become almost as important and requires nearly the time taken in the machining of the part. In the manufacture of large machinery, adequate heat treatment facilities with metallurgists and all necessary recording equipment is required to produce the parts of the particular physical properties required.

The handling and supporting of large parts of machines introduces problems in the economical operation of a manufacturing plant. Perfected means for welding together large masses of material has changed the balance between the foundry, machine shop, and plate shop.

For economical production, the component parts of large machinery must be castings, forgings, or welded parts which can be fashioned to meet the requirements of shape and stress for the least cost.

How large machined parts are made, machined, handled, assembled, and tested, what machine tools are required for economical production of large machinery, is fully illustrated by many lantern slides from photographs of the actual production of a multiplicity of large machines.

Discussion

Mr. Nelson: Dr. White's paper has been particularly interesting to us at the other end of the line. We also plan the erection of large machinery and have the numerous problems which the designer has to content with rather than the technical problems of the machines performance. I think there is room for a

little more co-operation between the designers and erecting men in the matter of having the designer study the problems which the field man has to meet in the matter of handling and direction. In the matter of handling, it is well for the designer to give some attention to the number of pieces into which the casting is divided, and there should well be considered the facilities on the job for hauling or lifting the particular machinery when the job is in a remote location, where the facilities may be very primitive.

Another thought is in the matter of foundation. I think the designer should confer with the man who is going to lay out the foundation and the man who is going to build it. The foundation can be greatly simplified which not only means the reduction of expense, but the minimizing of the danger of the loss of the machine. Another point which I believe would be pertinent is that in designing the machine the designer ought to remember that it some day has to be repaired and new parts needed on the machine. Unless that feature is remembered it is apt to be very serious and might mean a loss of the machine unless it has been planned for beforehand with that in view. These things are all practical points that I believe can only be taken care of by the designer making more frequent visits to the field where he can talk to the journeymen, so that he can correct the machines as they come out. I do not think any manufacturer that I know makes his designer go out as often as he should on the job.

Dr. White: The manufacture of large machinery is characterized by the difficulty of making and keeping large masses of machined parts to drawing dimensions.

A factor in the manufacture of large machines is that the shrinkage is not uniform. When you have a large casting, sometimes it will not shrink at all in one direction and shrink more in another. The designer may think that that is not his problem, and that it is the problem of the operator of the shop. We have found by long experience unless we do give it attention from the office, unless we are in constant touch with the shop and live with the operator during its construction, that later on we have a casting that does not meet the dimensions and then we will have to redesign some of the parts to try and save a $4,000 or $5,000 cast-

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ing. Consequently, we have to watch the operations and the casting and the handling of the casting all the way through.

MR. EUGENE FLOURNOY: I would like to know if in your experience in dealing with large cylinders of extreme large sizes, whether or not they can be bored in a vertical position and operated in a horizontal position.

DR. WHITE: You will find in most of our large shops that you will bore that cylinder in a vertical position if it is going to be operated in a vertical position. If your machine is bored in a horizontal position, it is operated in a horizontal position.

PROFESSOR J. M. ROBERT: Mr. Chairman, may I just make one remark. Any attempt of mine to discuss Dr. White's paper would be to paint the lily or gild fine gold. Of him we can only say what was said of Alexander Pope. "And more and more wonder grew, that one small head contained all he knew." I want to extend to Dr. White the thanks of Louisiana Engineering Society for coming here and speaking to us this morning.

Diplomacy

"How old would you say I am?" asked the foolish maiden.

"I haven't the slightest idea," replied the diplomatic youth, "but I can safely say you don't look it."

Pa: "Son, what did the teacher say about your arithmetic?"

Son: "She said she'd rather you wouldn't try to help me with it."

Patient (nervously): "I suppose the operation will be dangerous, doctor?"

Doctor: "Nonsense! You couldn't buy a dangerous operation for forty dollars.

"I'm sorry I forgot your party the other evening!"

"Oh, weren't you there?"

Customer: "I don't like the looks of that haddock."

Fish Dealer: "Lady, if it's looks you're after, why don't you buy a goldfish?"

THE EFFECT OF CORPORATE AND PUBLIC EMPLOYMENT ON THE PRACTICE OF CONSULTING ENGINEERING

By Arthur M. Shaw

Read at the Annual Meeting January 25th, 1936.

Introduction.

The purpose of this paper, and of the prepared discussions which are to follow, is mainly to present a survey of the present drift toward the employment of engineers by states and their subdivisions, by the Federal Government, and by corporations; and the influence of such employment on the business heretofore enjoyed by the engineer in private practice. As a corollary to this survey, some attention will be given to abuses which appear to be growing out of the system, at the same time recognizing the many benefits to the profession at large which undoubtedly have resulted from its operation. The committee which is responsible for the selection of our subject has expressed the hope that the discussions which it is designed to provoke will suggest a workable plan under which a correction of unwarranted conditions, prejudicial to the interests of the consulting engineer, may be devised.

In the preparation of this material, a serious effort has been made to comply with Arnold Bennett's specifications for a good talker. You will find 100% compliance with at least the last two sentences (and especially with the last) of the following quotation:

> "A good talker lets himself go. He does not stand on the order of his talking. He talks. * * * He is not a strict devotee of logic. He is ready to contradict himself, to alter his opinion without regret. He admits all the time that he is not the sole font of everlasting wisdom. At the end of the sitting you may decide that you are a more sagacious individual than he is."

Before proceeding with a discussion of the subject, it may be well to define the term *Consulting Engineer* as it is here used. We will not be confined by the strict dictionary definition but will consider the term as including all that considerable number

of engineers who are carrying on a private engineering business and who undertake design and supervision as well as strictly consulting engagements. Such engineers are usually engaged on a fee basis though they may be paid a salary for part-time service of limited duration.

That the business of the consulting engineer (as he is so defined) has been encroached on to a substantial degree by the increase of staff organization is obvious to the most casual observer but to just what extent the present unenviable position of the free-lance engineer is due to recent encroachments it is difficult to estimate. The depression has so submerged all other influences that their accurate determination is about as difficult as the measurement of an ordinary tide during the passage of a West Indian hurricane. If time permitted, this analogy might be carried further.

It would seem to be well within the province of the organized profession, as represented by the Louisiana Engineering Society, to be concerned over any practice or custom which affects the welfare of its membership, to study cause and effect, and to make a strenuous effort to correct abuses which are found to exist. From such a study however, we will find that not all of the inroads on the business of the consulting engineer may be condemned as some of them are unavoidable results of an economic evolution which has conferred, and undoubtedly will continue to confer, great benefits on society.

Engineering Employees of Public Bodies and Corporations.

One often hears it said that when an engineer enters the employ of a large corporation or a public agency, he sinks his identity and loses the opportunity for the exercise of initiative. This may be true to a certain extent but, without the opportunities afforded by well-equipped organizations, it is doubtful if Steinmetz could have gone as far as he did in the field of electricity, or Dr. White done as much in turbine design, or our own Bald win Wood been as successful in the development of the screw pump. If we are to be governed by those principles which are the basis of our generally-accepted codes of ethics, we must accept any condition which promises the greatest benefit to the

greatest number, even though it causes loss to some of our members.

For specific examples of business lost to the consulting engineer, we may refer to the increasing numbers of technical men employed by municipalities, State Highway Departments and the various departments of the Federal Government. Practically all of the large industrial corporations maintain, and train for specific duties, men who first studied some branch of engineering. It is seldom that such concerns find it necessary to call in outside consultants.

That great benefits to society, and frequently to the profession, often result from this departure from old-time practice can not be denied though we should not permit this to deter us from a critical study of the whole field nor prevent us from making strenuous efforts to correct evils as they are discovered.

Highway Departments.

Since the practical completion many years ago of our system of railways, there has been no wide-spread engineering construction in this country at all comparable to the highway program. Well within the memory of our older members, the United States had the unenviable reputation of possessing the worst system of public roads known but, in spite of our unequalled highway mileage, the most of our important routes are now "out of the mud" and we occasionally hear foreign travellers comment on the superiority of our roads over those of older countries. Such a wholesale change could not have been effected without a complete revision of the old system—or lack of system—of highway construction and maintenance. Almost no highway work has been left to the independent engineer, yet it seems doubtful that any plan, radically differing from that which was followed, would have achieved better results, or as good results at lesser cost. Errors have occurred and money has been wasted but probably to no greater extent than would have resulted from any other system.

Admitting the excellent work that has been done by the most of our State Highway Commissions, we still may ask the question as to just how far such a department should go in specializa-

tion of its staff. For example, should it maintain a complete bridge department, headed by a specialist competent to cope with the most intricate structural problems that may arise, or should an outside specialist be called in if an unusually difficult condition is encountered? Also, how complete a department should be organized for carrying through an extensive but a short-time program? Or what steps should be taken to bring the force down to normal after the extra need has passed? It would take a far wiser (or more incautious) man than the present speaker to hazard a guess as to just where these lines should be drawn though it seems apparent that from a purely economic point of view, some of the technical work now handled by staff employees of highway departments might better be left to the independent engineer. This seems to apply particularly to the design of important bridges. With practically all the highway bridge planning closed to the free-lance, and much of the railway work already gone in the same direction, how is the next generation to provide its Waddell, Steinman, Modjeski and others who have placed this country in the lead in bridge design? There are men who have served with these pioneers and have drawn inspiration from them, who should be worthy successors as leaders in this particular branch but if they are forced into some other line of endeavor they may develop only mediocre qualities. It is to the credit of our profession that those members who have been placed at the head of highway departments have so frequently been guided by ability rather than political influence in the selection of their assistants, but so long as our government retains its present system of appointment of civil employees, it is doubtful if the atmosphere of a political office will be found conducive to the development of the highest-caliber bridge designer.

While the most of us may feel that improvements could be made in the present system, we should not fail to give credit for these has been the closer and more intelligent supervision given the great reforms that have been effected. Most notable among to the thousands of secondary road structures. Our younger members may appreciate the following account of a bridge letting which is typical of conditions as they existed in the Middle-West a generation ago. The township system of road control

was in vogue, with no one in responsible charge who was equipped, either by training, experience or inclination to render service of any particular value. A new bridge was required for a minor stream crossing. The County Surveyor was employed to prepare a profile of the crossing and write the specifications. He professed no knowledge of engineering and the only work of reference to which he had access was a frayed copy of Gillespies' "Land Surveying". His specifications merely called for "a steel bridge of suitable design" and of stated span, which was to rest on four supports, each to consist of "three piles driven well into the ground, surrounded by a steel jacket filled with concrete". The bridge location was carefully tied in to adjacent section lines and the local variation of the compass given, but the only part of the structure which was described in detail was the oak decking plank. A portable sawmill had been erected in the vicinity by one of the township officials and oak plank of the type specified could be secured from no other known source.

The letting was at the bridge site, with no one present but the local officials, a few neighboring farmers and the bidders. Each proposal was handed in on a slip of paper and the award was forthwith announced, It is a well known fact that there was no hard feeling between the bidders on such occasions excepting in the rare case when one of them would fail to be bound by the gentlemen's agreement reached over the inevitable poker game of the night before.

Graft is still discovered in our day but it usually *is* discovered, and though it may be on a grander scale in the "good old days" of the county bridge racket, it is doubtful if it contaminates as many people as it did when control was more scattered.

The operation of the State Highway Departments is more or less typical of that of other public bureaus, such as the various State Boards of Engineers, the Federal Bureau of Public Roads, the Reclamation Service, etc. Their activities have been beneficial to the country and their continuance is most desirable but in their commendable desire to increase their usefulness, it seems to many that they have expanded beyond economic limits, with a resulting loss both to the public and the consulting engineer.

A General Survey.

With the idea of securing a perspective of conditions as they now exist in various sections of the country, a letter of inquiry was sent to about fifteen consulting engineers of prominence, the most of whom were among my personal acquaintances. Names were selected to secure as good a representation, geographically, as possible. After stating the title of the proposed paper and its scope, each engineer was requested to give such an account of his own experience with comments on the subject as he might wish to make available for our consideration. Each was assured that neither names nor specific cases would be made public. Each was a full member of one or more of the national engineering societies and all have an established reputation in some branch of the profession.

I wish to take this opportunity to express my appreciation of the responses received to the letters of inquiry. The replies are given more or less at length in the following excerpts. It will be noted that, in spite of the fact that many of the authors have suffered serious inroads on their business, there is no sign of lamentation or querulous complaint; good sportsmanship is evident throughout. These letters are a material contribution to the matter under discussion.

Comments of Other Engineers.

A—From an engineer who operates an office in New York and another in the Middle West:

> "The engineering organizations of many of the large corporations have taken over altogether the work that was formerly done by private engineering concerns, and in many cases the private engineer is called in only on unusual questions. If these orgaizations continue to expand, the work of the private engineering offices in the design and supervision of construction will —in my judgment—be largely a thing of the past."
>
> He also mentions the unfair and dishonest practice of companies which are engaged in the promotion of public utilities and which include in their promotion charges and unreasonable amount for engineering services.

B—A consulting engineer on the Pacific Coast, who is a member of the engineering faculty of a university, writes that he is:

> "Satisfied that public and corporation employment has very much limited the practice of consulting engineering." He adds:

"My consulting work has largely been confined to work for irrigation, flood control and reclamation districts, and expert work on water rights litigation for power companies. Frequently my engagements have been as a member of a consulting board of two or three engineers, and in cases where I have been first employed, I have usually insisted that some one or two engineers, not connected with the university, be also employed."

C—Another engineer on the Pacific Coast writes that:

"* * * the salaried engineer has to a large extent been absorbed by some of the alphabetical agencies but the man who maintains an office has lost out because all the brains are supposed to come from Washington." He adds that " * * * this leaves us with fewer clients and little hope for the future".

D—An engineer in the Middle West writes that he specializes in the design and supervision of construction of dredging plants. Manufacturers of dredging and other equipment have cut in on his business to a certain extent by furnishing free advise and plans for smaller units but by confining his recent work to the larger units, he has been doing a reasonable amount of business.

E—The following is from the experience of an old-established engineering firm in the East which has been principally engaged in the design and construction of municipal water systems:

"There is no doubt that public employment of engineers to serve in a professional capacity on water boards or water commissions, with more or less permanent positions, has considerably reduced the opportunity of the consulting engineer in our line of business."

F—A firm of engineers in the Middle West which devotes the most of its time to municipal sanitation and municipal power plants writes that it has suffered considerable loss of business of late as a result of competition from university professors and from employees of public agencies, notably from those of the Chicago Sanitary District. No complaint is made of such competition so long as it is conducted along fair lines, but mention is made of the occasional practice of cutting rates, this being made possible by the fact that the engineer who has another source of income, and frequently has free use of office and other facilities, is able to work for a fee that would be below that which would be possible for one who maintained his own office and full organization.

G—An engineer from the South mentions the encroachments on the business of the consulting engineer by machinery and

equipment representatives who offer free engineering service and advice. He also calls attention to the fact that while road work for parishes and counties formerly furnished him with a considerable amount of work, this is now practically all lost to the engineer in private practice, as it is now all handled by the State Highway Commissions.

H—Another engineer from the South, but whose contacts cover a large portion of the country, mentions particularly reports of employees of Federal Departments who have been given leaves of absence from their permanent positions to undertake extended engagements in Latin-American countries for the purpose of organizing and placing in operation public road bodies and other similar governmental agencies of a similar nature. It is reported that such Federal employees are permitted to return to their original status in the employ of this government on their return. This is direct competition with engineers in private practice and apparently is unwarranted.

I—A bridge firm, whose structures may be found all over the United States and in many other countries, mentions the fact that railway bridge design is now handled almost exclusively by the bridge departments of the various railways and that the bulk of the highway bridges are now designed by the staff employees of the various Highway Commissions. It is stated that—"The bridge engineer's practice at the present time consists mostly of city bridges, toll bridges built by various authorities, movable bridges and other special structures."

J—An engineer of the South who has specialized for years in flood control, irrigation and drainage, writes that until the past few years, his business has not suffered seriously from encroachments by the various Federal agencies but that the situation has changed materially in recent years. He states that:

"It is the increasing tendency of the Government to require that work in which they are interested be supervised by Government-employed engineers. On that account, the future looks hazardous to us because our operations may be seriously curtailed due to the activities of Government-employed engineers."

Direct Competition From Salaried Employees

It will be recalled that in more than one of the foregoing excerpts, mention is made of work undertaken by men who are on regular salary but which is not connected with their regular duties. In other words, devoting a part of their time to consulting work, thus introducing competition into those fields which

still may be considered as the logical province of the consulting engineer. While it was not originally intended so to do, we might profitably give some attention to the direct participation in the consulting field by individual members of salaried staffs who take on work to be done "on the side".

In many instances, outside activities are of such a nature that they seem to be fully warranted but no justification can be found for the salaried man who solicits or accepts business on a cut-price fee basis in competition with an independent engineer. The man who has an assured income may often take advantage of facilities provided by his own organization, at no cost to himself. He has no fixed overhead; his salary is presumably sufficient for his personal expenses, and he may even be able to get much of the routine work connected with the engagement done by the under employees of his own organization. This enables him to make a substantial profit out of a fee which could not be considered by a man who is compelled to maintain an independent office. No one can dispute the fact that such competition is unfair, unethical and prejudicial to the advance of the profession. It should be opposed vigorously by every member whether he has suffered directly from it or not.

On the other hand, it seems neither wise nor desirable to oppose all outside activities of engineers who hold salaried positions provided that they do not take unfair advantage of their special privileges. The second letter quoted, that from the university professor on the Pacific Coast, meets this issue fairly. He states that he is retained frequently as a member of a consulting board and that on other types of engagements he has usually insisted that some one or two other engineers, not connected with his university, be also employed. Men in the teaching branch of the profession are especially in need of outside contacts and it would be a distinct loss to society if such an experience were denied them. I have yet to meet the professor of engineering to whom I would be willing to entrust the training of the next generation of engineers if his fitness for the duty were limited by his own university training, a little desultory reading and his laboratory investigations. An occasional but not too frequent outside engagement will not only add directly to his knowledge but it will broaden his view, spur him to further study and enable him

to benefit more from such study than would otherwise be possible.

Apparently this whole subject of competition by men employed on a salary resolves itself into a question of fairness and of business ethics. The profession may well be concerned however with the frequent infractions of accepted codes of ethics and should be diligent to correct such offenses.

Competition From Sales Representatives

At this point, mention might be made of another type of competition, one which originates with manufacturers and sales organizations. The incident of the bridge letting previously referred to is but an extreme case illustrating a practice which still exists. Nearly every large corporation which manufactures industrial and construction equipment maintains a high-pressure sales organization and in recent years there has been an increasing tendency to employ men in this department who have had technical training. If these men and the interests which they represent confine their activities to their own proper fields, and it must be said that many of them do, the engineer-representatives can add dignity to their calling and reflect credit on the engineering profession, of which many are honored members. All of us who have gone into independent practice as consulting engineers recall with a feeling of gratitude the many occasions when we have received substantial assistance from men whose intimate knowledge of special problems could have been gained only by their association with an industrial or commercial organization. It frequently is only through contacts with such men that we are able to keep posted in regard to latest developments in our own special lines. For a simple but concrete illustration: When I left this country several years ago for an extended foreign engagement, there had been no talk of such an anomaly as a self-priming centrifugal pump and when an advertisement of such appeared some time later, my first impulse was to quote the classic remark of the rustic who took one look at his first giraffe and said: "They ain't no such thing". Instead, however, I kept my ignorance to myself until a man was found who was selling that same pump. The matter was put up to him and in less than five minutes he had restored my confidence in the advertiser,

satisfied my curiosity, and added materially to my knowledge of pumping equipment.

While we appreciate the valuable services rendered by the technical men who are engaged in selling, our profession should and does deprecate the practice of many who offer free engineering service as a part of their sales propaganda. A valuable safeguard has been provided to the public by increased respect of engineers for the ethical standards set up by the various technical societies. Under any of the known codes, a consulting engineer may not have a financial interest in the use of any equipment or device incorporated in the plans which he has been engaged to prepare. In this and many other ways, we try to insure to our clients an unbiased set of recommendations, often going to such extremes that we are accused of "leaning over backwards" to avoid even an appearance of self interest in advice given to clients. If such care is required of a man whose livelihood depends as much on his reputation for square dealing as on his technical ability, it does not seem possible that a prospective customer can hope to get an equivalent service from an individual or corporation whose prime objective is an increase in the sale of their own products. Manufacturers have been responsible for the development of much of the equipment, the advantages of which we are enjoying to-day, but so long as human nature remains as it is, the man whose living depends on the sale of a specific article, even though he be a competent engineer, is in no position to give impartial advice regarding its selection.

Engineering Contracting.

It was not so many years ago that the most of the contractors in this country were men who had worked up from the ranks of laborers, with little training other than that secured in handling men and materials. Their speech, if somewhat ungrammatical, was often picturesque and always forceful. Whatever they may have lacked in formal education and social graces was largely offset by their resourcefulness, energy and daring. In recent years, such men have either dropped out of the field or have associated with themselves those who have had a good engineering education. The result is found in our day in the engineering-contracting concerns which range all the way from individuals or

small partnerships to huge corporations. So long as such interests keep within proper limits, they do not encroach seriously on the business of the consulting engineer, even though they may meet and solve engineering problems of the most intricate nature —as many of them have done. It has quite generally been such contractors who have developed successful methods for tunnelling through mountains and under rivers; who have gone to unheard-of depths to secure firm foundations for our great bridges and buildings; and who have made possible the construction of the greatest dams that the world has known.

Some of the engineering-contracting firms and corporations have departed so far from their contracting business as to offer free engineering advice and other services as an inducement to owners. That this gives them an unfair advantage over the consulting engineer, the owner and competing contractors is obvious. It places them in much the same category as the engineering salesman previously mentioned. The practice is quite generally condemned by technical societies as unethical and prejudicial to the interests of the profession and the public. In many instances it has caused a serious loss of business of consulting engineers but as the subject has been thoroughly discussed in recent years both in society meetings and technical press, it will not be treated further at this time.

Increasing the Field for the Consulting Engineer.

There has been a tremendous field opened, especially for the young engineer, by the increase in technical staffs to which reference already has been made, but such employment and the opportunities which it presents do not come within the scope of this paper. There is one agency of the Federal Government however, the operation of which has resulted in a substantial increase in business for the engineer in private practice. This is one of the new "alphabetical" bureaus, generally known as the PWA but officially designated as the "Federal Emergency Administration of Public Works." This agency is peculiar in that it undertakes no design work and furnishes no construction superintendence, in the ordinary use of the term. Each applicant for a loan or grant through the PWA is required to employ its own technical aids for the design and supervision of its proposed works. It is

only required that the engineer or architect employed by the applicant be competent and suited to the position, that his plans stand up under examinations made by the staff of engineers employed by the Administration, and that the fees charged be reasonable. The inspection and supervisory service set up by the Government has been planned to interfere as little as possible with the normal administration of the various jobs, as usually carried on by an engineer in private practice.

I shall not attempt to go into the details of the workings of the PWA, one reason being that the data locally available are inadequate for the purpose and a still better one being that arrangements have been made for a guest speaker to present the subject more fully and more authoritatively than would be possible for me.

Conclusion.

A study of the present situation forces us to the conclusion that the field of gainful employment of the consulting engineer is gradually being restricted. It does not follow that the species will become extinct but economic evolution will inevitably limit our field of endeavor and undoubtedly will tend to reduce the number of men following our particular branch of the profession. This should not permit us however to pass unchallenged those practices which are detrimental to the welfare of the profession and the public. There will always be a demand for the services of a well-trained man of ripe experience to act as a guide and councellor for corporations, public bodies, private investors and the courts, any one of whom may, at some time, be in need of unbiased, intelligent technical information and advice.

The field of the consulting engineer of the future certainly will be narrowed, it perhaps will become more specialized, and it is possible that a higher intellectual standard will be required than now may be found in the average office. If such proves to be the stage into which we are passing, those who plan to enter the field of consulting engineering might with profit to themselves make a critical study of their own qualifications to make sure that they are equipped mentally, temperamentally and financially to cope with conditions as they now exist and as we have good reason to believe that they will develop in the future.

THE PUBLIC WORKS ADMINISTRATION AND THE CONSULTING ENGINEER

By Arthur J. Bulger *

Discussion of January 25th, 1936.

Colonel Shaw has ably presented the question of the encroachment on the field of the consulting engineer, as he has defined the term, by the public or corporate establishment of engineering staffs. He is entirely correct in summarizing the situation as one of economic evolution, which the members of the profession should recognize and prepare to meet. It probably means as much a change in character of work as well as in scope as the intensive side of technical development gains in importance.

Unfortunately there is apparently no quantitative data from which one may form an opinion as to the increase in the number of engineers employed on a permanent basis and the corresponding reduction in the numbers of consulting and professional engineers in private practice. We are forced to rely upon the general impression that we all have received in the past few years. However, at the present time such a survey is in progress. At the request of the American Engineering Council, the Bureau of Labor Statistics of the Department of Labor, under the direction of Dr. Lubin, is conducting a survey of the engineering profession. From this survey we will be able to get an accurate idea of the distribution of the engineering profession and, as the survey is continued, of trends in the employment of the engineering profession. This data will probably begin to be available within six months.

It may be interesting, however, to note the number of people affected by the subject under discussion. While we do not have the figures as of to-day, we can get some information as of the 1930 census. From those figures, it appears that out of industries employing 47 million people, 226,000 were engineers. The largest proportion of these engineers were classified as civil engineers, the mechanical, electrical, mining, chemical and

* Assistant Director of P. W. A. Engineering Division.

metallurgical engineers following in the order named. Of the 226,000 engineers about 25% were engaged as consulting engineers, the proportionate distribution as to profession being the same as in the total of all engineers. So, therefore, in 1930 there were approximately 54,000 professional and consulting engineers, some engaged in private practice and some on salaried staffs of engineering or industrial companies.

Among the various industries, the public utilities and communications systems had the highest proportion of engineers among their employees. As is to be expected, their engineering staffs were largely of the electrical and mechanical professions. Next in order was the government service, wherein approximately 25 engineers were employed per thousand of total employees. By far the largest number of engineers employed by the government are classified as civil engineers. The construction industry employed a much lower proportion of engineers on a permanent basis than any other industry, except perhaps transportation. I refer here to the number of engineers permanently employed in the construction industry and not to the consulting engineer, for whom it always has and will continue to provide a most important field for the practices of professional and consulting engineering. It appears that if we take the total number of engineers dependent on this industry, we will find a higher proportion of engineers than in any other industry. I mention this latter fact as it is of particular interest in discussing the relations between the Public Works Administration and the consulting engineer, because the Public Works Administration program has its greatest effect on the construction industry. For instance, the distribution of non-Federal projects, estimated to cost nearly two billion dollars, on July 1st of last year, was as follows:

Buildings	$736,000,000
Engineering structures	237,000,000
Sewers and waterworks	480,000,000
Streets and highways	146,000,000
Flood control and reclamation	72,000,000
Railroads, aviation, recreation and miscellaneous projects	236,000,000

At this point it should be noted that the construction industry provides a direct stimulus to other industries, which in turn demand the services of the consulting engineer.

I shall not discuss the causes of the encroachment of the corporate establishment of engineering staffs upon the field of the consulting engineer. It is well, however, to note that one of the principal factors which has reduced the field of the consulting engineer is the growth of the large corporation which can afford to maintain on a constant employment basis a staff of skilled and experienced engineers, because in their immense business organization the incident need for expert advice is very frequent. This condition is of comparatively recent growth, as in the days when corporations were smaller it was not economically justifiable for them to maintain such a staff and it was necessary for them to call in the outside consultant. Certain holding companies also have used the establishment of such an engineering staff as a means of assessment against subsidiary companies, and to this extent have often encroached on the field of the consulting engineer, where there is no economic justification for so doing.

While it is true that the larger cities maintain large staff of engineers, yet it is also true that where a new development of a project is planned they most often call into consultation one or more consulting engineers. For example, the city of Buffalo, in constructing its sewage disposal plant, has called into consultation a nationally known firm of consulting engineers. So likewise has the District of Columbia in its sewage disposal project.

The Public Works Administration as it was originally organized under the National Industrial Recovery Act promoted the fullest possible utilization of the existing productive capacity of industry, consistent with the providing of employment and the construction of useful projects. Under the Joint Resolution of 1935, it has continued the policy and this policy is of particular interest to the professional and consulting engineer. The Public Works Administration, as Colonel Shaw has called to your attention, does not perform any engineering services, except such as are necessary to administer the Acts

under which it is authorized. It does, however, require that all projects be planned and constructed under adequate technical supervision and allows the utmost freedom to its borrowers and grantees in the choice of their technical advisers, requiring only that such advisers be competent and that they be paid out of public funds not in excess of a reasonable amount. I quote from a typical letter of instructions of the Director of Engineering in regard to professional services:

> "The Public Works Administration is interested in contracts for professional services to the extent that such contracts provide for adequate engineering service at a reasonable fee. It is interested in the fee to the extent that such fee is to be paid from the funds advanced by the Government; that is, if a fee is proposed as payment which is considered unreasonably excessive, approval should be given with a notation that the proportion of that fee paid out of funds advanced by the Government is to be limited to a definite figure. It should be noted that the Public Works Administration's approval of engineering contracts is given in the sense that the Public Works Administration finds no objection to the contract and not in the sense that it endorses the terms of the contract. While no official recognition is given to the recommendations of the American Society of Civil Engineers as representing approved standards of fees, such recommendations may be accepted as constituting recognized and acceptable standards of payment for such engineers with the exception that the fees for planning and general supervision, as distinguished from resident supervision, are not to be approved for payment out of Government funds in excess of 7%. Additional recompense or fee is allowable for field engineering, field supervision and inspection, or for extraordinary demands for contract documents in accordance with the recommendations of the above-mentioned organization. In general, it is our intent to allow as free relations as are possible, consistent with the proper performance of work at reasonable cost, between the borrower and grantee and their professional advisers."

We have had complaints from consulting engineers who had planned projects and then later had been superseded in the carrying out of the work by other engineers. To such com-

plaints we have answered that this is a matter to be settled between the contracting authority and the engineer; that we do not in any sense consider professional advisers as contractors and that the relations between an engineer and his client should be the same as between a lawyer and his client; that where such conditions occur, professional ethics should rule, or, these failing, that the engineer may proceed to a legal settlement of his difficulties.

If we may look a bit ahead to the future, I think that we will be able to see that there will be several fields which will always remain open to the consulting engineer. One of these, of course, is the field of private building construction, wherein the average owner must receive outside assistance in the solution of his problems. Another field which will always remain open is that of the smaller community desiring public improvements. It is economically unsound for such communities to maintain permanent engineering staffs. It is further technically undesirable because by so doing they lose the value of the experience of the consulting engineer on varying kinds of improvements in different localities, with his opportunity to experiment and observe. There is, too, the field of the expert in some particular phase of engineering, particularly for the man who has devoted his own time to research in some particular field. An example of this is the man who has devoted his time to the study of soil mechanics, a recent development. I note also that a great many of the larger cities even, with competent engineering staffs, are employing well-known consulting engineers, not only for technical ability but also because of their ability to coördinate and manage in an efficient and effective manner.

As I have earlier mentioned, I believe we are at a stage of a more intensive development of industry. This is of particular importance to the important fields of electrical, mechanical and chemical engineering. I believe it is safe to say that we are at the threshold of a new era of technical development. It is even possible that within a few years we will suffer from a shortage of men who are technically trained to perform the duties they will be called upon to undertake. This point was recently

brought out by Dr. Davis, of Stevens Institute, who is far more competent than I to survey such a situation.

As Colonel Shaw has so well pointed out, we are in the stage of economic evolution. It is not for the engineer to object to this or to rail against it as disturbing established situations, but to realize that a development is taking place, to analyze it, to appreciate it, and to take full advantage of it, as he can do.

The Public Works Administration is duly appreciative of the efforts which the engineering profession has made toward the success of its program. There are many instances, particularly in small projects, where we know that the unflagging interest of the consulting engineer in planning and promoting the project has brought such project to the point of construction, where otherwise there would be nothing. These engineers have sacrificed time and oftentimes their own money in order to perform this work, and while we may say they are not disinterested in their action, that does not detract from the fact that they are performing a worthy public service. The nation owes a great deal to its engineers for the state of advancement which it has achieved, and there is a particular responsibility of its engineers in its future development and in the providing of greater comfort and happiness for its citizens.

He Had a Little Girley

Two engineers were discussing the merits of the various transits they had used. Friend wife entered the room just in time to hear her husband say: "Well, the smoothest thing I ever had was a little Gurley down in Arizona." Her eyes narrowed and with some asperity she said: "Well, William Jones, I'd like to know when such cuttings up took place.—Engineering and Contracting.

The peculiarly about a law is the amazing amount of breakage it can undergo and still exist.—Arkansas Gazette.

No matter how low the dollar may fall, it will never fall lower than some people will stoop to get it.—Atlanta Journal.

We don't blame these college professors for wanting to get jobs with Roosevelt. It's a darned sight easier than staying in the classroom and trying to explain to students all that is happening.—Albany Knickerbocker Press.

CORPORATE EMPLOYMENT OF YOUNG ENGINEERS

By W. P. Reymond, Jr. *

Discussion January 25th, 1936.

In the position of acting as substitute for Mr. Foster, Refinery Manager of the Shell Petroleum Corporation at Norco, Louisiana, I shall endeavor to discuss the phase of Colonel Shaw's paper dealing with the corporation employment of the engineer. Since both Mr. Foster and I are associated with the oil industry, I hope that my remarks, which are based on the practices presently followed by the Standard Oil Company, will to some degree coincide with the remarks which he would have made had he been able to be here. During recent years many changes have been generally affected in the methods of manufacturing and I know of no industry where manufacturing principles have been more completely revolutionized than in the refining of oil. It was only a few years ago that "rule of thumb" methods were all that were necessary in order to profitably manufacture refined oil products. Crude oil was plentiful and little thought was given to the quality of refined products. Truly in those days there was little need for engineers or technically trained men for the successful refining of oil. To-day, however, we are faced with an entirely different problem. The improvements which have been made and are constantly being made in combustion engines have necessitated that the refining of crude oil be done in a most scientific manner. Gasoline must be furnished which will meet the most exacting specifications. Lubricating oils which will satisfactorily lubricate and at the same time maintain their lubricating qualities during rapid changes of temperatures and at excessive temperatures are demanded. In other words the demand has been created for the highest quality of products and at the same time competition for supplying these products has become acute. To operate under this new system it has been necessary to discard rule of thumb methods and in their place to substitute the highest type of scientific procedures. This

* Standard Oil Company of Louisiana.

created a new field for the technical graduates and engineers. Each year the oil industry is absorbing a large number of graduate engineers from our leading colleges and universities. I would prefer to consider this employment of engineers as a new field rather than one which is in any way in competition with the well established practice of engineering as followed by the group of consulting engineers. While the oil industry to-day offers unlimited opportunities to chemical and petroleum engineers there are also unlimited opportunities for mechanical and electrical engineers as well. At our Baton Rouge refinery it is interesting to note that the general manager, the assistant general manager, the technical assistant to the general manager, the technical assistant to the general superintendent, the head of our technical division, the head of our co-ordination division, the mechanical superintendent, as well as many others holding important key positions, were first employed by our company as young engineers directly from college and the majority of these men had comparatively short service before being advanced to their present responsible positions.

I am sure that you will agree that any field of engineering employment which offers real opportunity for service and personal advancement is a credit to the profession. The many engineers who are annually completing their college courses are indeed fortunate, if able to locate with a corporation which can offer such opportunities.

Our management, realizing the potential opportunities for young engineers in its organization and its future need for leaders, has devised a system which permits careful selection of the type of men who possess the qualifications necessary for advancement into positions of greater responsibility and importance. Practical experience is essential for young engineers to learn to apply the theories which have been imparted to them in college. Many young men when leaving college are diamonds in the rough and only through practical training and experience can the necessary polishing be acquired to mould them into precious jewels in their line of work.

In selecting young engineers for technical jobs at the Baton Rouge refinery the following qualifications are desired, and each qualification is given a definite rating value:

Technical knowledge	15
Practical knowledge	15
General knowledge	5
Co-operative ability	10
Accuracy and dependability	10
Analytical ability	5
Initiative	10
Capacity	10
Ability to handle men	5
Engineering judgment	10
Executive ability	5
Total	100

Before employment each prospect is interviewed by a member of our Technical Division and a rating is made based on the aforementioned formula. It must be realized that the initial rating represents to a large extent the personal opinion of the interviewer and this opinion is greatly influenced by the applicant's college record, his experience, his personal attitude and the general impression which he creates.

Upon being accepted for employment the new man is first given a general lecture on plant operations and the elements of oil refining. An effort is made to show him how the various parts of the refinery are dependent on one another. He is given a general talk on refinery deportment including safety rules to be observed and his relations with the various operating and mechanical men with whom he may come in contact during his early period of apprenticeship. He is then given three months of training, during which time he is given simple assignments throughout various parts of the plant. This allows him to become familiar in a general way with the details of operation. During this training period he is under the close supervision of an experienced engineer, who is responsible for guiding his efforts and for helping him in every way possible to become adjusted to his new surroundings. Opportunity is afforded during this period for seeing how the new employee sizes up the various problems assigned to him and account is

taken of his ability to lay out the jobs in a systematic manner and to arrive at the successful solution of the problem. Experience has emphasized the broad chasm between class room and industrial activities. It has been our experience that men who have been fortunate enough to have had the advantage of summer employment in industry during their college careers have a marked advantage over those who have spent their summers making up deficiencies from the previous school term.

After the successful applicant has worked for a period of six months he is again rated by means of the same formula by his immediate superiors and by those in his department who are qualified to analyze his progress. If the average of these ratings is 60 or below it is our policy to interview the man in question and point out to him in a rather general way the weaknesses he has shown during this first term of employment. Suggestions are offered as to how he may help himself to overcome these deficiencies and an effort is made to determine what factors are influencing his lack of progress. At the end of the second six month period if the man has shown no improvement his case is reviewed and he is transferred to some other division where his better qualities may be more advantageously used or possibly he is dismissed from service. Those who have shown special aptitude in certain phases of refining problems are assigned to regular positions in these particular departments. These jobs may embrace the following lines of endeavor:

1. Experimental and Research Work in the Laboratory.
2. Engineering Process Control of Unit Operations.
3. Design of Refining Equipment.
4. Engineering Cost Analyses.
5. Trouble-shooting.
6. Process Survey.

Their rating procedure is continued after each six months and in this way a record is kept of the progress being made by these engineer-employees.

It has been our experience that men who make a rating of 100% or thereabouts possess the fundamentals necessary for advancement to executive positions in the organization. One

of the country's leading engineers was recently rated using this system (which, incidentally, has been developed by our company) and made a total of 98 credits out of the possible 100.

It must be borne in mind that the advancement to more responsible positions is dependent to a large extent upon vacancies arising; however, with the continuous changes being made in the principles of oil refining and with millions of dollars being annually expended for development and research work, young engineers with the proper qualifications can look forward to a bright future in the oil industry.

In my discussion I have endeavored to point out first that the employment of engineers in the oil industry has not been detrimental to the interests of the consulting engineers; second, that new fields are being continually opened for absorption of a large number of engineering graduates through new and improved methods of oil refining, and third, that through the methods of training and with the proper qualifications a young engineer has a real opportunity with a large oil corporation.

Discussion

MR. DURNING. I talk from the standpoint of the consumer about consulting engineering. In the United Fruit Company we started to install refrigeration on sea-going vessels, but due to a lack of definite information necessary for these installations we found it impossible to use the consulting engineers' knowledge at hand. By installing a refrigeration department, it proved both beneficial and economical to do our own design work. I think that it is true that the field for the consulting engineer is becoming more and more extinct because of the specialized knowledge necessary for any particular design work. I think that the broadest field for the future consulting engineers will be in municipal and governmental projects. As Colonel Shaw brought out in his discussion, in governmental and municipal projects, political influence is great. The status of the engineers used in governmental projects can be raised by following the practice of the State of New York. In New York State, starting in 1937, all municipal projects must be designed and approved by a pro-

fessional engineer. The professional engineer must get his license by passing an examination, both verbal and written, satisfactory to the Board of Education. Besides this, he must have had at least eight years of design experience. If such a practice were followed generally, the status of the municipal engineer would be raised and municipal projects would be benefited thereby.

MR. FRANSEN. So far we have heard the discussion between the consulting engineer and the employment of engineers by corporations and the government. It is claimed that the employment of engineers by corporations and the government has encroached upon the territory of the consulting engineer. I think we all ought to look into the future and consider the coming young engineers. It is a fact that we have more engineers being turned out every year from colleges and there should be some means of absorbing these graduates. While the consulting engineers are opposed to the employment of men on a salary basis, I think it is one means of encouraging young men to follow the profession. I think that more of the younger college graduates are working for large corporations to-day than are doing anything else and while some consulting engineers may claim to lose thereby, others say that it has no effect on their business at all. Just the same, young engineers still have to work up from the ground. If it were not for corporations, many of these engineers would not have a chance to develop the technical training that they have had, and get the practical experience which would naturally be required of the consulting engineer. This would cause many of us to forsake our profession and follow some other course. It certainly is a light of hope for engineers just out of college.

DEAN LASALLE. In a number of cases where engineers are employed, especially as experts in litigation, there is no scale or compensation generally recognized for engineers. In general, they ask fees far below those charged by medical experts. I am not criticizing the doctors for this as much as I am the engineers.

It seems to me that this point should furnish a very good topic for discussion at a future meeting of the Louisiana Engineering Society, so that there could be brought all available information to Louisiana engineers and some uniformity could be ob-

tained, so that the term "cut-rate" used by Colonel Shaw in his paper can be defined.

MR. LEVY. In order for the consultant to survive as an individual operator the scope of his work must be very narrow and he be a man exceedingly specialized in his particular branch. I feel that the future will develop the specialized type of consultant. The general spirit of our activity here in this country is one of bigness, nor will this administration be very effective in continuing to oppose it. In the future we will have consultant services for administrative and highly specialized activities. I am sure that it is the general type of service that will be rendered by the consultant.

PROFESSOR DERICKSON. It is my opinion based on a somewhat extended experience as both teacher and practitioner of Civil Engineering, that there is a decided opportunity for the consulting engineer and the college professor to render service mutually advantageous.

The consulting engineer must live and it is not unlikely that he accepts an engagement, from time to time, which forces him to seek assistance from outside of his own organization. Under such circumstances, it would seem that the practitioner is fortunate who can avail himself of the services of the engineering professor, familiar with the latest developments in that branch of engineering in which the problem lies. From the angle of the professor, he not only adds to his income, but, he increases his experience and becomes a more valuable teacher on account of such contact. The absent-minded professor of other days survives only in publications of a humorous nature. To-day the better sort of engineering college has many applications for the professorial position and the professor of engineering is quite apt to be a man of proven ability in the field of his specialty. Sometimes he is recognized as an authority.

I realize that there has been some comment throughout the profession in regard to the participation of engineering professors in active practice. I do not know that it is possible to make a blanket statement which is applicable to all professors or all engineers, as there are many different kinds of individuals in each classification. It does seem to me, however, that it is

quite plain from an ethical standpoint that the professor should not take advantage of his position to reduce fees. At least his charges should be as large as those recommended by the profession and supposedly should be commensurate with the position which he holds.

Without desire to be personal, I can say as a college professor that I have engaged in engineering practice for many years and, in so far as I am aware, I have not been in competition. Not all, but most of my engagements have been either from or in coöoperation with consulting engineers. Such connections seem to have been, in general, quite satisfactory. I know from by point of view that I have developed a high regard for those with whom I have been associated, and, I like to think as a result of such association that I have been able to pass on to my students something which later they will reflect in better engineering.

ADVANCES IN DISTRIBUTION ECONOMICS

By W. J. McLachlan *

Read before the Society January 24th, 1936.

The Problems of the Distribution Engineer

The problems of the distribution engineer have two characteristics which distinguish them sharply from those of other branches of engineering in the central station field.

First, the conditions dealt with change over a given period of time to an extent not even approached in the other fields. Loads are continually increasing and shifting and load areas are expanding. When John Jones decides to put in an electric range, it doesn't mean a thing directly to the transmission or generating station engineer, nor does it matter to them that he also puts in an electric water heater, and then the fellow next door, not to be outdone by the Jones family, decides to do likewise. Perhaps some day when all the Jones, Smiths and Browns in town follow suit, they may have some cause to start to worry. But the distribution engineer's worry starts right now.

We all recognize the diversity factor between the electrical demands of individual consumers and that on the generating station. It seems that there is also a diversity factor which must be applied to the problems of the distribution engineer, before they are developed into problems for the other engineering branches. However, I suspicion that this factor may be in the order of at least the second and maybe the third or fourth power of the electrical demand diversity.

This is not intended as any belittlement of the problems of the other engineering branches. They have their problems and plenty of them, but I do want to draw the distinction as the types of problems. The distribution engineer is faced with continually changing conditions with multitudinous problems. The other branches are faced with but a fraction of the number of problems.

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The second distinction is that the individual items dealt with by the distribution engineer are almost insignificant in themselves. The major objective of the central stations' and electrical equipment manufacturer's engineering organizations is at the present time and will continue to be the production and distribution of electric energy at continually reduced costs, and of a suitable order of service as measured in terms of voltage regulation and service continuity. That the opportunities for the distribution engineer to participate in such cost reductions are large, is now quite well recognized in the industry. However, it should be emphasized that where the transmission and station engineer may effect per item savings of hundreds and thousands of dollars, the distribution engineer must look for his savings in terms of cents and dollars per item. As a result, his work may not appear as spectacular, and unfortunately often is not appreciated fully. For instance, a saving of a few pennies in the cost of a pole installation is certainly not spectacular. That is, not until we stop to realize that such a saving may be multiplied by tens of thousands.

These characteristics of the task of the distribution engineer mean that he is faced with a terrific amount of detail, requiring attention. Unfortunately, in many instances the time required to attend to these details makes it impossible to do the real fundamental engineering that might be desirable. Often this neglected fundamental work is that which would yield the greatest profit to his company. For instance, in the time that an engineer takes to figure out how to extend the service to a new customer and perhaps figure out how to save five dollars by his ingenuity, he might be able to determine how to reduce the cost of all service entrances by a few cents each. Obviously the profit to his company would be a great deal larger if his time were spent in the latter way.

Prior to the financial depression from which we are just emerging, it was quite general for a distribution engineer to be so loaded up with detail work requiring immediate attention, that it was impossible to devote either the proper amount of time or effort to the study of the fundamentals of distribution engineering. In this respect the depression has probably been

a blessing in disguise, inasmuch as the amount of detail work decreased and more time could be spent on such fundamental work. In addition, a considerable amount of engineering talent which had previously been devoted to the other branches of central station engineering was turned toward distribution engineering by virtue of the fact that all expansion in the fields of generation and transmission was stopped. As a result of these circumstances, it is believed that considerable valuable fundamental work in distribution engineering has been done during the depression, and it is the intent to briefly review herein some of these accomplishments. It is hoped that the value of these accomplishments will be fully appreciated by central station executives and that sufficient personnel will be assigned to distribution work in the future so that at least the key men will be relieved of the responsibility of the great amount of detail so that they will be left free for further fundamental studies which can return enormous profits. The importance of distribution engineering is revealed by the fact that in the four years of 1929 to 1932 inclusive, 53.2% of the yearly expenditures of central station companies in this country were for distribution as contrasted with 15.6% and 31.2% for transmission and generation respectively.

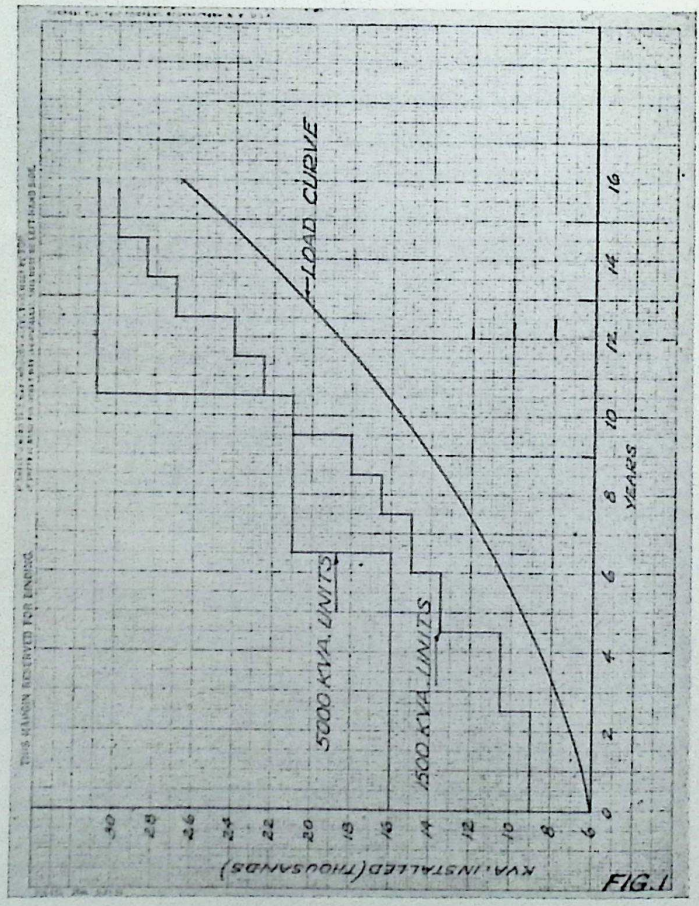
In the following a brief review will be made of some of the advances which have been made recently in distribution engineering from an economic standpoint. This will be done by the system toward the consumer. In the time allotted it will be possible to only briefly mention some of the more important starting at the distribution substations and working out on fundamentals of each of the ideas developed, inasmuch as a complete discussion of any one of them would require the entire time. However, it is hoped that such a discussion will serve to stimulate thought along such lines.

Substation Economics

There has recently been a rather radical change in the general opinion as to what constitutes the best practice in the field of distribution substations. There is a very definite trend toward the use of relatively small sized substations, arranged

to feed the load by a few feeders of short length, rather than large substations with numerous feeders of varying length.

Many recent studies which have been made have indicated that such use of small substations has a definite economic advantage. The main reason why this is true is indicated by Fig. 1. In this figure is shown an assumed load growth curve, and the installed capacity which would be required throughout



several years to serve such a load. First, on the basis of adding capacity in 1500 KVA units, and second on the basis of additions in 5000 KVA units. It is immediately obvious that with the larger units, a considerably greater average excess capacity is required throughout the period than is the case with the smaller units. Obviously, the carrying charges on this greater

capacity should be taken into consideration when determining the proper practice to be followed. This one factor has been found to throw the economic balance very definitely toward the use of the smaller substations. In considering the cost per KVA of substations, it is important that these costs be referred to, not in terms of the average cost per KVA of installed capacity, but rather in terms of the cost per KVA of average load carried by the substation throughout its life. It is obvious from Fig. 1 that the system with capacity added in 1500 KVA units will show to advantage from this standpoint, inasmuch as it will be possible to have the average load carried by the substations approach much more closely the installed capacity than is the case when 5000 KVA units are installed.

In addition, certain other outstanding benefits are gained from the use of small stations:

1. With the smaller stations the diversity between feeders as to circuit length and load characteristics is reduced to such an extent that it is possible to use bus regulation in the form of load ratio control equipment on the substation transformer, as contrasted with the necessity for individual feeder regulation in the larger stations due to the differences in the characteristics of the various feeders.
2. The smaller stations can be installed more quickly to meet load demands, which obviously requires less over-building, and the stations can be more readily moved in case load conditions change.
3. Major outages are generally reduced because of the shorter length of the feeders.
4. Much of the underground construction required to get away from large stations can be eliminated with the small stations, due to the few number of circuits emanating therefrom.

With such small sized substations being recognized as generally desirable, it becomes entirely feasbile for the electrical manufacturers to produce complete substations. An example of such a substation is installed in Rochester, N. Y. This is a 1500 KVA outdoor substation, arranged with a 3-phase transformer, equipped with load ratio control for voltage regulation,

and is typical of a substation having four outgoing distribution feeders.

Furthermore, with units of this small size, it is possible to place such a station in an underground vault, in cases where real estate in a desirable location is expensive.

These stations are also built in smaller units for application in suburban areas. In such applications there is normally no question as to a large versus a small substation, as the capacity is dictated by the small amount of load available in the area. It has been found, however, that this type unit can be installed for approximately the same cost as a typical outdoor substation, and the advantages of safety due to the metal-clad features and improved appearance gained.

Primary Feeder Economics

In considering the economies of primary feeder arrangements, it is essential that losses be included at to-day's valuation and not at some figure arrived at several years ago. In the last 15 years, generating station efficiencies have improved to such an extent that one pound of coal now produces the same number of kilowatt hours as two pounds did 15 years ago. Furthermore, reductions have been made in the capital cost per unit of system capacity. The combination of these facts results in losses being worth considerably less to-day than even a few years ago. On this basis, therefore, true economics should call for higher loading of primary feeders, which with distributed load means longer feeders.

However, feeder losses and voltage drop go hand in hand so that the feeders cannot be loaded to obtain these higher losses without increasing the feeder voltage drop. As a result, it has been necessary to limit the loads and lengths of feeders, on the basis of voltage drop, rather than for economy. A realziation of this situation caused the manufacturers to recently bring out a line of pole type regulating devices, which can be installed in the primary feeders, thereby eliminating the criterion of voltage drop along the length of the feeder. The availability of these devices should make it possible to install much more economical primary feeder combinations, and it is essen-

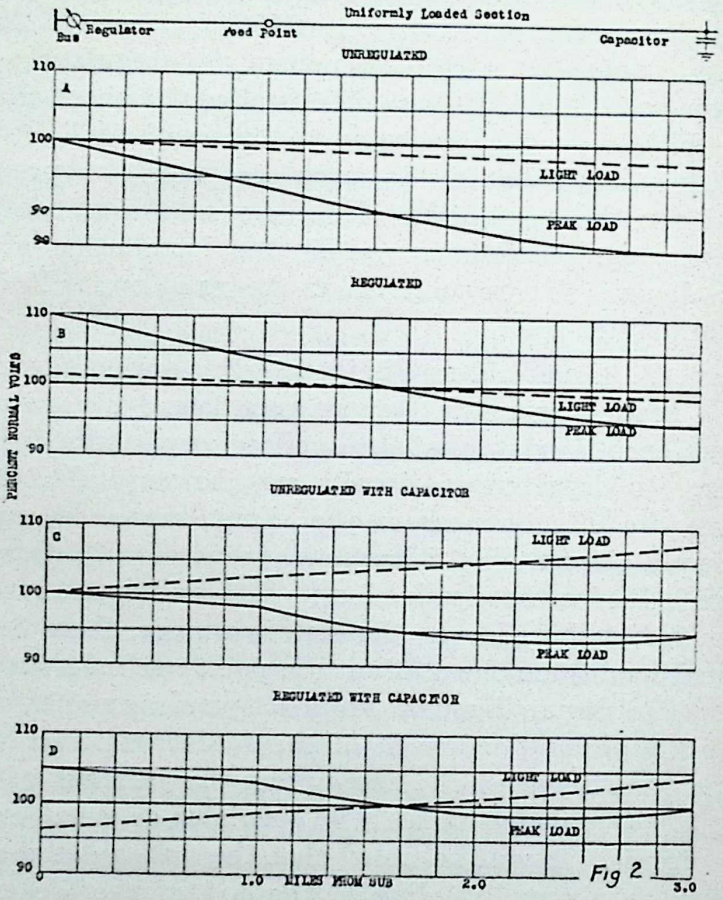
tial that the practices in primary feeder arrangement be reconsidered correspondingly.

A pole type induction regulator may be installed in a single phase primary feeder branch. Similar devices may be connected in open delta on a 3-phase feeder. Branch feeder step regulator is arranged to regulate the voltage in 4 2¼% steps. A one step branch feeder booster can be arranged to boost the voltage when required, either 5¼ or 10%, as desired. It is interesting to note that with these new devices regulating capacity as low as 10 KVA can now be installed for about the same cost per KVA as could previously be done with 48 KVA equipment. This means that if this larger equipment was previously justified for the regulation of feeders at the substation, it should now be possible to justify the installation of these smaller devices for regulation of the smaller loads on the feeder branches.

As an additional aid in eliminating this voltage drop criterion as a limit on primary feeders, recent analysis and operating experience indicate that the application of shunt connected capacitors to distribution circuits may be very effective. To illustrate the effectiveness of the shunt connected capacitor on a simple circuit, Fig. 2 has been prepared. On this figure is shown a feeder three miles long. The load on this feeder is uniformly distributed over the last two miles, there being no connected load from the station to a point one mile out on the feeder. The upper diagram of this figure shows the voltage distribution along the length of the feeder at times of light load and peak load, on the assumption that the bus voltage is held at 100% and that there is no regulator or shunt capacitor on the circuit. It will be noted that the voltage at peak load conditions is about 15% low at the end of the feeder. Obviously this condition is entirely unsatisfactory. The second diagram illustrates what can be accomplished by the application of a station regulator to this feeder, in order to hold the load center voltage. However, it will be noted that the load nearest the station receives a voltage approximately 4% above normal where that at the end of the feeder receives voltage 5½% below normal at times of peak load. This gives a differ-

ence of 9½% between the voltage of the first and last consumers on the feeder, due to primary feeder drop alone. This would normally be considered excessive.

The third diagram of this figure shows what can be accomplished by a shunt capacitor alone, without the feeder regulator. It will be noted that the peak load voltage conditions



are improved over that shown in the top diagram, but it wlil also be seen that the shunt capacitor causes an excessive voltage rise along the length of the feeder at times of light load. In the bottom diagram of the figure is shown the conditions with both the regulator and the capacitor. It will be noted that the voltage of the first consumer is now about 3% above normal, and the lowest voltage along the length of the feeder

is about 1½% below normal. Thus the difference between the highest and lowest voltage which any consumer receives has been reduced from 9½% to 4½%, which shows the effectiveness of the shunt capacitor. It will be further noted that the regulator prevents the objectionable increase in voltage under light load conditions, due to the shunt capacitor. The shunt

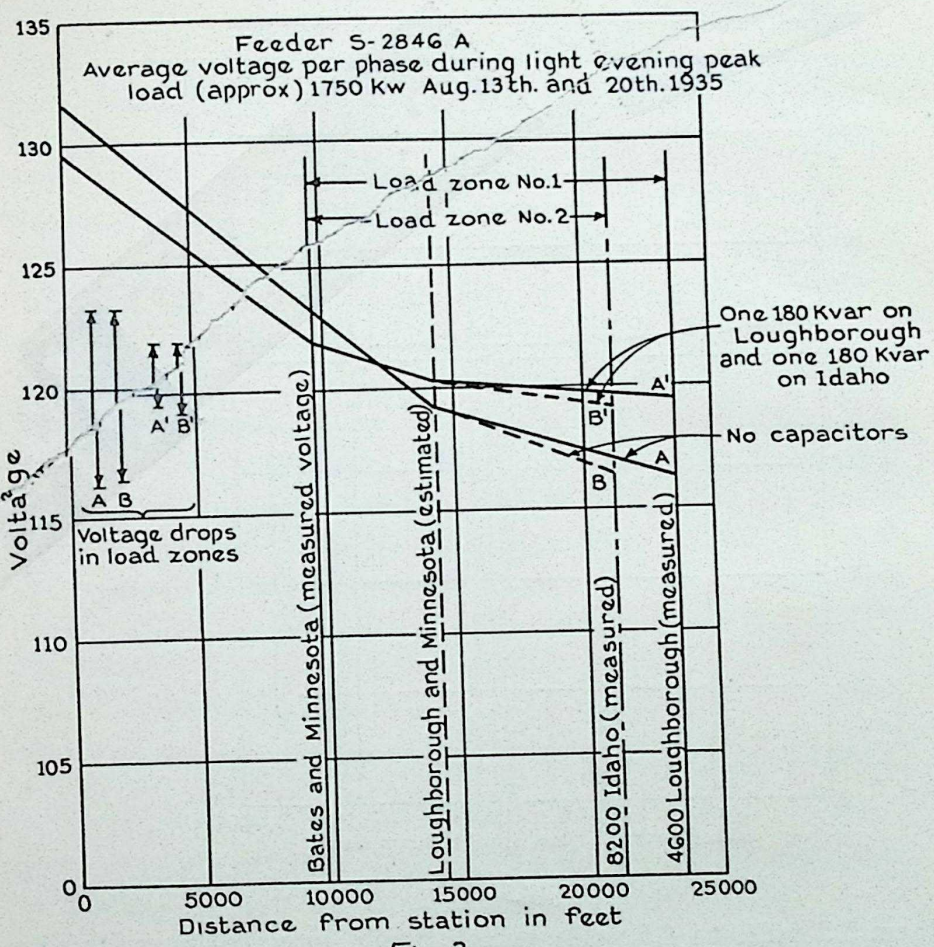


Fig. 3.

capacitor serves to reduce the drop along the length of the feeder and the regulator to hold the average level of voltage on the feeder, the two thus making an ideal combination.

Fig. 3 shows the voltage distribution along the length of the feeder during the evening lighting peak load, both with and without the capacitors. The arrows at the left hand side of

the diagram illustrate the difference in voltage between the first and last transformers served by the feeder. The longer arrows at the extreme left show the conditions before the capacitors were installed and the shorter arrows the conditions after the capacitors were installed. It was found that these two capacitors resulted in decreasing the voltage difference

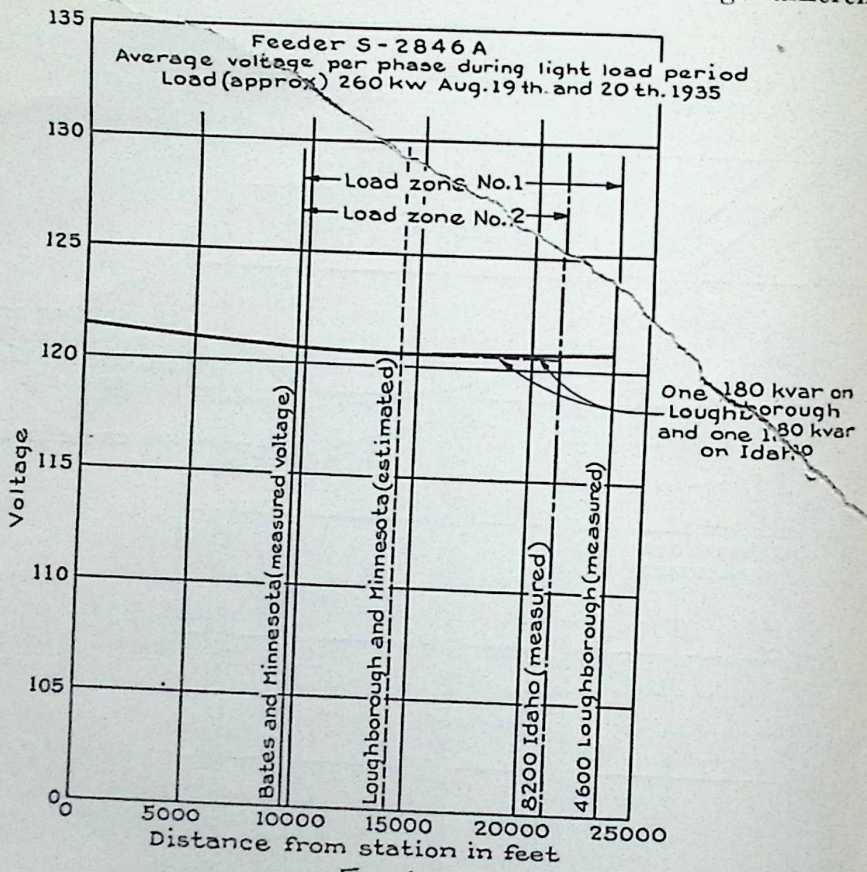


Fig. 4

from 8.2 volts to 4.6 volts, which it will be noted is well under the 6 and 4 criterion value considered as the maximum allowable. Fig. 4 shows the voltage distribution along the length of the feeder at times of light load, which is obviously very satisfactory. Fig. 5 shows the results of tests as to the current in one phase of the feeder with and without the capacitors. These curves are not directly comparable, since one curve was taken on Monday and the second on the Tuesday following.

However, examination of the load curves of this feeder had revealed that the Monday and Tuesday loads were practically identical prior to the time these curves were taken. Furthermore, the results check the calculated results quite closely, so it is believed that these curves can be taken as indicative of the reduction in current accomplished by the capacitor application.

As has been noted above, the voltage drop along the length of the feeder was reduced well below the 6 volt criterion, by

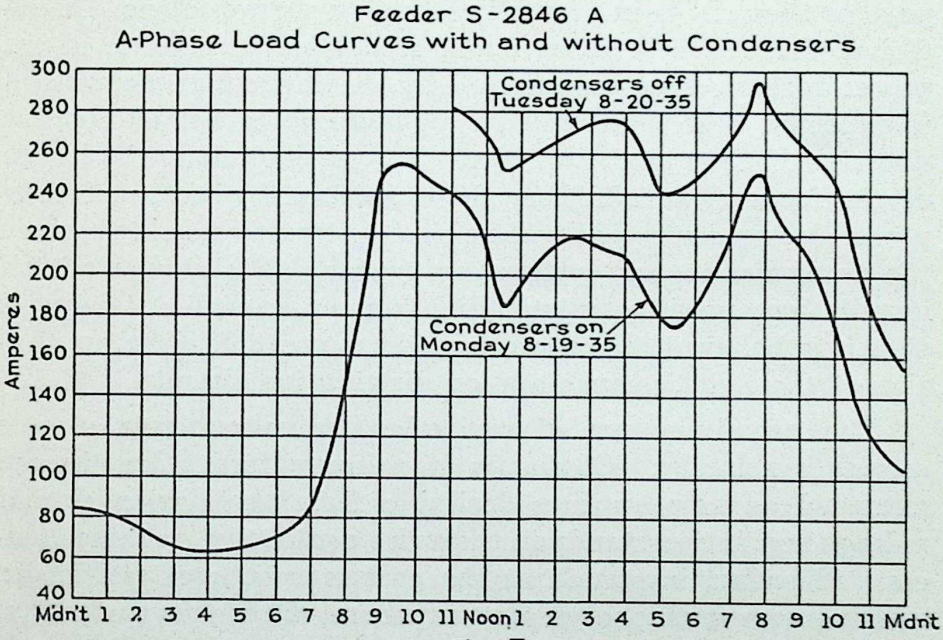


Fig. 5

the application of these feeders so that from this standpoint the feeder can now take on additional load. However, the load of the feeder was up to the capacity of the station regulator, so that the ampere rating of these devices now served as the bottle neck limiting the load which could be carried on the feeder. Analysis and tests of the conditions with the capacitors on the feeder revealed that sufficient range of regulation could be obtained with the regulators connected for their 5% connection instead of 10% connection, in that the capacitors had raised the level of voltage on the feeders so that the regu-

lators were required to operate to a greater extent on the bucking side. As a result, the regulators have been reconnected for the higher ampere connection, and it will now be possible to carry approximately 500 kilowatts additional load on this feeder.

These two capacitors, installed, cost approximately $3500, which is slightly less than the annual carrying charge on the investment which would have been required for the new feeder. As a result, it may be said that each year that the capacitors forestall the necessity of the new feeder installation they will pay for themselves in saving in carrying charges alone. In addition, there will be a saving in feeder losses, because of the power factor correction effected by the capacitors, and also it is expected that there will be an increase in annual revenue due to holding a slightly higher voltage level along the length of the feeder. In addition, the capacitors by virtue of their power factor correction will releave kilowatt capacity back in the transmission and generating system. The results of this installation appear so outstanding from an economic standpoint that it is believed that there must be a great field for application of these static capacitors on distribution circuits.

The second measure of service besides voltage regulation is service continuity. Obviously if primary feeder lengths are extended as now appears desirable from the economics and voltage regulation standpoint, service continuity on these feeders will suffer, inasmuch as the customer outages per feeder will increase with the greater exposure of the longer feeders. A device known as an automatic recloser has been developed for application in these longer circuits, so that the feeders can be broken up into sections and faults in outlying sections will not affect the service continuity of the remainder of the feeders. Thus by the application of devices of this kind, it will be possible to give the same degree of service continuity on the longer feeders than has been possible on the shorter and less economical feeders.

Secondary Economics

Another economic problem in distribution which has received considerable attention recently is the problem commonly

referred to as secondary economics, and involves the economical combinations of transformers and secondary copper size. Consider two streets—A street and B street, on which the loads are identical. A street is served by ten 15 KVA transformers, and it is found that with No. 4 secondary, the maximum voltage drop in the secondary with uniformly distributed load is 3%. B street on the other hand is served by six 25 KVA transformers, and it is found that in order to limit the drop to the same value of 3% that 2/0 secondary is required. Obviously the ten 15 KVA transformers on A street will cost more than the six 25's on B street, but on the other hand, the No. 4 secondary on A street will cost less than the 2/o secondary on B street. Which then costs less—the system on A street or that on B street? Would some other combination cost still less? What combination would be most economical for other load densities? This is a simple statement of the problem which we are faced with.

Fig. 6 shows the results of a study which has been made of this question, showing total installed cost per 1000 feet of secondary, as a function of secondary wire size for various load densities from 10 to 100 KW per M feet. The secondary voltage drop with uniformly distributed load, is limited to 3% transformers are loaded to a maximum of 125%, and are assumed as being banked. The solid lines show the cost with triple braid, weather-proof wire at 10c per pound, and the dashed lines for wire at 20c per pound. It will be noted that with the 10c wire load densities up to 60 KW per M feet can be served by No. 4 most economically, and for densities up to 100 KW per M feet, it is not necessary to go above No. 2 secondary conductors for economy. With 20c copper, which is more indicative of conditions to-day, it will be noted that No. 4 secondary appears to advantage even up to 100 KW per M feet.

It should be noted that these curves show cost on the basis of limiting the voltage drop with uniformly distributed load. However, it is necessary that other criterions be included in the design of secondary systems and chief among these is the limitation of voltage flicker when appliance motors start. This

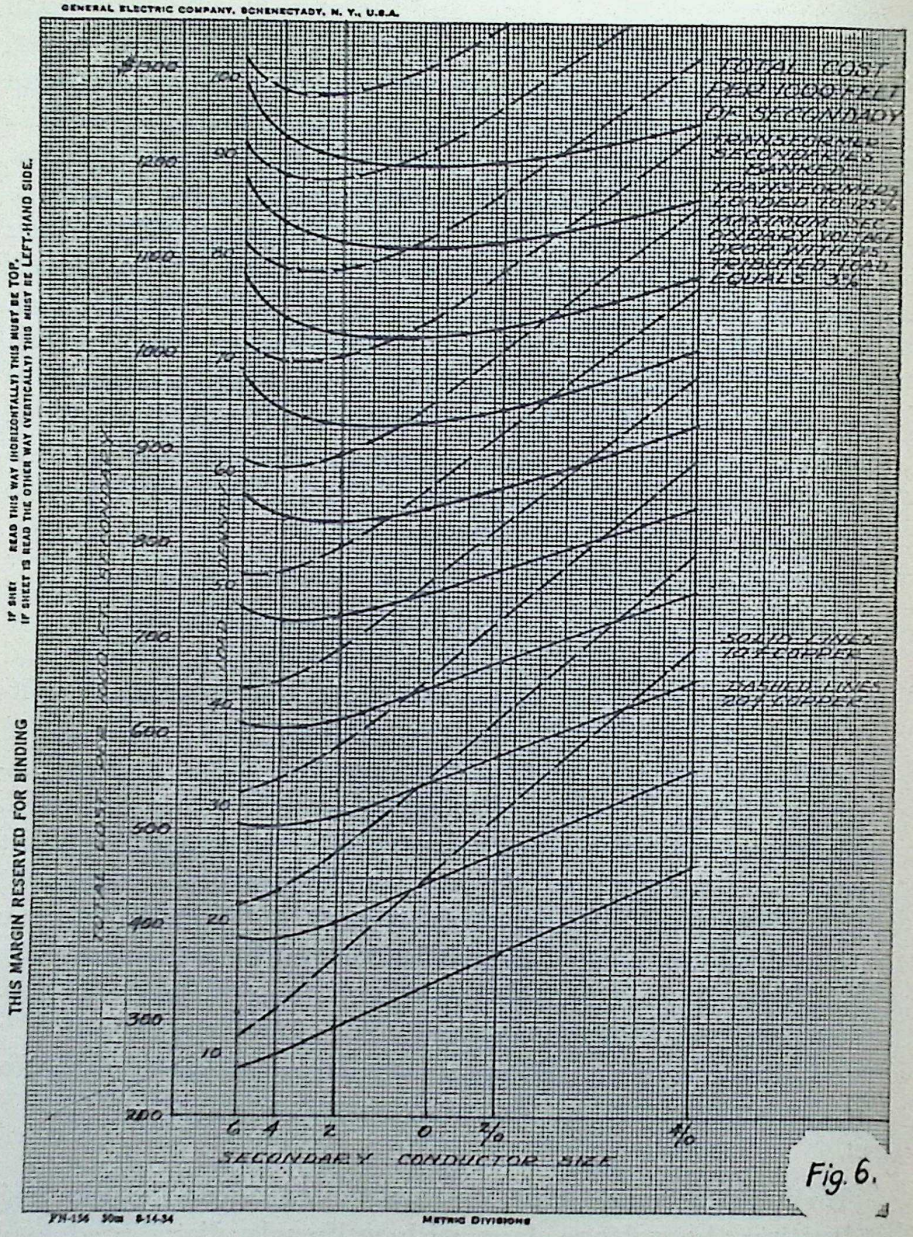

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., U.S.A.
THIS MARGIN RESERVED FOR BINDING
IF SHEET IS READ THIS WAY (HORIZONTALLY) THIS MUST BE TOP.
IF SHEET IS READ THE OTHER WAY (VERTICALLY) THIS MUST BE LEFT-HAND SIDE.
TOTAL COST PER 1000 FEET OF SECONDARY
TRANSFORMER SECONDARIES BANKED
TRANSFORMERS LOADED TO 125%
MAXIMUM SECONDARY VOLTAGE DROP WITH DISTRIBUTED LOAD EQUALS 3%
SOLID LINES 10% COPPER
DASHED LINES 20% COPPER
TOTAL COST PER 1000 FT. SECONDARY
LOAD DENSITY
$1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
6
4
2
0
2/0
4/0
SECONDARY CONDUCTOR SIZE
FN-156 30m 8-14-34
METRIC DIVISIONS

Fig. 6.

problem is becoming more aggravating every day, and its effect on system cost should obviously be included. We have curves which show the effect of limiting the voltage flicker with radial secondaries to a maximum of 3 volts when an appliance motor draws a starting current of 20 amperes at 50% power factor. In order to meet this criterion so that such a motor could be started on the end of any secondary on the system, requires an increase in cost from about $275 per M feet to over $480 per M feet. This is at a load density of 10 KW per M feet. At a density of 20 KW per M feet, the cost increase is not quite as marked and it will be noted that at 40 KW per M feet the increase is very slight. However, it is obvious that this flicker criterion requires an enormous increase in investment, at the lower load densities, and naturally arouses curiosity as to whether there is not some way in which this flicker criterion can be overcome more economically.

One means which has been used to help limit the flicker when 115 volt motors start is the installation of auto transformers on the 115/230 volt, 3 wire secondaries, so that the 115 volt motor starting current will be drawn from the 230 volt conductors. This means has been found very effective in limiting the voltage flicker when such motors start. However, it seems somewhat doubtful as to whether it would be desirable to design a distribution system on the basis of having such an auto transformer connected on the end of every secondary on the system. It seems that this auto transformer is a very fine means for correcting conditions which are difficult to eliminate otherwise, but that we should look further for a more satisfactory general solution of the problem.

The above outline has touched only the high spots of a few of the more recent advances in distribution economics. It is hoped that this discussion will stimulate thought along similar lines, which will result in improvements in distribution systems and reduction in their cost.

The Importance of System Data

In dealing with distribution engineering problems, there is one fact which stands out as a handicap above all others. This

is the lack of actual data as to the performance of the distribution system. It seems that the taking such data as a measure of the effectiveness of the system when viewed in the light of the following considerations should be all important.

The millions of dollars invested in utility systems have been invested for one primary purpose only. That is, to give electric service. This service is measured in two terms—first, voltage, and second, continuity. How then can the effectiveness of this entire system investment be known unless the actual voltage and the degree of service continuity which is delivered to the consumer be ascertained. In certain cases where extensive data of this sort has been obtained, it has become immediately obvious that certain minor portions of the particular system in question were acting as a bottle neck to the effectiveness of the system investment. In cases where extensive data of this kind has been taken, it has revealed the following:

1. It has shown the actual degree of service being rendered by the system. In this connection it is interesting to note that one large company which studied the practice of making extensive voltage surveys found in their initial survey that 24% of their customers were receiving voltage which was outside the limits considered as good service, whereas the voltage complaints received were less than 1%, making it very clear that complaints received are no criterion of the service being rendered.
2. Such data will show clearly when additional system investments should be made to improve the service.
3. Extensive data of this type will reveal not only when system investment should be made to improve service, but also where in the system this investment can be made most effectively. At times it is found that considerable expenditures are made in portions of the system which cannot and do not return appreciable benefits, whereas if complete data were available, it would be immediately obvious that the expenditure of a considerable smaller total sum in another portion of the system would yield far greater returns.

4. Such data will also reveal the effectiveness of investments which have been made to improve service. This is done by comparing the data before and after such investments are made.

It is believed that operating companies can make no wiser expenditure than to authorize whatever cost is necessary to accumulate data of this kind. Companies which have authorized such expenditures and have obtained this operating data, report that the cost of the surveys from which the data is obtained is repaid to them over and over again by the savings which result from having this data. It is believed that the importance of obtaining this information cannot be overstressed. It is further believed that if the Central Station Industry at large will collect such data, that its analysis will reveal further advances which can be made in the economies of distribution systems with the result that the cost of such systems can be reduced to the mutual benefit of all concerned.

HISTORY OF THE LOUISIANA ENGINEERING SOCIETY

By H. J. Malochee

January 24, 1936.

The Louisiana Engineering Society is called to-day for its 38th annual meeting and by that fact, it establishes itself among the oldest of the state engineering clubs or societies in the country.

On December 22, 1897, at the call of Mr. J. F. Coleman, Principal Assistant City Engineer, fourteen members of the profession were convened in the City Engineer's office in the City Hall at New Orleans.

There were present at this original conference the following gentlemen:

Alonzo C. Bell	Frank M. Kerr
Alex L. Black	Sidney F. Lewis
H. J. Burt	Fred. T. Llewellyn
C. H. Chamberlain	Gervais Lombard
J. F. Coleman	Thos. L. Raymond
R. E. DeBuys	Alfred F. Theard
W. H. Hoffman	Willis B. Wright

On January 15th, the organization was perfected by the election of the following officers:

S. F. Lewis	President
C. H. Chamberlain	Vice-President
J. F. Coleman	Secretary
Alfred F. Theard	Treasurer
Directors:—Thos. L. Raymond	3-Year Term
A. C. Bell	3-Year Term
F. T. Llewellyn	1-Year Term

The Constitution and By-Laws had already been prepared and adopted as of January 8th, 1898. The Charter of the Society was signed on February 3, 1898, and approved the same day by District Attorney R. H. Marr. The Charter members were recruited as follows: Eight from the Board of State Engineers, four from the City Engineer's office, four from the Drainage Commission of the City of New Orleans, three from

the U. S. Engineers' local office, two from local railroad offices, and six independent engineers.

Of the above 27 Charter members, only 9 are still living, viz.: Messrs. J. F. Coleman, R. E. DeBuys, W. H. Hoffman, Gervais Lombard, Alfred F. Theard, A. C. Duval, E. T. Llewellyn, C. A. Miner, and W. S. White.

In order to give those present at this meeting some idea of the work done during the early days, I shall review briefly the more important features and events of the first ten or twelve years.

The first ten years are noteworthy for the loyalty of some 40 members of the group who joined the Society in the years 1898 and 1899. These members not only retained their membership, presented many of the technical papers read at the meetings, but continually urged other engineers to join the Society and do their duty towards the profession by raising the standards of ethics, etc.

The membership was small during those ten years, ranging between 58 and 78, but in 1908 the number of members was increased to 121 and steadily rose to its peak in 1930, when the distribution was as follows:

Full Members	341
Associate Members	30
Junior Members	49
Student Members	91
Total	511

Compared with this, at the beginning of 1935, the total for all classes was 320, and in 1936, 399. It is probable that poor business conditions is the cause for this reduction in membership.

The attendance at meetings during the first ten years varied considerably. Some years the average attendance per meeting was 14 or less, while in other years it was as high as 35, with some meetings recording an attendance of 93 members and guests.

The January 15th, 1898 meeting, was held in the rooms of the Drainage Commission in the City Hall, through the courtesy of Major B. M. Harrod, Chief Engineer. Thereafter and until

September, 1900, library and meeting rooms were established on the second floor of No. 712 Union Street, in connection with the New Orleans Camera Club.

For two years following, we occupied quarters at 806 Gravier Street, and then for three years, rooms in the Tulane-Newcomb Building. For about eight months, upon the suggestion of the University authorities, the Library was moved to the Tulane Library on St. Charles Avenue, and the meetings were held in Gibson Hall. Owing to the distance from the business center, the Library was moved in May or June, 1908, to what is known to-day as the Carondelet Building, but at that time occupied by the Hibernia Bank & Trust Co. The meetings were held in the Directors' room of the Bank.

Our meetings were as a rule very decorous, but at times levity prevailed. For example, one of our members was on his feet very often and always ready to speak. In the first year or so, almost every paper was prefaced with the statement, "Gentlemen, as you know, engineers are "doers', not 'speechmakers', hence I beg of you to excuse my mistakes in grammar, in sentence construction, and, especially please, overlook my poor delivery."

After a number of our members had presented this trite excuse, the member who was always ready to speak, stated that it was rather tiresome to listen to practically the same introduction every time that a member read a paper and that he thought it quite unnecessary.

The Chair, addressing the objecting member, said: "Mr. X, I believe that there are thirty-seven members in the Society and it is my impression that there are 30 members who are exceptions to the rule that engineers are 'Doers' rather than 'speechmakers' and it is also my impression that you are all of these 30 exceptions rolled into one person."

The beginnings of the Library were small. For example, the first year subscriptions for periodicals cost $37.95. Due to the generosity of some members, we secured some 130 volumes and 145 pamphlets on engineering subjects; the donors were Col. S. F. Lewis, our first President; Major B. M. Harrod, and Capt. W. J. Hardee. Through purchase, we also acquired dur-

ing the first year, 66 books, some of which were of considerable value; this collection belonged to one of our brother engineers who wished to dispose of that portion of his library.

To-day, we believe that quite a valuable collection has been accumulated through purchase and by gifts from members and others, the number of volumes being estimated at 1500 books and some 750 unbound Transactions and Miscellaneous pamphlets.

From the very beginning, our Society was active in civic matters. In March, 1899, it endorsed by resolution and by other methods, the movement for sewers and water supply for the city of New Orleans. In July, 1900, and for several months following, a committee of this Society made a study of the building laws of the city of New Orleans co-operating with the City Engineer's office in drafting the laws which were finally adopted by the City Council.

Another important work undertaken by the membership was assisting in the assembly and preparation of an exhibit for the St. Louis Fair to show some of our more important engineering works.

It is proper to recall that the initial work towards having the Legislature pass an Act to regulate the practice of the profession in this state was done by the Society as early as the year 1898. During the 1900 and succeeding sessions of the Legislature bills were introduced at the Society's request, but it was only during the session of 1908 that the Legislators realized that the efforts of the Society were altruistic and directed toward the protection of the public rather than for the individual benefit of its members.

As you well know, the engineers are likable, sociable fellows, and I well remember that the Society's meetings always ended in pleasant reunions of the several groups within its membership. It is therefore not astonishing that as early as October, 1898, the first general outing of the Society took place, when 42 members and 250 guests including many ladies visited the beginnings of what is to-day our drainage system. The central power plant of the system located in the lower Ninth

ward was under construction and during our visit there refreshments were served. Following this the party went to Port Chalmette, below the city, which was intended as the terminal facilities of the St. Louis and San Francisco system.

Smokers or banquets were held at practically every annual meeting since December, 1899; the first banquet took place in January, 1905, at Antoine's.

Other outings were held in 1900, 1901, 1902, 1906, 1907, 1908, each having as its object the double purpose of improving the social relations of the members of the Society, and to give them an opportunity to inspect some more or less important engineering work.

Among the memorable outings I should mention that of 1900, when the Society visited the Avery Salt Mines. The Southern Pacific Railroad furnished a very comfortable train of day coaches, but without vestibules. The mine officials were most courteous, allowing all to go below and witness the mining of the salt. The committees in charge were very efficient, furnishing many comforts on the train and a very enjoyable dinner at the island.

The general committee in its announcement stated that light refreshments would be served on the train. As one of the committeemen, carrying a tray of sandwiches, reached one of the platforms, he encountered another member going in the opposite direction. There was a slight delay, sufficient, however, for a gust of wind and a lurch of the train to cause most of the sandwiches to be carried off the tray and onto the railroad right of way. The incident spread like wild fire and everyone began to talk about the light refreshments served by the committee, and until late in the afternoon members of the committee were besieged with questions concerning these refreshments.

During the first eleven years there were presented 73 formal technical papers besides several informal talks. The principal topics included Levees, Floods, and Bank Protection as related to the Mississippi River and its tributaries.

However, you will find in the list many other subjects of importance such as: Deep Bridge Foundations at the Atchafa-

laya River, Evolution of Structural Steel Design, Progress of Drainage in New Orleans, Removal of the New York Obelisk, Purification of the Waters in the New Orleans Area, Gas and Its Manufacture, The Story of Sulphur in Calcasieu Parish, Reinforced Concrete Construction, Facts and Figures on the Panama Canal, Modern Power Station Construction, The Pitot Tube and Its Formula, etc., etc.

The question of printing the authors' papers was discussed by the Board of Direction at its very first meetings, and in July, 1898, recommendation was made to the Society that it join the Association of Engineering Societies.

The membership of the Louisiana Engineering Society was completed in October of that year and the technical papers which had thus far been presented were sent to Association headquarters for publication.

The Association was composed of some eleven societies and we of the Louisiana Society had the advantage of receiving all the technical papers read before the other ten members of the Association. The papers sent by the Louisiana Engineering Society were always printed in full, including maps, drawings, photographs, etc., and as I recall it, the cost was very reasonable.

This sketchy description of the first few years of our life's struggles will, I hope, prove interesting to the younger as well as to the older members, and may I add, that a complete history of the Society is in preparation.

I have found the work involved in gathering the above data very interesting, and I appreciate the honor conferred on me by our President, delegating me to finish the proposed history. In this work I am being assisted by our fellow member, Mr. Leonard Kirst, who has been designated to collect data covering the last few years, and I am sure that with his collaboration the completed work can be presented within the next few months.

MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Regular Meeting of the Society, February 17, 1936.

The meeting was called to order at 8 p. m. in the Hunt Room by Vice President Williamson. Fifty-three members and guests were present.

Minutes of the last meeting were read and approved.

Mr. Lanphier read a resolution on the death of Frank A. Muth. The resolution was adopted, and ordered incorporated in the minutes of the Society.

The Report of the Committee on Employment was read.

Mr. J. M. Todd announced that a dinner would be held Friday night, February 21, in honor of Sir William Batt, President of A. S. M. E.

The technical exercises followed, Mr. C. Glenn Cappel delivering an illustrated talk on "Moving a Five-Story Brick and Concrete Building a Distance of One Hundred Sixty-Two Feet in One Hour and Fifty-Eight Minutes."

An interesting discussion followed. After tendering the speaker a rising vote of thanks, the meeting adjourned to the usual collation.

ARTHUR M. HILL, Secretary.

Minutes of the Meeting of the Board of Direction March 6, 1936.

Present: Hackett, Godat, Grehan, Ricker, Hill.

The meeting was called to order by President Hackett. The minutes of the previous meeting were read and approved.

A letter from Mr. O'Neill stated that the consensus of opinion of his committee was in favor of the present method of electing new members.

A letter from Mr. O'Neill was read embodying a suggestion of one of the members of the committee that the Society write a letter expressing our desire to co-operate with the Engineering Council for Professional Development. The Secretary was directed to gather further information before writing.

The names of Dr. L. J. Lasalle, Mr. Claude Kelly, and Prof. P. H. Humphries were approved by the Board for membership in the Society.

It was asked that the Membership Committee Div. A review the membership list and suggest names of members who should be transferred from Junior to Full Members.

The names appearing for Standing Committees for 1936 were reviewed, and revisions were made where members had stated that for various reasons they could not serve.

The Board then voted the approval of the Committees as appointed.

There being no further business, the meeting adjourned.

ARTHUR M. HILL, Secretary.

Regular Meeting of the Society, March 9, 1936.

The meeting was called to order at 8 p. m. in the Hunt Room by President Hackett, 56 members and guests were present.

Minutes of the previous meeting were read and approved.

The report of the Employment Committee was read. Prof. Ricker announced a meeting of the A. I. E. E. on March 30.

Mr. McLean, Chairman of the Entertainment Committee, reported that progress was being made on plans for the Baton Rouge meeting.

President Hackett asked for an expression of opinion concerning a smoker for the Society. Mr. Todd called attention to the fact that a golf tournament is scheduled for April, and suggested that the smoker and tournament might be combined.

President Hackett stated a committee would be appointed to arrange details.

The names of the Standing Committees for 1936 were read.

Prof. W. B. Gregory gave an interesting illustrated address entitled "A Modern Rice Irrigation System."

A discussion of the paper followed. Col Shaw outlined some of the differences in methods of cultivation and irrigation of rice here and in the Orient.

Mr. Lorio made a few remarks about the large draining pumps in New Orleans.

Arising vote of thanks was tendered Professory Gregory, and the meeting adjourned to the collation.

ARTHUR M. HILL, Secretary.

ACTIVITIES OF LOCAL SECTIONS

President,
CLIFFORD H. STEM
1st Vice-President,
H. A. SAWYER
2nd Vice-President,
W. H. RHODES
Secretary,
CHAS. M. KERR,
5831 S. Robertson Street
Treasurer,
A. J. NEGROTTO
501 S. Rendon Street



STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

ANNUAL MEETING

Second Tuesday in January.

The Annual Meeting of the Louisiana Section was held Wednesday evening, April 15, at the residence of Mr. Ole K. Olsen, 508 Millaudon St., where the meetings have been held every year, in the large spacious quarters Mr. Olsen provides for that purpose. This was the largest and best-attended meeting in the history of the local section.

Under the guidance of Mr. F. P. Hamilton, Retiring President, the section has grown to its largest membership. This indication of growing interest in the local section is due to Mr. Hamilton's untiring efforts.

At the meeting Mr. Ole K. Olsen, noted far and wide for his good fellowship, energy, and engineering ability, was honored by his fellow engineers by being elected an honorary member. He is the only honorary member that the local section has ever had.

The technical high point of the evening was the presentation of a paper by Lieutenant Colonel Francis B. Willoughby, Engineer, Gulf of Mexico Division, U. S. Corps of Engineers, on the use of asphaltic concrete in the construction and repair of jetties. This paper was a technical education in itself being based on facts obtained by experiments leading a new field of engineering endeavor. The paper furnished further evidence of the open-minded manner in which the Corps of Engineers undertake the solving of any problem which presents itself.

The paper was discussed by Mr. H. A. Thompson, Principal Assistant Engineer, 2nd N. O. District, Mississippi River Commission, Mr. Rossiter M. McCrone, Principal Assistant to Colonel Francis B. Willoughby, Mr. Horace Carey, Assistant Engineer, 2nd N. O. District, Mississippi River Commission, Lieutenant John H. Carruth, 1st N. O. District, Gulf Division, Captain P. H. Timothy, 2nd N. O. District, Gulf Division, Colonel A. M. Shaw, Consulting Engineer, Major Victor Bedell, Chief Engineer, New Orleans Public Belt Railroad, and Mr. Bert Rhodes.

PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

VOL. XXII. JUNE, 1936 NO. 3

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EDITORIAL NOTES AND COMMENT

The Socialization of Engineering. Engineering is at the tail-end. Tail-end of what? Tail-end of the group of the three professions (Medicine, Law, Engineering) with regard to socialization.

By socialization we mean a social system whereby an individual acts more or less as a member of an economic group rather than as an individual—and gets paid on the same basis.

With this thought as a basis for grouping, the order stands: Medicine, Law, Engineering.

Consider the medical profession first. A careful survey will show that almost universally the doctor acts as an individual. The nature of his service makes such individualism necessary. Very rarely do you see a doctor as a member of a firm or as an

employee of an organization. As a matter of fact the frequent lack of respect for the "company doctor" on the part of the general public—and even the medical profession itself—is well known. Of course, there are a few exceptions, of which the great Mayo Clinic and Rockefeller Foundations are notable examples. Such dignified and respectable exceptions are so rare, however, that they do not affect the general proposition that the doctor almost universally acts as an individual. Not his patients (who are his employers) but he, himself, determines his recompense. In this he has the support of the great American Medical Association, a powerful, comprehensive organization devoted to the interests of the *whole* profession.

Next in order is the legal profession. In individualism this profession stands between medicine and engineering. While there are a great many lawyers practicing as individuals, so also are there a great many firms of lawyers, composed of two or more individuals, practicing law as a firm. Too, a great many members of the legal profession are employed by firms and corporations.

Whether operating as a law firm, or whether as an employee of some large corporation, they still have the professional respect of their legal brethren and also of the public at large. And note this well. Like the doctors, the compensation of lawyers is determined by the lawyers themselves or employers. In this they (like the doctors) have the backing of the American Bar Association, another powerful, comprehensive organization, an organization devoted to the interests of the *whole* legal profession.

And then, in the language of Gertrude Stein, comes as a poor third, with a poor showing, the poor engineering profession. The great body of engineers, quite unlike the doctors and lawyers, are not practicing engineering as individuals, nor even as engineering firms, but as the paid employees of firms or corporations. Another glaring dissimilarity is the fact that the engineer's compensation is determined not by himself, but by his employer. In effect, the engineer is told, "There's the job, the pay is so much. If you don't like it, we'll get another engineer who does." Socialization (or regimentation) almost complete.

Think of telling a doctor that you will pay him so much to cure you, or a lawyer so much to win your case! Think of telling either of them that if he doesn't like it you will get someone else!

And does the engineering profession have one all-encompassing organization which is powerful enough to *enforce* the demands of the *whole* profession? IT DOES NOT!!

The founder societies are specialized groups with more or less specialized interests. Each group contains a fraction only of the total number of professional engineers. The theory of "United we stand, divided we fall," has not yet seemed to penetrate. Truly "A house divided against itself." And that is that!

Entrance Fees Abolished for Remainder of 1936. Get your man! Here's the ammunition. For the remainder of 1936 the Board of Direction has abolished the entrance fees in all grades of membership. Furthermore, new members taking advantage of this arrangement will have to pay 1936 dues for the last quarter only. This is a generous inducement for many engineers to become members who could not heretofore join.

Can't each of us constitute ourselves a committee of one to bring in at least one new member? The Secretary will be glad to furnish you all the application blanks you need. Let him know how many. Do it now!

Group Service Hospital Plan. Attention is called to the advertisement of the Hospital Service Association in the advertising section.

The members of the Louisiana Engineering Society may now take advantage of group hospitalization. This is a plan whereby those participating pay a small stated sum each year and when illness overtakes, the contract holder is entitled to as many as twenty-five days of free hospitalization.

In addition the contract holder receives a discount of 33 per cent on the hospital bills of dependent members of his family.

This is an opportunity for the members of the Society to ease themselves at a time of anxiety.

Annual Meeting—Conference of Engineering Students. One of the high-lights of the Annual Meeting last January was the conference of engineering students. In this issue we print two papers delivered at this conference. One of these was read by our member, Mr. A. J. Sarré, a man who has had long and intimate experience in personnel placement. His article entitled "Human Problems in a Changing World" contains much that will give rise to thoughtful interest.

The other paper was entitled "A Few Thoughts on Industrial Education." The author, Mr. H. G. Martin, has for many years been the Principal of the Delgado Trades School of New Orleans. As one of the outstanding leaders in industrial education, his exposition of the relations which must exist between the technically trained engineer and the man trained for the industrial trades was both interesting and stimulating—not only to the university students present, but to the attending members of the university faculties as well.

A Modern Rice Irrigation System. In this issue we print a summary of a paper read by Professor W. B. Gregory at the regular meeting held on March 9th. Professor Gregory has had a long and varied experience in solving some of the problems of the rice irrigation country, and he speaks with authority. The Orange County project which he describes is a recent one on which he and Mr. Merrill Bernard were appointed to do the engineering work. The paper is quite lengthy as well as interesting. In the interest of conservation of time in reading, Professor Gregory reduced the paper to the summary printed in this issue.

PAPERS AND DISCUSSIONS

INTEGRAL COMBINATIONS OF STRUCTURAL TIMBER AND CEMENT CONCRETE IN COMPOSITE CONSTRUCTION.

By J. F. SEILER *

Read April 20, 1936.

There is nothing new about composite construction. In general, it is an expression of the attempt to combine different materials in construction in such a manner as to utilize to best advantage the outstanding characteristics of all, while eliminating, so far as possible, the structural limitations of each. Probably the best known example of composite construction is that of reinforced concrete, a development in the combination of steel and cement concrete which has virtually revolutionized engineering construction during the past 30 years.

Composite construction is particularly important, where in addition to utilizing certain properties of the component materials to advantage, and avoiding others, certain purposes contributing to the adequacy of the structure as a whole may be served. The combination of structural timber with reinforced concrete, as applied to floors and decks of bridges, buildings, wharves and piers, serves as an example of such a case.

The development of composite timber-concrete beams or slabs for highway bridge decks is marked by at least three definite stages through which it has passed in the last twenty years. Originally, a concrete deck or floor was placed on timber stringers or a sub-floor of wood primarily for the purpose of affording a wearing surface for traffic. Sensing the possibilities of the construction, engineers conceived the idea of placing nails or spikes in the timber so as to protrude into the mass of concrete, to facilitate the bond between the two and

* Engineer, Service Bureau, American Wood-Preservers' Association, Chicago, Illinois.

thus increase the integrity of the construction. This denotes the second stage of the development, and as a result of this, the third stage, wherein the two materials are combined to form, in effect, a monolithic beam or slab, with all the forces involved carefully investigated and provided for, is now apparent.

Examples of the construction as applied to highway bridges, illustrating the first stage of the development, are known to the author to date back or prior to 1916. Numerous examples of the construction in its second stage occur in various of the states, particularly in Alabama, Georgia, and the Carolinas, where, for the most part, excellent results have been obtained. As for the third stage of the development, the State Highway Department of Oregon has been principally responsible for its inception, both in point of research and actual construction.

In view of Oregon's contribution to the development of this construction, it is fitting to quote from a paper on the subject, by C. B. McCullough, Assistant Highway Engineer. "The type developed in Oregon . . . . . differs from types used heretofore, principally in the introduction of a rigid shear connection between the timber stringers and the concrete deck, thus converting the entire unit into a monolithic T-beam. The advantages inherent in this type were readily apparent. The first was that the overhanding concrete roadway afforded a waterproof and fireproof shed or roof over the creosoted timber stringer system . . . . . In the second place, it was clear that a monolithically placed deck would add stiffness to the stringer system, eliminating in large measure any tendency toward the development of cracks in the roadway surface. As a third advantage, the integral ultlization of the two materials rendered it possible to space roadway expansion joints at considerably greater distances than formerly, thereby improving the riding properties of the deck. The fourth advantage arose from making the concrete deck act as a T-beam flange for each of the stringers, thus materially reducing unit stresses. In the fifth place, the employment of a composite rail or balustrade, ... rendered the structure architecturally pleasing and suitable for localities where ordinary trestles would be somewhat

out of keeping with the general surroundings. And finally, as a sixth advantage, the composite utilization of the materials reduced the first cost sufficiently to render the type economically sound for many locations."

By far the most comprehensive research project on the subject was carried out during the summer of 1932 by the Oregon State Highway Department, and a brief description of the work and the conclusions reached is of interest at this point. The project consisted of testing to destruction 22 full sized composite beams and taking measurements of deflection, fiber distortion and slippage due to shear, for each increment of loading. In addition, certain beams were subjected to repeated or alternated load tests through a number of cycles and to alternated temperatures varying from 15 to 69 degrees Fahrenheit. All beams were 16 feet long and 15 feet between supports. Loads were applied at the third points in each case. Five types of shear connections were used, as follows:

Type A, consisting of a system of round spikes driven into the timber web in holes bored slightly smaller than the spike diameter.

Type B, consisting of daps in the timber . . . . . .

Type C, consisting of a combination of spikes and daps.

Type D, consisting of metal pipes used in much the same manner as the spikes were utilized in Type A.

Type E, consisting of ¾-inch steel plates driven into slots in the timber and allowed to extend up into the concrete.

The following facts developed as a result of the research project are reported by Mr. McCullough:

(1) "The ultimate strength of a composite beam, suitably connected at the junction plane and suitably designed, is at least twice that for the same materials and the same dimensions employed independently.

"(2) The deflection of such a composite beam under a given loading will not be more than 25 per cent of the corre-

sponding deflection for the same sizes and materials used independently.

"(3) The metal pipes and the combined spikes and daps, for shear connections, produced the best results, all things considered, with the combined spike and dap method presenting the further advantage of greater economy in first cost.

"(4) Repeated or alternated loads did not appear to have any detrimental effect on this type of construction.

"(5) Variations in temperature produced stresses of sufficient magnitude to warrant a definite provision for the same in design. This feature can be taken care of adequately, however, through proper design of the shear connection. The secondary bending resulting from thermal effects does not appear to induce stresses of sufficient magnitude to cause concern. However, the development of tension as a result of restraint in the lower portions of the concrete slab, points to the advisability of an adequate percentage of longitudinal temperature reinforcement.

"(6) The ordinary transformed-section formulas yield results which, within working limits, are sufficiently accurate for all practical purposes."

It is readily appreciated that certain features of the Oregon or the so-called McCullough type of composite timber-concrete deck, are not so well adapted to conditions in the eastern part of the United States as they are to those in the West, in respect to timber utilization. For example, the design contemplates the use of relatively large size timbers of considerable length as the beam stems. Such timbers are difficult if not impossible to obtain in eastern or southern species, and at best are high in cost. The use of smaller joists involves difficulties in providing sufficient areas in the undapped portions to resist the shearing stresses concentrated at the plane of junction between timber and concrete, and the design of necessity contemplates a series of simple spans without continuity of action.

In view of the foregoing, the idea was conceived of applying the principle of composite action to solid slab construction, wherein the underside of the slab consists of relatively thin

planks placed vertically in the manner of laminated construction, with the concrete placed thereon to form the upper surface. In order to provide means for transmitting horizontal shearing forces from the concrete to the timber, the arrangement of alternate smaller and larger laminations, or the same

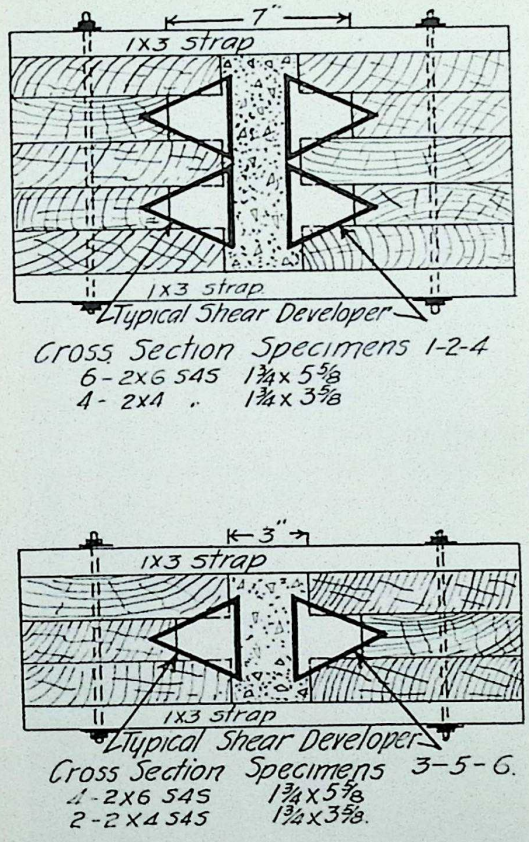


Fig. 1

in vertically staggered positions was effected. This resulted in the formation of longitudinal grooves or channels into which it was possible to place transverse metal plates, engaging each of the three laminations forming the channel, and extending up into the body of the concrete.

The following advantages appeared to accrue from such an arrangement: First, the use of small sizes of timber readily

available at comparatively low cost; second, the elimination of nearly all the form work for concrete; third, the reduction in thickness of the concrete and amount of reinforcement steel; fourth, by suitable arrangement and splicing of laminations the possibility of securing a considerable degree of continuity,

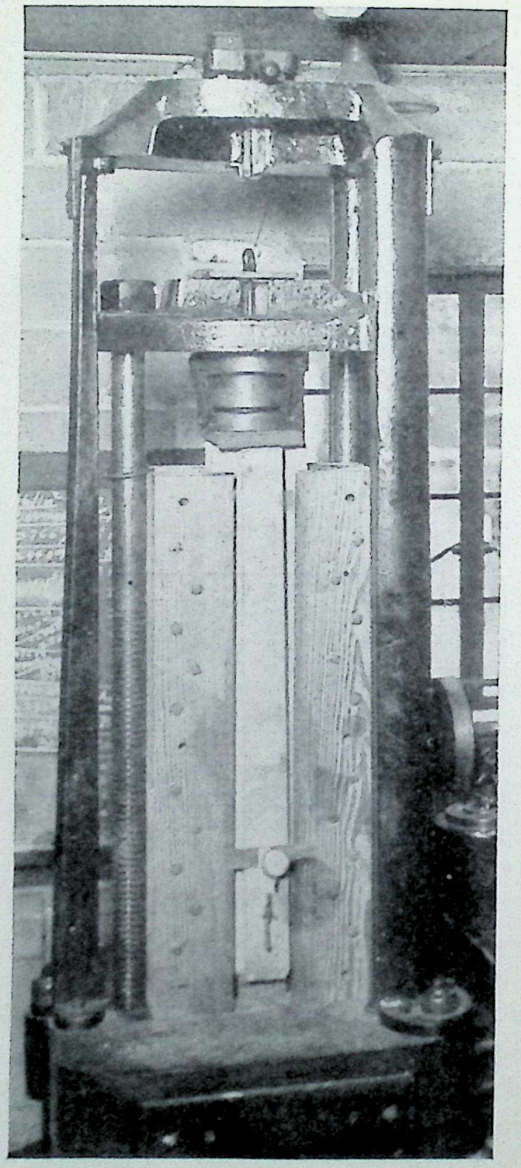


Fig. 2
Vertical Test to Determine Preliminary Values for Shear Developers.

thus reducing bending moments; fifth, low tensile and shearing stresses in the wood by virtue of slab action; sixth, the absorption of vibration and impact forces through distribution among numerous elements of the construction; seventh, low cost of the shear connections and the ease of placement; and, finally, eighth, the virtual fireproof nature of the composite slab.

Preliminary tests on a composite beam of this type were undertaken prior to the design of the Tampa-Clearwater Causeway, financed by a loan from the Reconstruction Finance Corporation. Tests were carried out in the field on full size beams, approximately 12 inches in width and 60 feet in length, tied

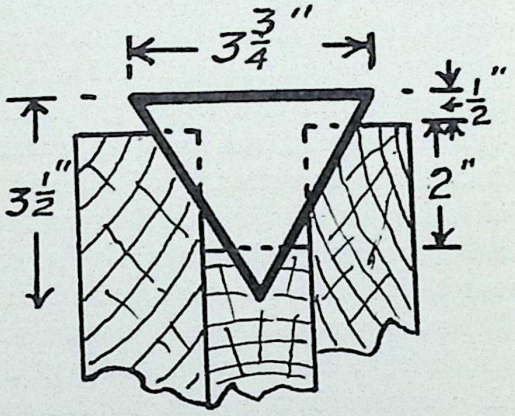


Fig. 3

down at the ends and supported on two intermediate piers so located as to form a continuous girder of three equal spans. Three beams were tested, two of composite construction and one consisting of the laminated wood pieces only, as a control, the dimensions of the wood being the same in the three beams.

The make-up of the composite beams consisted of seven (7) laminations, 2x10-inch and 2x8-inch pieces alternately spiked together, extending the entire length, with four (4) inches of cement concrete topping the upstanding laminations, the bottom edges of the laminations being laid flush. The wood pieces were surfaced to a uniform width of 1¾ inches, thus making the width of the beams 12¼ inches. The surfaced depth of the 2x10-inch pieces being 9½ inches, the over-all depth of the

composite beams was 13½ inches. Shear Developers, the term applied to the shear connections, were installed at an average spacing of 18 inches in each groove or channel of one composite beam; the other composite beam contained no Shear Developers. The control beam, of wood only, was constructed in every respect similarly to the wood section of the composite beams.

The center span of each beam was loaded uniformly with sand bags, carefully weighed as placed, and measurements of deflections taken for various increments of load up to a total of 50,000 pounds for the composite, and approximately 35,000 pounds for the control beam. Deflections for the two composite beams were virtually identical for corresponding increments of load, up to the conclusion of loading, but after a period of 48 hours subsequent to loading, the deflection of the beam without shear connections was approximately double that of the other. For increments of loading up to 35,000 pounds, the deflection of the control beam was more than three times that of the composite beams. During the 48-hour period subsequent to loading, there was no significant increase in deflection of the composite beam equipped with shear connections, which indicated that bond between the materials had been maintained, whereas in the case of the composite beam without shear connections, the initial bond between wood and concrete had been virtually destroyed. The field tests, so far as they went, corroborated roughly the conclusions drawn from the Oregon tests in respect to stiffness, taking into consideration relative dimensions of beam elements and size and shape of beams.

The results of the field test indicated the desirability of somewhat more accurate tests, carried on under laboratory conditions, and this was arranged during the summer of 1933, the work being done in the Engineering Laboratory of George Washington University in the District of Columbia. One of the principal purposes of this project was to determine the value of the Shear Developers for design purposes; hence in addition to the beam specimens tested, some six (6) specimens of the type shown, in lengths varying from 24 inches to 40

inches, and carrying from none to a total of 12 Shear Developers each, were constructed and subjected to a so-called "push-out" test. A cross-section of these specimens is shown in Figure 1. Figure 2 shows one of the specimens in a 100,000-pound Olsen testing machine and indicates the method of test whereby a direct thrust is imposed against these members. Figure 3 indicates the size and shape of the Shear Developer,

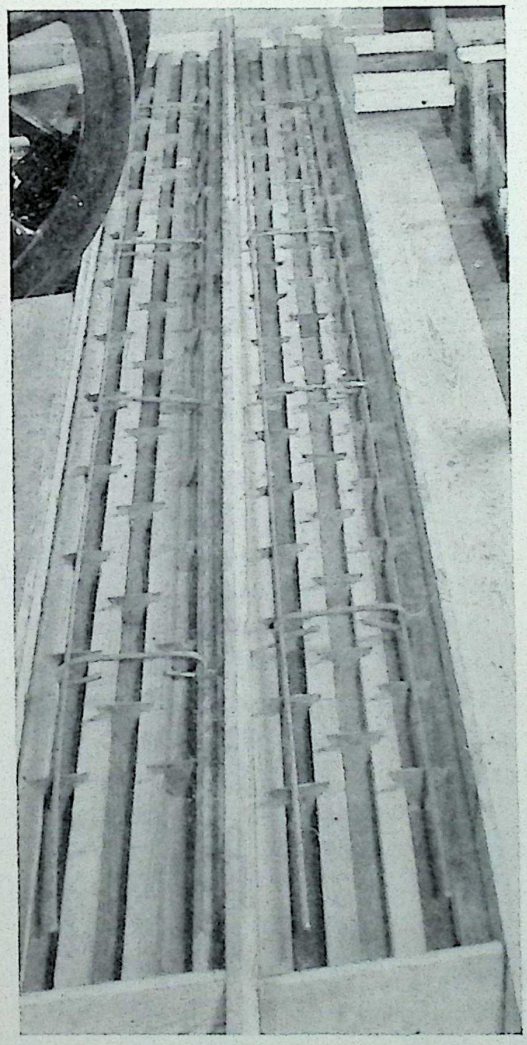


Fig. 4

Wood Portion of Test Beams with Shear Developers in Place, Ready for Concreting.

which is a 3/32-inch thick steel plate, the triangular form of which is obviously to facilitate placement, at the same time dictated by considerations of securing maximum efficiency. The push-out tests gave an average ultimate value of 6,880 pounds each, for these members.

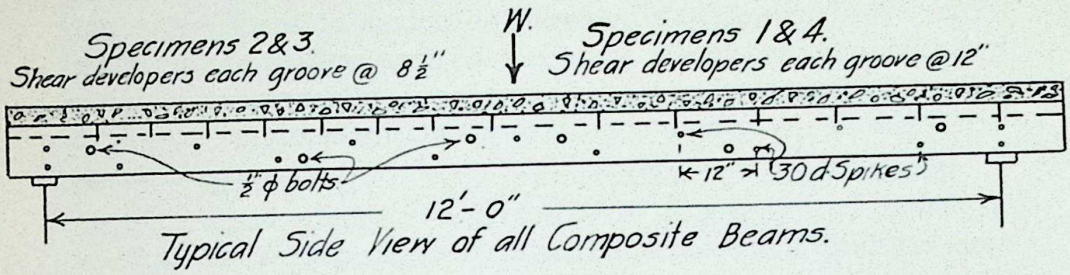
Apparently the actual ultimate value of these members is considerably in excess of this figure, as it reflects very nearly the minimum value of three out of the four test specimens containing these members. The average was reduced by one specimen which gave 5,656 pounds, and it seems likely that this particular test was not carried to actual failure.

Preliminary calculations indicated, on the basis of bearing in the wood, that a working value of approximately 1,800 pounds might be assigned the shear members, there being, on the basis of dimensions of test beams, a bearing area against end grain of 1.54 square inches. Ultimate values of approximately 7,000 pounds as developed in the push-out tests, and to exceed that in the beam tests made subsequently, indicated such a value to be very nearly correct, and eventually a value of 1,750 pounds was adopted as a working load.

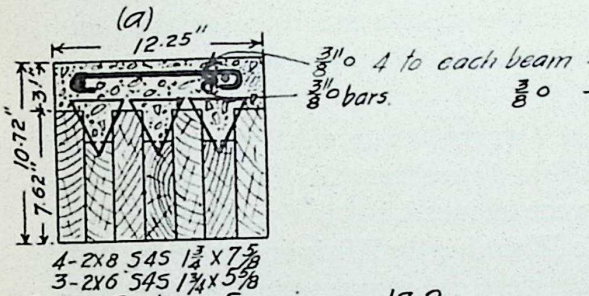
Figure 4 shows the test beams, four in number, before application of the concrete topping. Beams 1 and 2 were made up of alternate 2x6-inch and 2x8-inch pieces, and the others of 2x6-inch pieces staggered vertically, forming longitudinal channels on top and bottom sides. One of each type of beam was prepared with a total of 35 Shear Developers, and the other of each type with 50 of the members. Concreting was done so as to secure the same total depth of beam in all cases, measured from the bottom edge of the wood to the top of the concrete. Beams 3 and 4, consisting of the staggered laminations of the same depth, were designed on the assumption that the strength of the beam is limited by the compressive strength of the concrete, and that the full section of timber would not be developed in tension.

A fifth beam made up of laminations similar to beams 1 and 2 was also constructed and tested to destruction, as a control.

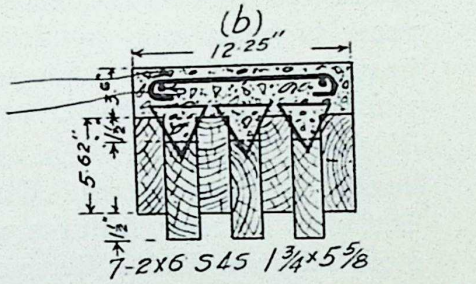
End slip and deflection of the beams were measured in a manner similar to that described by McCullough for the Ore-



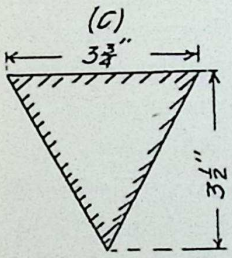
Typical Side View of all Composite Beams.



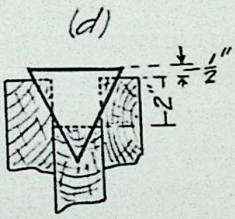
Cross Section Specimens 1&2



Cross Section Specimens 3&4.

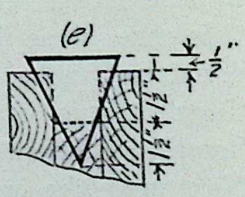


Detail of Shear Developer
Mild O.H Steel plate $\frac{3}{32}$ inch thick



Detail of position of Shear Developer.
Specimens 1&2
Area Wood Engaged 12½ Sq. ins

Specimen No 5
was a plain timber beam made up of 2x6 and 2x8 planks
Cross section identical with timber portion of Specimens 1 and 2.



Detail of position of Shear Developers.
Specimens 3&4
Area Wood Engaged 22½ Sq. ins.

Fig. 5

gon tests, except for minor details in placement of the Ames dials. And, instead of loading the beams at the third points with symmetrical loads, a single load was applied at the center point. This method of loading produced, of course, a maximum condition of shearing stress throughout the beam.

Beams 2 and 3 illustrate the effect of the greater number of Shear Developers in that a higher ultimate beam strength was attained, accompanied with a high degree of stiffness almost to point of failure. It is interesting, however, that there is practically no difference in the stiffness of the four beams up to about the yield point, which in general is very nearly the same for all.

McCullough found in the Oregon tests that the composite beams developed about double the strength of the controls. But in those tests, failures were secured in tension, in the wood stem section. In the George Washington University tests, failures in the composite beams were in compression in the concrete, while the control beam failed in tension. Therefore it was not possible to make any definite comparison of strength. For example, had sufficient depth of concrete been added to the composite beams to make it possible to get failure in tension in the wood, it is likely that strength relations would have been indicated in line with those of the Oregon tests.

Although the series of tests on composite beams disclosed the broad principles on which design might be based, and which in the case of T-beam deck construction yielded virtually complete information, numerous problems presented themselves in connection with the design of the composite slab deck. In this case, since it was advantageous to utilize continuous beam construction by a proper arrangement and splicing of laminations, it was first necessary to determine the distribution of bending moment as between points of support and midspan. Next was the question of lateral distribution of concentrated load, both for moment and for shear, and finally the determination of the amount of steel reinforcement, not for calculated stresses, but for shrinkage and curling action.

Lateral distribution of concentrated load was assumed as equivalent to that in an ordinary concrete slab, which for spans

in excess of 15 feet would be seven (7) feet for a single load and four (4) feet for passing wheels. This is for calculation of stress due to bending. A lateral distribution of three (3) feet was assumed for shear calculations, which compares essentially with relative distribution of loads at mid-span points and critical shear points assumed in recent investigations of the subject by the U. S. Forest Products Laboratory.

As moment distribution in continuous beams depends on variation in moment of inertia of the beam section, it is clear that the plan of splicing laminations has an important bearing on the behavior of the slab in bending. As a practical matter it has been assumed that any scheme of splicing the timbers, if carried out uniformly across the width of a given slab, will yield an equivalent uniform amount of inertia of section throughout the span length. On this premise it follows that the construction may be treated as a series of spans of uniform moment of inertia, restrained as to bending, by virtue of connecting links over each support. In this case, the connecting links are sections of zero length and of the moment of inertia determined by the pieces continuous over the supports, together, of course, with the negative steel in the concrete.

For dead load calculations, tangents to the link sections will remain horizontal owing to symmetry, and the distribution of moment as between midspan and support is determined by equating the M/I areas, positive and negative. Where the whole construction is concreted in a continuous operation, and no support is afforded the slab, all dead load stresses pass to the wood. If midspan portions are concreted first and allowed to cure, and the intervening sections poured later, then only the dead load of the wood and that of the first-poured concrete sections will pass to the wood, and the remaining concrete load will be determined in effect in the mid-span composite section, roughly speaking, and on the assumption that the first poured section extend at least from quarter point to quarter point. Various other arrangements and sequences of concreting may be worked out, if desired.

All live load stresses are borne in the composite section. For maximum positive bending the criterion (for short spans

contemplated) for load position is at midspan in the span under consideration, and for all practical purposes we may again consider tangents at the links to be horizontal, although actually the points of horizontality will be slightly beyond the supports. For maximum negative bending, the criterion would be for load at midspan of adjacent spans, but again for all practical purposes it is sufficiently accurate to assume all spans loaded, and in this case, as well as for positive bending, we may assume the tangents at supports to be horizontal, and then utilize the same principle of equating M/I areas, as done for dead load stresses.



Fig. 6
Placing the Laminated Timber Portion of the Slab.

In the Tampa-Clearwater bridge, for reasons of economy, the following arrangement of laminations was utilized: Every fourth lamination was a full length piece, extending from support to support, a length of 20 feet. This was followed by three pieces of length 6 feet, 10 feet, and 14 feet, respectively, each centered over the support, with pieces of corresponding lengths centered at midspan after the fashion of cantilever design. Dead load stresses were calculated as for a cantilever with suspended span slightly longer than the average of the three central pieces to compensate for the single full length lamination. For live load the section modulus of the composite section was calculated as follows: for the pier link, 3 out of 4 laminations, wood only, as construction joints were made over each support.

For the span section, the concrete plus 2 out of 4 laminations, that is, the concrete plus half the width of the wood. Sections were not transformed on the basis of relative elasticity of concrete and wood, it being considered this procedure was more conservative. With the above procedure, for live load, it will be noted that due to the very small section over the supports, the stresses were virtually as for simple spans.

The structure referred to above, now in service for approximately 20 months, has come up to expectations in all respects

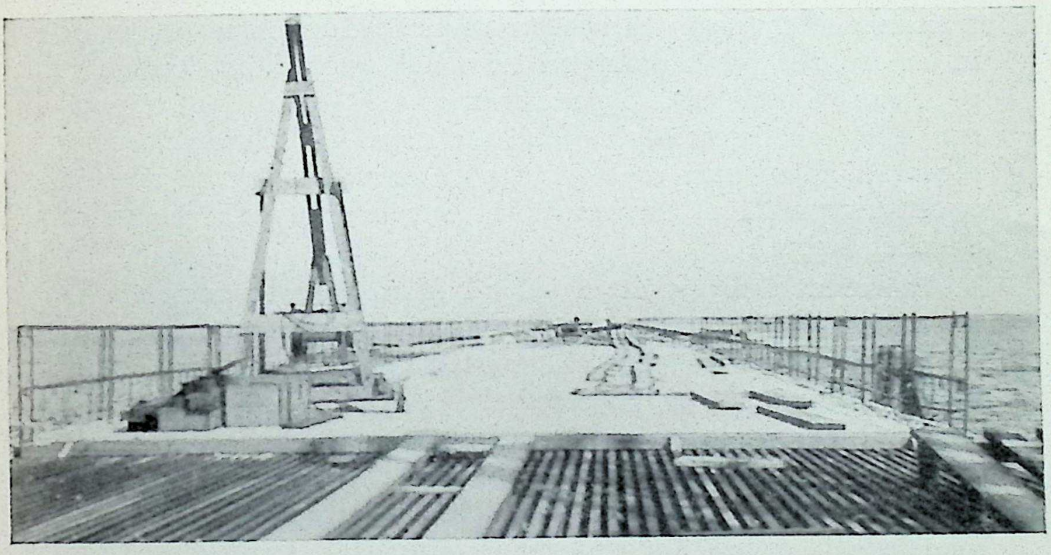


Fig. 7
Concrete Portion of the Slab in Place.

as a rigid, substantial highway bridge. It is true that considerable cracking of the concrete slab has taken place, which occurred very soon after, if not at the time of completion of the work. However, during the 20 months of subjection to very heavy traffic, there has been no tendency for the cracks to open up or otherwise result in deterioration of the slab. It appears to be well established that the lack of any attempt to cure the concrete was responsible for the usual type of shrinkage cracks, and as for certain well defined cracks extending in a direction parallel to the center-line of roadway, and located

about half way between the curbs and center-line, it seems to be the consensus that these were caused by the separate pouring of the curbs and rails, weighing about 300 pounds per running foot, before the roadway slab had developed normal strength. It is also clear that insufficient reinforcement was furnished for the concrete, there being ⅜-inch round bars at 24 inches longitudinally and 12 inches transversely.

In shear calculations for the purpose of determining the number and spacing of the Shear Developers, maximum horizontal shear as acting at the neutral axis, is determined for the maximum live load. In general there is no dead load shear transmitted through the shear members. Placement of load is in accordance with usual criteria and lateral distribution is as above pointed out. Total shear on one square foot of horizontal surface is calculated, and the number of Shear Developers at 1,750 pounds each is then determined for the area in question, and from the result the spacing in each groove or channel is fixed.

In recent designs, attention has been given principally to the matter of arrangement of laminations, as a factor in securing the best possible results in continuity and rigidity of action. Recently a number of projects have been undertaken involving this type of composite construction, in which an arrangement of laminations differing from that of the Tampa-Clearwater bridge, has been worked out. At the outset, all pieces are full span length, except for end spans. In what is considered the best arrangement, every third lamination extends from support to support, another one is spliced at one quarter point, and the remaining one of the group at the other quarter point. The arrangement results, for all practical purposes, in a uniform moment of inertia throughout, with two out of three laminations effective in any section. It is to be borne in mind, in this type of construction, due to the action of the Shear Developers and neglecting the effect of the horizontal spiking of laminations, each piece must bend under load, according to its position in the assembly and the radius of curvature determined for the beam by the loading.

It will be noted by reference to the load-deflection curves of the George Washington University tests, that no difference in

strength of beams 2 and 3 is apparent. The over-all depth of each beam was the same, but No. 2 beam was constructed of 2x6-inch and 2x8-inch wood pieces, while No. 3 beam was constructed of 2x6-inch pieces staggered. The result was as expected because of the limitation in compressive strength of the concrete. From this has developed the practice of utilizing 2x8-inch pieces of timbers only, staggered as indicated in test beam No. 3, and numerous designs have been worked out with such an arrangement. In such designs, it is necessary to supply bearing blocks over the supports, to fit in the channels left

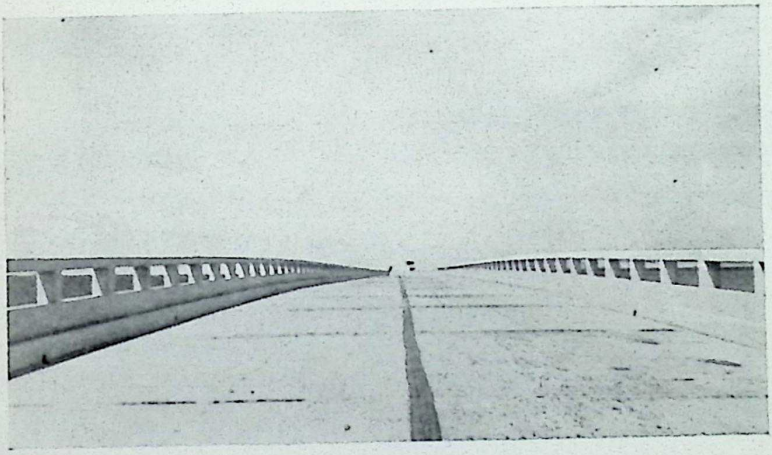


Fig. 8
Completed Structure.

by the outstanding laminations. Some designers have gone a step further in utilizing 2x8-inch and 2x10-inch pieces spiked alternately, but allowing the 2x8-inch pieces to occupy the position of the up-standing members, and by this means the effective depth of the wood section is increased, without a corresponding increase in volume of wood. A number of interesting arrangements of laminations may be effected owing to the purpose in mind.

Bridge designs employing the arrangement of 2x8-inch pieces as above described, and 4 inches of concrete, have been prepared, and in some instances are under construction, by the Bureau of Public Roads and several of the State Highway Departments. A Public Works Administration project involv-

ing a large bridge near Jacksonville, Florida, now on the market for bids, employs in the design the scheme utilizing the 2x8-inch and 2x10-inch pieces placed as just above described. An Alabama State Highway project employs an additional feature in the design, known as "uplift" spikes. These consist of spikes driven in pairs over each groove or channel. The spikes are inclined at an angle of about 30 degrees in opposite directions to each other, and the plans call for a spacing of 48 inches for each pair in each groove. The device is for the purpose of maintaining a close contact, vertically, between wood and concrete, and thus resisting any tendency to separation between the elements due to curling action or other causes. It will be observed that this device must be effective in its action.

For 20-foot spans commonly used, and the H-15 loading of the American Association of State Highway Officials, end spacing of Shear Developers is about 10 inches in each groove, the position of the members being staggered in adjacent grooves. Spacing is rapidly increased as the midspan point is approached, and the average throughout the span is approximately 13 inches in each groove. In ordinary designs, this results in slightly over 3 of the members per square foot of deck slab.

Recent designs also call for a minimum of ½-inch round rods at 9 inches each way in the concrete, which is considered good practice, and as a rule the specifications require curbs to be poured with the roadway slab. As the shear members are installed under the curb as well as throughout the balance of the roadway, it is apparent that a very stiff beam is secured along the edges of the construction. It is noted also that considerable attention is given to the placing and spiking of the laminations, to preserve uniformity in the depth of the grooves or channels. This is exceedingly well taken, because of the importance of uniform position of the shear members. The requirement not to exceed ⅛-inch variation in depth of grooves for a distance of 5 feet either side of the supports, with a tolerance of ⅛-inch for the balance of the span lengths, is believed well warranted, and is practical to secure.

Specifications usually provide that the Shear Developers shall be placed in slots cut by a tool approved for the purpose, and then driven to a tight bearing. The tool consists of a sharpened chisel of the exact size and thickness of the shear member, mounted in a steel or forged housing so shaped that the slot may be cut accurately and without damage to the wood pieces. The housing is carried up in the form of a bar, extending 24 inches to 30 inches, which receives the blow of the sledge, usually an 8-pound size, to perform the work. If the

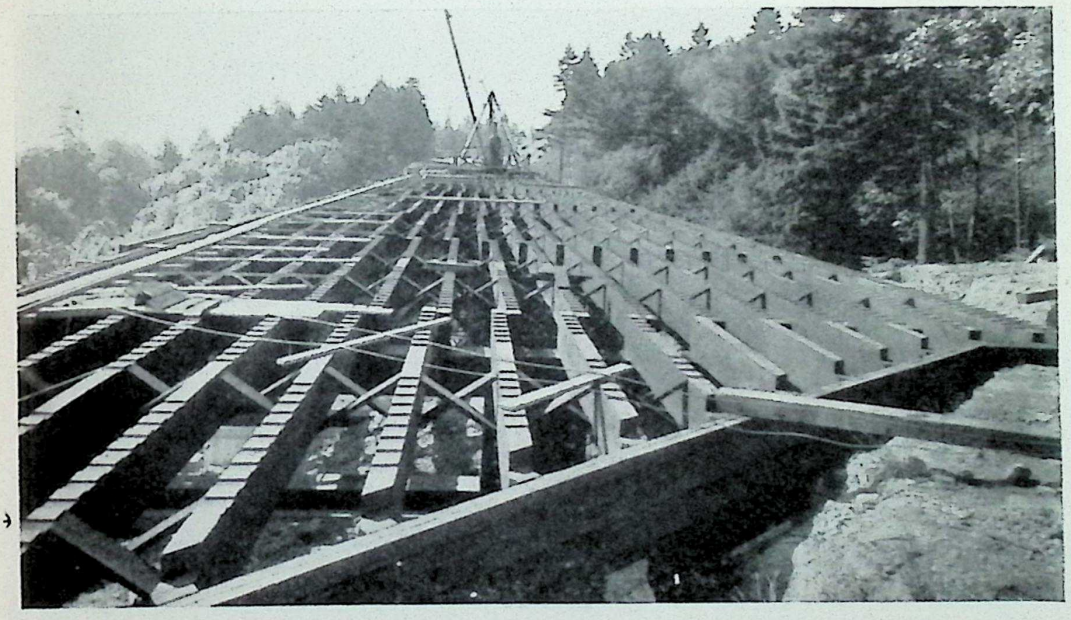


Fig. 9
Oregon Design of Composite Construction. Creosoted Stringers in Place.

chisel is well made from the best grade of steel, no difficulty is encountered in cutting the slots which is generally done with one blow of the sledge, after the tool is in place. An extension of the tool on one side permits the chisel to be withdrawn after the slot has been cut. Three men can cut the slots and place from 1,500 to 2,000 Shear Developers per 8-hour day.

For structures of considerable length, the placing of expansion joints at intervals of not less than 200 feet, is entirely sufficient and takes care of a temperature variation of 100 de-

grees Fahrenheit. Due to the fact that both wood and concrete are compelled to act together in changes of length due to temperature changes, it follows that stresses in both materials will be induced. These can be calculated and provided for in the design. Where expansion joints are introduced, it is necessary for the break to extend completely through the wood as well as the concrete of the composite slab, and the joints may be left open or provided with water stops as desired. No other

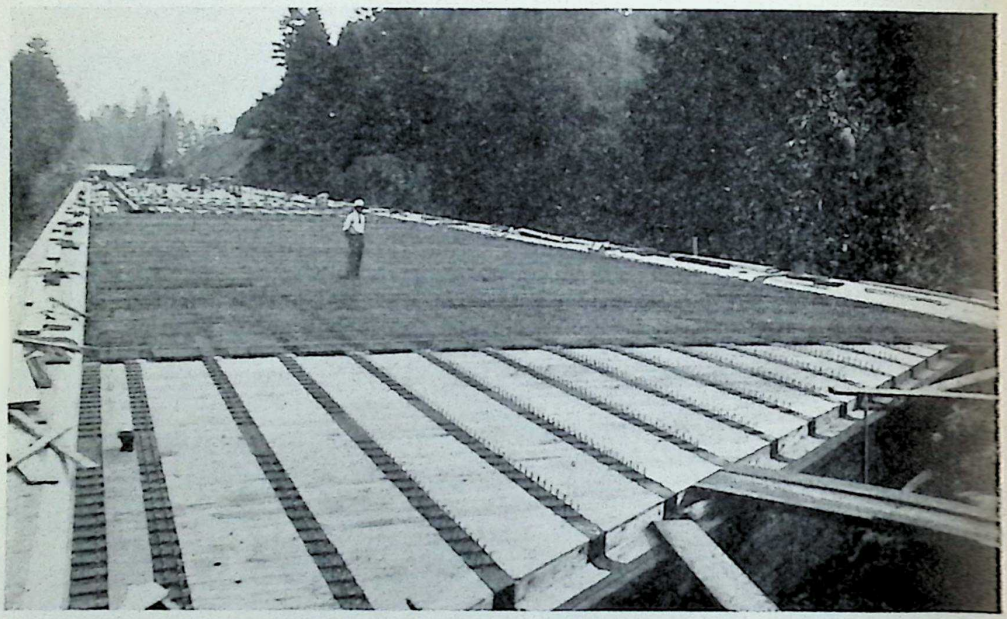


Fig. 10

Placing Reinforcement Before Concreting Deck. Note the Form Work Between the Rows of Creosoted Stringers.

joints, except for construction purposes, should be left in the structure, and the result is a smooth uniform roadway surface throughout.

There has been sufficient observation of the action of laminated decks, both in composite construction and otherwise, to dismiss any apprehensions as to the effect of shrinkage of the wood on this kind of construction. The difficulty in this respect experienced with stringer construction similar to the Oregon type of bridge decks was due to the fact that concrete

diaphragms were poured between the beams over the supports, these diaphragms actually resting on the pier caps. It is obvious that as shrinkage took place in the timber stringers, the concrete floor itself rode clear of the beams by virtue of its support on the diaphragms. In later designs a clearance is left for the diaphragms, if any, and in the laminated composite type no diaphragms are required.

There will be the normal shrinkage in individual laminations unless they are carefully dried to the correct moisture content at the time of construction. In that event they may absorb some moisture during the concreting operation, though with freshly creosoted material most of the water would not be absorbed but pass down through the spaces between the laminations. As a rule the cross shrinkage in individual laminations may amount to as much as 0.1 inch, which results in no over-all contraction, but only in the opening of the spaces between the laminations.

McCullough has emphasized the factor of appearance which it is possible to obtain with composite construction, and there is therefore no need to dwell further on that topic. His remarks in this respect apply to the laminated, as well as the beam type of composite construction, as is obvious. Otherwise it is believed that an improved and durable type of structure is had in the laminated design, and from the standpoint of wood utilization it is important to the pine producing sections of the country, where small sizes of timbers are abundant and low in cost, and where on the other hand the use of the largest sizes and highest structural grades not only operates to penalize the user, but is disadvantageous in numerous other respects.

In the foregoing, the application of laminated composite slab construction to bridge desks has been emphasized, including steel span structures of any length or roadway width, as well as trestles, but it is obviously applicable to a variety of constructions such as piers, wharves, warehouses, and industrial establishments, where heavy-duty service is involved in handling and storing a wide variety of commodities. In each case, the same principles of design govern in respect to arrange-

ment and splicing of laminations, the spacing of Shear Developers, and other factors involved. For special cases of loading, the flexibility of the assembly lends itself readily to the achievement of the particular end sought, and in this respect the design is likely to find its most advantageous application.

DISCUSSION

MR. O'BRIEN: Why must the expansion joint be cut through both concrete and wood?

MR. SEILER: Since concrete and wood are integral and are compelled to act together, if the joint is to be effective, both must be cut through.

MR. GALLAGHER: You referred to specifications allowing tolerances of one-eighth of an inch. How is this checked in the field?

MR. SEILER: The Alabama specifications are very strict with regard to sizes of laminations. The tolerance of ⅛ inch referred to was in connection with depth of grooves for a distance of five feet on either side of the support. The tolerances are checked by a metal gage which may be slipped along the groove. All of the material used for laminations is surfaced on four sides.

MR. O'BRIEN: What is the practical length of span?

MR. SEILER: Twenty feet is about the limit. Spans of twenty-four feet or even more are perfectly possible, but are not economical as a rule.

MR. KERR: What is the modulus of elasticity of the composite section?

MR. SEILER: This is not definitely known until a test is run on a sample section. However, it can be estimated quite closely, knowing the characteristics of concrete and wood, and their relative dimensions in the cross-section.

MR. KERR: How are the laminations fastened together?

MR. SEILER: They are spiked. Bolts are not used. Spiking is not an important factor, as the concrete slab distributes the load to the laminations.

MR. KERR: What grades of lumber can be used?

MR. SEILER: Lower grades can be used, due to lower fibre stress developed in the wood, or tension side of the beam. Typical calculations indicate less than 1,000 pounds per square inch maximum fibre stress in the wood.

MR. O'BRIEN: Can 2x6 and 2x8 be used together, with 2x6 above?

MR. SEILER: This combination gives only about 3½ inches for nailing, which is probably somewhat scant for practical constructions.

MR. NAQUIN: Are any wooden forms used except for the side rails?

MR. SEILER: This is the only part needing forms.

MR. GODAT: How is thickness of concrete on top of beam determined?

MR. SEILER: There is, of course, no definite answer to that question, as any desired thickness of concrete may be used. However practical considerations furnish the cue to this situation. For example, in any clab design there is usually a fairly well fixed size of wood laminations which may be used, determined usually by allowable deflection under dead load.

Thickness of concrete above the wood, as then determined, is a minimum, first to properly distribute load without dependence on the spiked laminations. For concentrated loads usually encountered in highway bridge design, about 4 inches of concrete is considered the minimum necessary, for properly distributing such loads.

If required strength of the *composite slab* is attained with the minimum thickness (say 4 inches) of concrete, the design is satisfactory; if not, then either more concrete or wood must be added—preferably concrete, since additional quantities involve practically only the cost of the mixed materials, and would be cheaper than equal volumes of treated wood.

MR. JOHNSON: How about costs compared to concrete?

MR. SEILER: Costs are surprisingly low. Cost is less than when using stringers and concrete floor. In that design you have forms, more reinforcing is used, and more concrete is required.

MR. O'BRIEN: Are formulas developed for this work?

MR. SEILER: Formulas are well known, and incorporate standard assumptions.

MR. KERR: Has any consideration been given to railroad work for this type of construction?

MR. SEILER: A great deal of consideration has been given to this type of construction for railroad work. Obviously, it would compare with so-called ballast deck type of railway bridges.

In ballast deck railway bridges, the crossties, an integral part of the track structure itself, performs the function of distributing loads laterally; hence this important function of the composite design in deck slabs is already provided for.

It is believed composite construction would permit use of longer spans in railway trestles, but the larger size and greater length of laminations would tend to increase the cost, and unless longer span length should be the essential consideration, it is questionable whether economical construction would result.

A MODERN RICE IRRIGATION SYSTEM

By W. B. Gregory *

Summary of paper read March 9, 1936.

Rice is the principal food for about forty per cent of the human race. The United States produces only about one-half of one per cent of the world's supply; the farm value of the crop in the United States is about $33,000,000.00. The average yield of rice per acre was 49.0 bushels in 1935 while that of wheat was 11.8 bushels.

In the Carolinas rice has been grown since about the year 1700. For many years these states were the center of the rice industry in this country. The development of the prairie lands of Southwest Louisiana in the eighties and early nineties brought farmers from the middle west accustomed to planting wheat and shifted the center of rice production. The Year Book for Agriculture for 1935 gives the total production for the United States as 38,296,000 bushels, divided as follows:

Louisiana	50%
Texas	19%
Arkansas	17%
California	14%

The value of the rice crop as compared with some other crops as given by the census of 1930 is approximately as follows:

Rice	1%
Wheat	25%
Corn	50%
Cotton	48%

Rice is planted in a well-prepared seed bed in the same manner as wheat,—usually by drilling. When the rice plants are 4 to 6 inches high water is applied; the irrigation period varies with varieties and weather conditions but usually is between the limits of 70 to 120 days. Contour levees are used with dif-

* Professor of Hydraulics, Tulane University.

ference of level from 0.2 to 0.3 of a foot. The water is drained off a few days before the crop is ready to be harvested.

The amount of water pumped by the large canals is sufficient to cover the acreage served to a depth of 29 inches; this is in addition to an average of about 18 inches of rainfall. The duty of water in rice irrigation is about as follows:

Transpiration	15 to 18 inches
Evaporation	14 to 11 inches
Seepage	2 inches
Loss in Transit	2 inches
Waste	14 inches
Total	47 inches

A part of the waste is due to careless and inefficient irrigation. A large portion is lost during storms when field levees are overtopped resulting in loss of field water as well as the rainfall.

The Orange County Project

This project is located in Orange County, Texas. It is designed to water 18,000 acres annually. Its canals and laterals are about 85 miles in length and reach an acreage of about twice the amount to be watered annually. The land will be planted on alternate years.

The capacity of the pumping plant is 12 gallons per minute per acre irrigated; this gives 216,000 G. P. M. for 18,000 acres. There are four units in the pumping plant each consisting of a McIntosh & Seymour 400 H. P. Diesel engine, direct connected to a 48-inch screw pump built by the Morris Machine Works, Baldwinsville, N. Y. The difference of levels of suction and discharge basins is as follows:

Minimum	17 feet
Average	22 feet
Maximum	24 feet

This project is one of the few privately owned enterprises undertaken by the Public Works Administration, from whom we borrowed the sum of $489,000.00. The project will be self-liquidating.

HUMAN PROBLEMS IN A CHANGING WORLD

By A. J. Sarré *

Read to the Conference of Engineering Students at the Annual Meeting, January 24, 1936.

An old man standing at the carpenter's table where for years, with a few helpers, he had devoted himself to fine cabinet work, was trying to give friendly counsel to his restless son. He was not succeeding very well. He talked about the craftman's delight in skill, about the joy in creating objects of use and beauty. "Every job," he said proudly, "as well done as it is possible to do it." The young man, hands in pockets, shrugged his shoulders at the familiar shop with its odors of hardwood and pine; "But not where I work; not in a factory where from eight to four your job is to give six hammer-taps every time the assembly-line moves . . . "

Our world has outgrown most of its established codes. The ideas and institutions that protected and guarded us in the First Industrial Revolution are fast being swept away. Standards that guided us in the past have departed and left us groping in the dark. In moments of thoughtfulness we wonder about things and what they all mean. We wonder if it will be possible to establish a footing on which to erect a new set of principles, or must we remain torn between the call of the old and the hope of an enlightened far distant future. Must we remain bound by blind trial and error searchings, or can we erect a solid framework of a new order that will be more satisfying than that which is passing? Can we recast our thinking and established a new set of principles that will guide us in dealing with the human problems that we meet in this transitional period?

We cannot depend upon "muddling through". We need more than old rules of thumb and kindness of heart to guide us in dealing with our world and our fellows. We must seek an interpretation of our time and work that will enlighten our minds as well as guide our judgments in dealing with our fellowmen.

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* Personnel Service Bureau, New Orleans.

To accomplish this we must have some knowledge of the laws and varieties of human behavior. We must know something of the general situation in which the behavior takes place. We must, for example, see the individual worker more than a member of a commercial organization who operates a machine or keeps books for a given number of hours each week. We must see him as a member of society whose home life, religion, politics, and daily thinking are modified by his working relations; and that these in turn influence his attitude toward his work and his efficiency.

Our modern machine age has given us abundant material possessions but these possessions do not necessarily convey happiness to the individual. On the other hand, the absence of things does not constitute social progress. *Things must have meaning for individuals.*

It is important that we seek to understand the social forces, economic movements and psychological principles that are producing our abundance of things. We must not stand in fear of the world in which we live. We must understand these forces clearly ourselves and assist others in understanding them and utilizing them to the fullest extent.

We must increasingly use the available findings of modern science, and not look upon ourselves as being overpowered by it. We must see man in the midst of the forces of a scientific age, manipulating them and utilizing them to the advantage of the individual and the group. In order to bring about such a sense of appreciative participation it is not so important *to increase our fund of knowledge* as it is to learn how to interpret and coordinate our present knowledge and activities.

The nature of the economic system under which we live is less important than the extent to which the system gives the individual an opportunity for a sense of worthful participation. Naturally, no economic or political system is desirable unless the people of the nation desire it and are happy in it. When we visit other countries we find people happy under systems that would be burdensome to us. We can accept as axiomatic the fact that the economic system or situation is best which harmonizes with mental lives of the people who are involved.

When we devise idealistic plans for the future of the modern worker we are controlled by subtle emotional influences that often neutralize our intellectual goals. Our beautiful dreams are constantly checked by human beings who behave. Our rose-colored visions often fade when we try to apply them to a world that is peopled by simple folk rather than by altruistic men.

We can never hope to achieve an ideal economic system in which all leaders, workers, and teachers will function according to their best intellectual choices. Communists, socialists, and others often devise schemes for an industrial order that demands obedient angels rather than human beings who are only a few centuries removed from their savage forbears. We are not logical beings; we are psychological creatures.

Progress can take place only through change which brings maladjustments and requires new modes of living and thinking. The survival of the fittest means the survival of the enlightened and self-controlled. They alone can adapt themselves to the perpetual shifting of conditions produced by social progress. The individual must learn to deal with his life problems through direct attack; that is, he must analyze his difficulties, recognize major trends, utilize industry for intelligent self-expression and feel himself a worthy participant in our changing times.

The American worker has already achieved considerable relative progress, and may achieve even more satisfying advancement in the future. However, he will never reach a complete solution to all of his problems. Each age brings with it characteristic problems; new solutions give rise to new dilemmas. The hope for a state in which the individual has no problem belongs to the millenium. Our hope lies not in the desire for a heavenly life of nothingness, but in an intelligent insight and active participation in the economic scheme of which we are members.

Social and economic changes take place in uneven lines of advancement. When armies wage their battles the lines of advancement are not on an even point. One body of troops makes more rapid advancement than its neighbor. The line of battle presents jagged thrusts and lagging segments. The same principle seems to apply to advancements in our socio-economic developments. Progress takes place in some channels more rapidly than in others.

Certain currents seem to lag behind others until a group in society becomes acutely conscious that general progress is being retarded and then some drastic action is taken to overcome the difficulty.

The many reasons why progress takes place unevenly can be summarized under these general influences:

(1) Environmental pressures
(2) Individual differences
(3) Interest groups.

Environmental Pressures. Include such factors as governments, international interdependence, religions, culture heritage, natural resources and climatic conditions. These are so varied that a complete treatment of them would carry us far afield from our discussion of human relations.

Individual Differences. Differences in adjustment tendencies in the individual as well as differences in intellectual capacity. Some people still believe the sun moves around the earth. The lag between demonstrated fact and its incorporation into practice is often twenty to fifty years and this in spite of our modern facilities for dispersing information. Few of us probably realize that at least 50% of the worlds' population still carries a charm or amulet around its neck to protect it from evil spirits, bad luck or sickness.

One evidence of the differences in abilities between individuals which are especially important to industry is evidenced in the number of patents that are granted. During the fiscal year ending June 30, 1932, the patent office granted one patent for each 2,569 persons in the United States. Greater activity on the part of American inventors than that on the part of foreign inventors resulted in the granting or more patents to American inventors than to those of any other two nations. This fact must have some bearing on the frequent occurence of changes that naturally affect markets and distribution in the United States.*

Interest Groups. The more we study individual differences the more is obvious the principle that every population is always

* (Labor Economics and Labor Problems.—Toder.)

differentiated into classes, exhibiting various degrees of vitality, of intellectual capacity, of moral growth, and of culture refinement. Individuals perceive that they have certain similarities, sympathies, and objectives. Gradually they tend to recognize their mutual interest and combine into interests groups as a result of their consciousness of kind. These interest groups are an inevitable part of life. There are many of these public interest or reform groups that have played an important role in our political life and thereby influenced our economic movement, such as the Anti-Saloon League, Methodist Board of Temperance, prohibition and public morals, the National Security League, and the various Veterans Organizations, Organized Labor, etc. The activites of the various special interest groups either "public" or "self" have brought about, directly or indirectly, important changes in our social and economic system. Their activities cause one to wonder whether much change takes place because all people—society as a whole—wish the change. Rather, organized minorities slant through our political and economic life, seeking changes that oppose the interest of other groups. Political, economic and social changes are closely bound together.

Interest groups have always existed in every civilization and apparently will continue to function independently. The impacts resulting from their unco-ordinated activities have pronounced effects upon the modern industrial worker as well as upon management, the stockholder and society.

When we examine the birth figures of European nations we notice that with few exceptions the rate is declining in the industrial countries and increasing in the agricultural. Differences in birth rates between nations cause differences in nationalistic ambitions. In European countries the statesmen are interested in the numbers who can bear arms and they show as much interest in each other's population figures as they do in trade balances and armament budgets. The United States has not yet reached a static population and may not reach it until 1960, but its effects are already playing a part in modern industry. An industrial concern that started in the "nineties" could be successful if it merely supplied the needs of a growing population. Now the

number of "new" customers has decreased to such an extent that competition has become much more acute. Even though the percentage of age distribution of the population were to remain constant the youth of each generation would demand some change. Every year two million boys and girls grow into men and women. Youth refuses to stand still; it is confident and seeks new worlds to conquer. The very nature of life demands change and change brings with it uncoordinated growth.

The age of distribution in the United States may be indicated in percentage as follows: **

	Calendar Year			Ultimate Stationary Population
	1850	1920	1950	
Under 20 years	52.5	40.7	32.7	29.0
20-50 years	38.6	43.9	43.7	40.0
Over 50 years	8.9	15.4	23.6	31.0

One of the severest criticisms of our present economic system is the presence of thousands of unemployed and unemployables. They are with us in the years of prosperity as well as in depression.

Evidence of the fact that changes in our social and economic life always involve strain. Those unco-ordinated changes that seem to be such an integral part of life are reflected in the thinking and plans of employers who in turn manage their enterprises in a manner that involves the welfare of the employees. The consumer, the investor, the employer, and the worker are all insecure because of changes they cannot predict. A study by the Bureau of Standards indicates that of one hundred factories started in 1930 only 38 will be left in 1960. The average life span of a factory is approximately seven years. If industry itself is not secure, the man who works for industry cannot be secure.

It has been estimated that in times of depression since 1900 there have been from one to fifteen millions idle for months at a time, but no one knows how to get the exact figures. No one knows the exact percentage of unemployed who apply for public aid, but in March, 1933, a peak period of unemployment over 21 million persons were dependent wholly or in part on public re-

** (See Human Relations in Changing Industry.—Hepner.)

lief. It is estimated by National Industrial Conference Board that there were 7,431,000 unemployed in 1931, 11,489,000 in 1932, and 12,000,000 in 1933. Along this same line interesting figures have been prepared by the National Bureau of Economic Research:

Year	Population of United States	Persons Gainfully Employed	Percent of Population Gainfully Employed
1899	74,799,000	29,973,000	39%
1909	90,691,000	34,255,000	38%
1914	97,928,000	27,782,000	39%
1919	105,003,000	40,282,000	38%
1923	111,511,000	42,156,000	38%
1927	118,141,000	45,747,000	39%
1929	121,455,000	48,832,589	39%

No one can prove that unemployment is steadily getting better or worse over a long period of years. Hundreds of cases of technological unemployment have been cited.

We know for instance that the invention of the linotype machine eventually created more work for printers, but we also know that displaced workers cannot easily shift from one kind of work to another. The occupational adjustment of some of these displaced workers is most difficult even though society and the individual workers eventually benefit by the progressive movements within industry.

"Technological unemployment" has been used as a current term for what is assumed to be a definite development of the "Machine Age"—actually it has been stretched to cover scientific, economic, and social changes in which mechanization has been a relatively small and indeterminate factor. The passage of the Prohibition Act caused a shift in employment; its repeal another shift. Modern woman's desire to "lay aside weight" in respect to clothing and even food has acted against steady employment. Political, social, and scientific changes produce unemployment. Changes in weather, insect plagues, changes in fashion, wearing fewer clothes, men going hatless, eating less, all cause fluctuations in unemployment just as much as does the invention of machines.

The effect upon the worker and industry of changes resulting from the forces developed by *Individual differences, interest groups* and general *environmental* factors that result in business cycles with their depressions and unemployment have been suggested, and even each major depression despite its disadvantages has resulted in desirable improvements in our laws and practices.

In the following quotation and comment by George I. Cochran writing in the New York American and appearing in the text "Human Relations in Industry" by Hepner, called attention to one of the earliest depressions:

"The laws are cast out and men walk upon them in public. The law-breaker is lord of wealth, the rich man has lost all. Scanty is gold; craftsmen are without work; the reaper of the harvests gets nothing, while he who plowed not profits. The land is depleted. I show thee a land upside down."

That was published in the Egyptian city of Memphis, on papyrus 5,000 years ago. So you see that gang rule and business depression were rampant in the land of the Pharoahs more than 3,000 years ago, before the birth of the Christian era. But history reveals that the calamitous period thus pictured was followed by one of unexampled prosperity.

The business cycle is evident in the history of the Pharoahs of Egypt. The ancients became so accustomed to succeeding periods of fat and lean years that one of their number, Joseph of Biblical fame, saw the need for foresight and induced the people to prepare for the "depression". In 594 B. C., under the reign of Solon, a depression spread over what was then known as the whole of the civilized world. In 33 A. D., the Roman Empire was in the grip of a pronounced economic crisis brought about to a great extent by a large, unprofitable investment incurred in connection with a huge army and navy. Unemployment became so serious a problem that free distribution of grain, the dole of that day, was necessary. In the fourth century another depression resulted from the migration of races. A century and a half later a ravaging plague caused economic disturbances in Europe. In the tenth century, distress throughout Europe was so great that one historian wrote "not to be killed and to have a good

sheep-skin coat in winter, for many people, is the height of felicity''.

An exhibition called ''Depressions the World Has Lived Through'' was shown in Schermerhorn Hall, Columbia University. The years of publication and titles of a few of the books were:

1816—''A Review of the Present Ruined Conditions of the Landed and Agricultural Interests''.

1842—''Not Over-Production, But Deficient Consumption. the Source of Our Sufferings''.

1873—''The Terrible Financial Panic of 1873''.

1884—''Excessive Saving, A Cause of Commercial Distress: Being A Series of Assaults Upon Accepted Principals of Political Economy''.

Miss Dorthula Wilcox, who arranged the exhibition, said:

''We have about one hundred and fifty volumes in our collection on depressions since the seventeenth century, and they are practically all the same. Every one of them declares theirs is the worst depression that ever happened; they all say it should teach the world something; they all offer the same panaceas; and they all blame it on the same causes. They always blame the tariff and poor laws, or what we now call the dole, and since the industrial revolution they all blame technological unemployment''.

Problems in human relations cannot be solved by any single remedy of social or economic reorganization. Even if we could develop a perfect economic system, we would still have the same problems in human adjustments that we now have. This does not mean that we should require or neglect environmental, social, and economic conditions. None of our difficulties are the effect of a single cause. Life and industry are exceedingly complex. Long ago we learned that crime is not caused by a change in religion, that business depressions are not caused by a political party, a presidential election, or high tariff, and that the difficulties of the workman are not caused only by a capitalistic system. Nor can our mental and vocational problems be attributed solely to the thwarting of the sex instinct, to heredity or to faulty

conditionings. All of these and more play a part in the complexities of the causes of human relations problems and their effects and solutions.

Each Person Has a Unique Adjustment Pattern. Each person has a distinctive pattern of tendencies. Each person is unique and his rewards of life must be singular. No one behaviour pattern is perfect, nor is it the ideal for all men. Many people have wholesome, well-balanced personalities and great minds *even though they never achieve eminence.* Such great minds are found among members of all races, nationalities, and occupational groups.

Under any system of political or social economy the individual remains the important unit. The strength of any nation is not in its natural resources, climate, social life or material imports, but in the character of its people.

American Education has never been directed toward the development of individuals who are entirely economically self sufficient to the extent that they can stand the strains of inevitable changes. Most of us merely rant and rave at problems of unemployment, at our problems in human relations, new ways of living and materialistic ambitions. Or we loudly demand a panacea or a new "medicine man" to apply the old remedies. Either at best would bring new problems and take us out of the frying pan into the fire. It is certain that no system will ever solve our problems. Since life is a series of risks and changes, stresses are absolutely certain to arise. We should therefore create an educational system whose goal will be that of training individuals to function happily through adjustments to an ever-changing world. Any person should learn how to use his resources in a manner that will give him security, food, clothing and shelter and a feeling of worthwhile participation in the changing scheme.

We often hear those who have the knack of handling people talk about their methods to others frequently less gifted. Unfortunately they cannot impart to others that which is an integral part of their personalities. Their difficulty is similar to that of an artist who tries to tell the bystander how to paint a picture. If the bystander has artistic talent he can add to the

talent by studying the artist's methods and in time he may himself become famous by applying the same methods. The art of handling men cannot be acquired in a day or even a year. Skill in dealing with people does not begin when a person enters business; it begins in childhood. Those who learn early as young men and young women to make adjustments to psychological barriers through dealing with people have a practical technique ready at hand when they enter industry. Training for industrial leadership should not begin after the individual enters industry but long beforehand. Those who have made their adjustments to life through a skillful manipulation of their fellows are more likely to succeed in jobs that require executive ability than those who have obtained satisfaction from studying books. The search for expression through influencing people has had its beginnings in family life, in the elementary school room and in college. Nearly anyone can acquire the knack of handling men, but the acquisition must be an active important part of the individual seeking for self expression—his adjustment development.

Executive or leadership ability is very complex. It is neither dependent upon any single factor such as intelligence, pleasing manners, appearance, moral conduct, nor does it depend upon the total pattern of such qualities. "Leadership ability is the way a unique personality pattern functions"* Modern leadership has changed from a definition of accomplishments of production and service to a definition that includes also the effects of the accomplishments upon the followers, subordinates and customers.

As Mr. W. H. Cowley stated in his article "The Study of Leaders":

"A leader is an individual who is moving in a particular direction and who succeeds in inducing others to follow him."

"A 'headman' is an individual who because of ability or prestige, has attained to a position of leadership".

The intelligent adjustment of the worker to changing industry must come about through managers who themselves have an insight into and can interpret to workers the changing social,

* Hepner—Human Relations in Changing Industry.

political and economic world. The competent manager must develop skill in enabling the worker to make direct attack adjustments in his own psychological development, that is, he must not only understand but be able to give an understandable explanation of industry, of how social and economic advancements benefit the masses even though such advancements temporarily displace some workers, of how pride in craftsmanship pleases the customers as well as it satisfies the worker, and of how the worker may feel himself a worthwhile member of considerable importance in our ever changing industrialism.

The system under which we live and work is incidental. The important factors are intelligence and leadership of executives, their desire to explain, and willingness to think of workers as colleagues.

Such a leader does not say "We will change the system of government for you and give you employment and justice", or "We will co-ordinate all changes and prevent maladjustments that harm you". Rather he says, "We are part of an evolving, ever changing industrialism. Life is risk, change and chance. Let us come to a full realization of this fact, anticipate changes and co-ordinate them in so far as possible. Do not retreat within yourself when you meet difficulties, identify yourself with and adapt yourself to these changes".

A FEW THOUGHTS ON INDUSTRIAL EDUCATION

By H. G. Martin *

Read to the Conference of Engineering Students at the Annual Meeting. January 24, 1936.

When it was first proposed that a meeting of under-graduate engineers be held in connection with the annual meeting of the Louisiana Engineering Society, I wondered if we were not taking an unfair advantage by preaching to you two years ahead of your graduation, on which momentous occasions, we "old timers" beset you with all of the do's and don't's that we can thing of, almost believing that you would be unable to get along without our advice. However, in discussing the program with the committee, it developed that the real purpose was to get acquainted and to paint for you a picture of the future, the good things you can look forward to, trusting that you will have the ability to make proper use of these things when you arrive.

Those of us who are connected with industrial education assure you that we are considering our duty very seriously and are endeavoring with all the skill and ability we possess to prepare young artisans, and to assist the older artisans in their efforts, to co-ordinate their work with that of the technical engineer so that while you are learning to design and construct bigger and better devices and structures, these youthful and adult tradesmen are making like progress, and when you meet them in industrial life you will be most happily impressed with their sincerity and with their understanding of your objectives.

I may best carry my thoughts to you by going back a few steps into history and telling you of some of the problems that the early industrial designers had to meet, problems that we as educators are anticipating for you so that your work may be successful.

When America's famous industrial hero, the designer of the steamboat, was giving his first demonstration, the spectators were thrilled and awed. It was evident that the boat could be

* Principal, Delgado Trades School.

driven by steam and driven effectively. The designer himself and his colleagues were joyful and were doubtless discussing the points of design, when suddenly the designer was called to the engine room—something had gone wrong. Was it the design? No. Was it faulty workmanship, or lack of co-operation? No. It was a simple fault in installation due to a lack of understanding on the part of the mechanic as to the designer's objective. A ship carpenter had set the timbers as he would for a carpentry job. There were no machinists nor engine mechanics available in that day. No one had been trained to adapt his trade methods to engines and like machiney. No ship carpenters had been trained in possible new developments of ship design. Artisans all, and sincere, but none trained to keep abreast of the designers.

In the period between 1890 and 1900 great advances were made in mechanical designs and artisanship. Highly skilled and specialized mechanics were developed, men who could execute most intricate designs. But here industry slipped. Young mechanics were being specialized, their speeds and mechanical efficiencies increased, but the scope of their work was limited to special operations. Multitudes of highly skilled lathe hands, machine hands, etc., became available, production was well speeded up, but suddenly industry saw itself facing another dearth of mechanics who understood the objectives of the designers. Industry was again facing lack of co-ordination between the design room and the shop.

At this point, the trade school movement began. A scientific study of the problem showed the necessity of a broader training than skill in the manipulative operation. The broad foundations of fundamental skills had to be supplemented with a knowledge of engineering principles, a knowledge so given that artisans would appreciate and understand the intent of the engineers' specifications, yet not be misled into believing that he replaced the designer.

It was further evident that he should have sufficient of these engineering principles that he would anticipate the constantly advancing line of technological changes and be able to adapt himself thereto. And, so a modern trade school embodies

in its courses first, fundamental manipulative skill; secondly, mathematics for accurate shop calculation; thirdly, drafting the common language of industry; and fourthly, testing of materials in connection with specifications.

When the World War broke out, we were put to a severe test. Airplanes were then in the most elementary experimental stage. To meet the demands of war, more scientific and improved designs were needed and more skilled workmanship than the flier experimentors had furnished. Our colleagues, the engineers, were able to respond with brilliance, and the trained mechanics responded in turn with new and better mechanical methods. They made the designs successful because of their anticipation and understanding of the designer's objective.

The mechanics of to-day are making every effort to meet you on common ground, with increased confidence in you, born of an understanding of your field of work. When you meet them after your graduation you will find a most admirable group of men, red blooded and able. Able to keep the wheels of progress moving ever forward, and upward, for the great comfort and joy of physical man.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Board, April 18, 1936.

The meeting was called to order at 7:45 P. M. by President Hackett. Present: Bres, Godat, Grehan, Hackett, Ricker, Williamson, Hill.

The minutes of the last meeting were read and approved.

Applications of the following were reviewed and approved: G. C. Mattison, F. B. Medford, W. P. Wallace, W. Whipple, Leon de Salignac, subject to final approval of Membership Committee.

Mr. S. G. Schieb applied for change in grade from Non-Resident to Resident. The application was approved by the Board.

A letter from Mr. H. J. Malochee was read, outlining work done toward preparation of the history of the Society.

A letter from the Standard Homestead Association was referred to the Finance Committee.

It was decided that it would be advisable for each committee to render a report to the Board monthly.

The suggestion was made that some publicity be given to the certificate and pin which the Society furnishes.

A letter was read from Prof. Pegues suggesting May 11 as the date for the Baton Rouge meeting, and this date was agreed upon by the Board.

The Board agreed to underwrite the Golf Tournament-Smoker to the amount of $75.00.

The name of Edward S. Bres will be submitted to the Governor to fill the vacancy on the State Board of Engineering Examiners caused by the death of F. A. Muth.

The name of Frank Grevemberg was added to the Committee on Civic and Industrial Affairs.

Mr. F. N. Billingeley was selected as Chairman of the General Committee for the 1937 Annual Meeting.

President Hackett named the following to continue the study of Administrative Improvements in the Society: J. M. Todd, Chairman; John Riess, C. S. Williamson, Jr., A. T. Dusenbury.

President Hackett appointed John Klorer, Harry Jacobs, W. B. Gregory as delegates to the Rivers and Harbors Congress.

Adjourned.

ARTHUR M. HILL, Secretary.

Regular Meeting of the Society, April 20, 1936.

The meeting was called to order by President Hackett, 47 members and guests were present.

The reading of the minutes of the last meeting was omitted.

The report of the Chairman of the Employment Committee was read,

LIBRARY of LOUISIANA Engineering Society

Mr. Frost reported on the Smoker-Golf Tournament, outlining the plans for the event. The date was set as May 21.

The Secretary announced the date of the Baton Rouge meeting which is May 11.

Mr. J. F. Seiler, Engineer with the American Wood Preservers' Association, gave an interesting illustrated address entitled "Integral Combinations of Structural Timber and Cement Concrete in Composite Composition."

A lively discussion followed, with a number of the members participating. A rising vote of thanks was tendered the speaker, and the meeting adjourned to the usual collation.

ARTHUR M. HILL, Secretary.

Minutes of the Board of Direction, May 8, 1936.

The meeting was called to order by President Hackett about 7:30 P. M. Members present: Bres, Godat, Ricker, Williamson, Hill. Mr. J. M. Todd and Mr. F. N. Billingeley were present by invitation.

The minutes of the previous meeting were read and approved.

It was voted to write to the Governor, recommending Col. Bres to fill the vacancy on Board of Examiners caused by death of Frank Muth.

Life membership was awarded to Mr. M. V. Haulard and Mr. John Riess. It was suggested that these awards be presented at the Baton Rouge meeting, May 11.

A letter was read concerning the Third World Power Conference. It was suggested that Mr. Coleman might represent the Society, if present in Washington during the conferences.

A letter from Col. A. M. Shaw was read, suggesting that during a certain period the entrance fee be abolished, namely from the present date until the end of 1936. It was suggested that Col. Shaw give a short talk on "Membership" at the Baton Rouge meeting. The suggestion was also made that the Secretary give publicity to our action regarding entrance fees through the various secretaries of the Local Sections.

It was voted that President Hackett appoint a committee to study the student membership situation. The committee appointed is as follows: Prof. C. W. Ricker, Chairman; Col. A. M. Shaw, Dean L. J. Lassalle.

Upon written request of Mr. J. S. Janssen his status was chanegd from Junior Member to Non-Resident Junior Member.

Mr. Todd outlined the progress which has been made on the bill for the licensing of engineers, which bill will probably be brought up in the Legislature at the coming session.

Mr. Billingeley outlined some of his plans for the coming annual meeting.

There being no further business, the meeting adjourned.

ARTHUR M. HILL, Secretary.

ACTIVITIES OF LOCAL SECTIONS

President,
CLIFFORD H. STEM
1st Vice-President,
H. A. SAWYER
2nd Vice-President,
W. H. RHODES
Secretary,
CHAS. M. KERR,
5831 S. Robertson Street
Treasurer,
A. J. NEGROTTO
501 S. Rendon Street



STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

ANNUAL MEETING

Second Tuesday in January.

The annual meeting of the Louisiana Section was held at the Ole K. Olsen home. A resume of the current year's happenings was given by retiring president, F. P. Hamilton, which indicated that the Chapter's affairs were in good condition. The paid membership in the Local Section amounted to 90, a substantial increase over the previous year. If the collection of dues continue at this rate it is anticipated that the Board of Directors will be in position to reinstate the scholarships at Tulane and Louisiana State University.

Three amendments to constitution and by-laws of the Section were discussed and recommended and will be effective when approved by the parent society. Those recommended are in general that the office of secretary and treasurer be combined; that the annual meeting of the Section be held during the second week in January instead of the second week in April; that a degree of Honorary Member be created as a mark of award, and that the constitution and by-laws be re-adjusted so as to agree in every detail.

The new officers of the current year were then elected. Mr. Clifford Hoey Stem succeeded Mr. Hamilton as President. Mr. H. S. Sawyer and Mr. W. H. Rhodes were elected first and second vice-presidents respectively. Mr. Allen Negrotto was selected to fill the office of treasurer, while Mr. C. M. Kerr retained his position as Secretary.

The speaker of the evening, Col. F. B. Wilby delivered a very interesting paper on "The Use af Asphaltic Concrete in the Repair of Jetties," after which the meeting adjourned to the Rathskeller, where a highly enjoyable finale terminated the evening's activities.

THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

LOUISIANA-MISSISSIPPI SECTION

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J. H. Thickens, Masonite Corp., Laurel, Miss.
E. Wander, Bay Chemical Co., Weeks, La.

Regular meetings are held on the first Friday in February, May, October and December in the Richardson Chemistry Building, Tulane University, New Orleans, La.

PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

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EDITORIAL NOTES AND COMMENT

United We Stand (Do We?). The Engineer is a peculiar animal. To him has been allotted the task of bringing civilized order out of chaos. He has been charged with the invention and development of the material benefits to mankind.

This has called forth one of the great abilities of the engineer—his ability to organize. He has been able to organize great material and human forces and put them to work to furnish the myriad present day comforts that modern man thinks he cannot do without.

But "the shoemaker's children go without shoes."

While the engineer has been able to organize almost everything and everybody, he apparently *hasn't been able to organize* himself. It is about high time that he should. There is no person on earth better qualified than the engineer to understand the benefits of organization—and no person more poorly applies the benefit of organization to his own problem.

In this matter the engineering profession again runs a poor third to the legal and medical professions. Take the legal profession for example. The supreme arbiter of things professional is the American Bar Association. This association rules the legal roost, both within and without the profession. There are civil lawyers and criminal lawyers, and admiralty lawyers, and other lawyers, but the American Bar Association takes care of them all. They may have other group organizations to take care of their specialized interests, but these are all subsidiary and complementary to the great central national organization. The American Bar Association is the one national organization to which lawyers of all classes and interests can and *do* belong. And therein lies the strength of the legal profession. Consider the benefits the legal profession is able to demand (and get) for itself as compared with those the engineering profession is able to demand and get. The lawyers have been able to appreciate and to avail themselves of the benefits of one central, powerful organization.

Look at the medical profession. There are internists, surgeons, pediatricians, gynecologists, neurologists, psychiatrists and other specialists galore. What is the mouthpiece of these various special interests? The great and powerful American Medical Association. Its membership is over 100,000. No wonder the physician is able to dictate legislation favorable to the profession! No wonder he is able to fix his own fees rather than have them fixed for him by his employer! An organization with over 100,000 members, and devoted to the interest of those members, is big enough and powerful enough to get very nearly anything those members want. The difference between the economic position of the doctor and that of the engineer is largely the difference between the all inclusive A. M. A. and the lack of any comparable organization in the engineering profession.

While the legal and medical professions have long ago learned the value of complete solidarity, we find that the engineering profession is struggling along with approximately *ninety* national engineering societies. Even the biggest of these has only a few thousand members. But what a powerful group the aggregate membership of all these societies would make, could they be combined into one all-inclusive engineering association. We fear, however, that any such proposition would quickly meet with very violent opposition from within the separate societies because any such consolidation would, of necessity, mean the abolition of some very desirable salaried positions.

Notwithstanding all the arguments that would be brought to bear against such a consolidation, there seems no *reasonable* argument against it.

We engineers have been able to organize every interest we come in contact with. WHY CAN'T WE ORGANIZE OURSELVES?

Dean Anderson Retires. After forty-four years of loving and loyal labor in the service of Tulane University, Dean Douglas Anderson retires from active duty September first.

Still young in outlook and spirit he nevertheless has earned a right to the enjoyment of the things life has to offer following a vigorous, crowded and successful life as teacher, counsellor and administrator.

He has been a member of the Society since 1909 and is now an Honorary Member.

As editor of the *Proceedings* for sixteen years he built the publication to the position of dignity and respect in the field of similar publications.

We hope that his retirement will not interfere with his attendance at meetings. His presence and good counsel could always be counted on.

The Society and the *Proceedings* wish for him in his retirement the enjoyment of all the things he has heretofore been too busy to consider.

Professor Robert Now Dean of Engineers at Tulane. As a matter of record, it is noted here that Prof. James M. Robert, editor of the *Proceedings*, has been elected Dean of Engineering at Tulane University, to fill the vacancy caused by the retirement of Dean Douglas Anderson.

Watch the Advertising Pages. Why not watch the advertising pages very carefully? Frequently new advertisements appear and old ones are changed. If you do not watch them regularly you will perhaps miss a great deal that you should see.

And don't forget. The advertisers contribute generously to the support of the *Proceedings* and, therefore, to the Society. It is a matter of loyalty to the Society to patronize these advertisers whenever you can.

Messrs. Coleman and Todd on Important Committees of American Engineering Council. It gives us pleasure to report that two members of the Louisiana Engineering Society are on important committees of the American Engineering Council.

Mr. J. F. Coleman, past president of the A. E. C., has been appointed on the Nominating Committee and also on the Public Works Committee.

Mr. J. M. Todd has been appointed a member of the Rural Electrification Committee.

Pay Your Dues Promptly. Each of us puts off paying his dues because we feel that the sum involved is so exceedingly small that the Society could not possibly be embarrassed by its non-receipt. When *all* of us do so, however, the total income of the Society is involved and the embarrassment becomes acute.

The officers are doing a herculean job in improving the Society. Won't you help them by paying your dues NOW?

The Baton Rouge Meeting. Once more the Society is indebted to the hard working members in Baton Rouge and Louisiana State University for a most delightful meeting.

May 11th was the date. The meeting was a dinner meeting held in the Venetian Room of the dining hall at L. S. U. The dinner was tendered the Society by the university. No effort was spared by either the Baton Rouge members or the officials of the university to make the occasion both enjoyable and memorable.

Junior Members on Standing Committees. In an effort to make available to the Society the potential assistance and the enthusiasm of our younger members, it will be noted that each standing committee contains the name of one Junior Member. The younger men are the future "older men" of the Society on whose shoulders the full responsibility of the Society's affairs will rest.

Placing them on standing committees is excellent training for their future responsibilities.

New Members. A letter ballot has been ordered by the Board of Direction on the following new members:

Resident Members.

Michael C. Abrahm, 317 Baronne Street, New Orleans. With New Orleans Public Service Inc.

Charles B. Dicks, Jr., 2037 Audubon Street, New Orleans. Associate Professor of Chemical Engineering, Tulane University.

Harold A. Levey, 311 Audubon Street, New Orleans. President Products Mfg. Co., New Orleans.

Non-Resident Members.

John M. Middleton, Hammond, La. Supervising Engineer on Federal Works Program.

George P. Meade, Gramercy, La. Manager, Gramercy Refinery, Colonial Sugars Co.

PAPERS AND DISCUSSIONS

PRESENT TREND IN GENERATION AND TRANSMISSION OF ELECTRICAL ENERGY

By FRANK G. FROST *

Read at the Annual Meeting, January 25, 1936.

The generation and distribution of electrical energy has its beginning with the completion and putting in operation of the Pearl Street Station by Thomas A. Edison in New York City on September 4, 1882. It is obvious that this was a steam driven station. It is interesting to note that during the same year a small 250 light generating plant was installed in Appleton, Wisconsin, which is generally referred to as the first hydro-electrical central station in the United States. These facts are brought to your attention to show that the use of water power and steam power for generating electric current have gone hand in hand since the very beginning of the industry.

The Steam Generating Station

At the Jubilee Meeting of the British Association for the Advancement of Science in 1881, Sir Frederick Bramwell, then one of the leading scientists of his day, made the following statement:

> I believe the way in which we shall utilize our fuel hereafter will be . . . not by way of the steam engine . . . I doubt whether those who meet here 50 years hence will then speak of that motor except in the character of a curiosity to be found in a musuem.

In 1884, just three years later, before the same association, Lord Raleigh, also pessimistic towards the use of steam, stated:

> The efficiency of the steam-engine is found to be so high that there is no great margin remaining for improvement. The higher initial temperature possible

* Member. General Superintendent Electrical Dept., New Orleans Public Service Inc.

> in the gas-engine opens out much wider possibilities, and many good judges look forward to a time when the steam-engine will have to give way to its younger rival.

These men had foresight in predicting rapid development of the internal-combustion engine; on the other hand they had no vision as to the possible advances to be made in the more efficient use of steam. The overall efficiency from fuel to terminal of the generator of that day was well under 5%. About the time these statements were made Sir William Parsons was working on a steam turbine which was made practical and commenced to be generally used to drive electric generators at the beginning of this century. Bramwell's death sentence for the steam engine was up in 1931, when only 1½% of the generating capacity of his own country was powered by internal-combustion engines. In 1935 1.6% of the generating capacity of this country was powered by internal-combustion engines.

Considering the steam electric station and including in this category binary vapor cycles in which other vapors than steam are used, rapid strides have been made in the past decade and a half, which have all tended towards a reduction in fuel costs, operation and maintenance charges, and investment costs per K.W. of capacity. Let us consider the steam plant first from the standpoint of efficiency.

Fifteen years ago the low pressure, simple "Rankine steam cycle" was in common usage in the modern plants of that day. This cycle consisted of a boiler, generally equipped with an economizer, supplying superheated steam to the turbine, with the condensate being returned through the economizer to the boiler to complete the cycle. Maximum pressures ranged from 200 to 300 pounds per square inch and final steam temperatures rarely exceeded 650°F. With a plant of this type, housing the best equipment then available and operating under ideal conditions, B.T.U. consumption per K.W.H. of station sendout was seldom below 17,000 B.T.U. This represented a fuel consumption, using an average grade of coal as a basis, of 1.4 pounds per K.W.H. net.

From this existing state, the first step in the improvement of station design was a change to the "regenerative cycle" of operation. This change was also accompanied by an increase in operating pressure and temperature, so that pressures of 400 pounds and temperatures of 750°F. were considered normal operating practice. The regenerative cycle differs from the simple Rankine cycle in that turbines are equipped with a number of bleed off points, a portion of the steam thereby being bled off from various stages into closed heaters for the purpose of heating the returned condensate before it reaches the boiler. This cycle eliminated partially or entirely the use of economizers as part of the steam generating equipment. This was accomplished without any reduction in overall boiler efficiency by the introduction at this time of the air preheater, used entirely in the beginning with pulverized coal, but later applied to stokers and other forms of fuel firing.

The advantage of the regenerative cycle was represented by the reduction in steam exhausted and condensed at a definite load, with a corresponding reduction in latent heat loss in the condenser. With a station operating on this cycle, with large capacity units, with a boiler efficiency of approximately 85% and a minimum of back pressure at the turbine exhaust, heat consumption rates dropped to about 14,000 B.T.U. per K.W.H. of station output; or put in terms of coal consumption about 1.1 pounds of coal per K.W.H. net.

The next step in central station refinement was a further increase in steam pressure and final steam temperature, the latter representing the principal limiting factor. Due to improvement in metallurgical treatment of steels, final steam temperatures of 800° to 850°F. were now possible without resorting to excessive installation costs. The limiting pressure at these temperatures for economical and practical turbine operation was approximately 600 pounds per square inch. This increase in pressure and temperature warranted the use of additional turbine extraction stages. At this time also greater heat liberation rates in furnaces were made possible by the introduction of water-cooled furnace walls. Higher rates of heat transfer in boiler heating surface were made possible by the

reduction of this heating surface and the proportionate increase in economizer and air preheater surface. This resulted in a greater output from steam generating units of a given size, and meant a decrease in unit heat losses. These changes resulted in a further reduction in heat consumption per K.W.H. of station output, so that rates of 12,800 B.T.U. could now be equalled under ideal conditions of operation. This is equivalent to 1.02 pounds of coal per K.W.H. net.

The next step forward was the change to the "reheat-regenerative cycle". In this cycle steam is generated at a high pressure (1200 to 1400 pounds most commonly used) and at a final steam temperature of 800° to 850°F. This steam is allowed to pass through the high pressure turbine, or through the high pressure end of a compound turbine, and is exhausted to a reheater, where its temperature is again raised to the desired point for use in the low pressure turbine or low pressure cylinder of the compound machine. The low pressure end of this cycle is primarily a regenerative cycle, and in most cases extraction points are also located in the high pressure turbine. This type of cycle has enabled some existing plants to obtain a large increase in operating efficiency by superimposing a high pressure station in connection with an already existing medium pressure station. The water rate of a high pressure unit of this type, operating non-condensing, will vary of course with the initial steam temperature and the exhaust pressure, but generally ranges from 35 to 40 pounds per K.W.H. generated. This means that the ratio of low pressure to high pressure generation will be 3.5 or 4 to 1 with a low pressure turbine rate of 10 pounds. Thus a 10,000 K.W. high pressure turbine would require a 35,000 or 40,000 low pressure turbine to take care of full load operation.

Let us consider a definite case, say a large station operating with 1200 pounds 800°F. steam at the throttle of the high pressure turbine exhausting at 350 pounds pressure and reheated to 800°F. before being supplied to the low pressure turbine, this turbine operating with a back pressure of 1" Hg. With a boiler efficiency of 85% the heat consumption rate of this station will reach 11,500 B.T.U. per K.W.H. output. This is equivalent to 0.92 pounds of coal per K.W.H. net.

The next step towards increasing operating efficiency has been made possible by the use of the "binary-vapor cycle", the most common of which is the "mercury-steam cycle".

In the binary-vapor cycle, as its name implies, two distinct vapors are used with the one cycle superimposed on the other. In the mercury boiler, mercury is vaporized usually at 95 pounds absolute pressure (850°F. boiling temperature) or at 135 pounds absolute pressure (946°F. boiling temperature) and in the vapor form is allowed to pass to the mercury turbine. On being exhausted from the turbine, the vapor passes to the mercury condenser or boiler, which is also a steam boiler. Steam is generated in this condenser, and is further superheated before passing to a steam turbine to complete the steam cycle.

Let us consider a mercury-steam plant operating at 85 pounds absolute pressure and 885°F. on the mercury cycle, and 500 pounds 800°F. on the steam cycle, this latter cycle being regenerative. The division of load in this case would be approximately 0.4 for the mercury turbine and 0.6 for the steam turbine; or in a plant of 50,000 K.W. capacity 20,000 K.W. would be mercury turbine capacity and 30,000 K.W. steam turbine capacity. In this cycle, as in the high pressure steam reheat cycle, the large increase in efficiency is due almost entirely to the elimination of condenser losses on the primary cycle. Heat consumption rates, based on the data given below, would equal approximately 9800 B.T.U. per 16 W.H. of station output. This is equivalent to 0.78 pounds of coal per K.W.H. net.

For the purpose of a better comparison, the table of possible operating results with various cycles is given below:

Station	Steam Press.	Data Temp.	Cycle	B.T.U. per K.W.H. Output	Pounds Coal per K.W.H. Output	Thermal Efficiency of Cycle
1	200	700	Rankine	17,000	1.40	20. %
2	400	750	Regenerative	14,000	1.10	24.5%
3	600	850	Regenerative	12,800	1.02	26.7%
	1200	800	Reheat			
4	300	800	Regenerative	11,500	0.92	29.7%
	85	885	Mercury Vapor			
5	500	800	Steam	9,800	0.78	34.8%
6	.....	.....	Diesel	13,000	.....	26.3%

In glancing back over the actual operating results for the United States as a whole, we find that in 1920 electricity generated in steam electric stations equalled 27.4 billions of K.W.H. at an average fuel consumption of 3.0 pounds of coal per K.W.H. In 1935, however, 56.7 billions of K.W.H. were generated at an average fuel consumption rate of 1.47 pounds of coal per K.W.H. This represents a decrease of some 50% in unit fuel consumption, and is in line with the figures given above.

Investments

The investment for steam-electric station construction, or rather the capital cost per kilowat of installed capacity may vary widely for different installations depending to a large extent on land value, foundation conditions, size of generating station, etc. During the past few years the trend has been definitely downward. This reduction in investment cost, accompanying as it does the many refinements in plant equipment, may require some explanation. A number of reasons are, therefore, listed below:

1. Increase in the size of generating stations. This is usually accompanied by a decrease in capital cost.
2. Increased output per unit of boiler heating surface and water wall surface.
3. Increased heat liberation per cubic foot of furnace volume, resulting in a smaller furnace for a definite boiler output.
4. Increased use of welding of boiler drums, steam piping, etc., with the resulting reduction in manufacturing and installation costs.
5. Improvements in steam separation and more reliable feed pump and regulator operation, allowing for the installation of smaller water storage space; or a reduction in boiler drum sizes for a definite output.
6. Reduction in space requirements by steam generating units due to increased outputs.
7. Reduction in boiler room building costs, due to reduced space requirements.

8. Increase in boiler availability factor (80 to 90%) allowing for a reduction in standby boiler equipment.
9. Increase in turbine capacities with a corresponding decrease in cost per K.W. of capacity.
10. Decrease in ratio of condenser cooling surface to turbine capacity due to better utilization of installed surface and decrease in steam condensed per unit of capacity.
11. Reduction in size of circulating pumps, hotwell pumps, boiler feed pumps, etc., due to improved turbine water rates.
12. Reduction in turbine room building costs due to decreased space requirements per unit of capacity.

While at first glance it would seem that the investment cost of a generating station would increase proportionately as the operating pressure is increased, this is not always the case. Some operating companies having built 1200 to 1400 pound stations report no increase in capital cost, while other authorities estimate an increase of about 10% over low pressure plants.

It is natural that the cost of all station equipment affected by the increase in pressure, will increase to some extent. This apparatus is chiefly boilers, economizers, reheaters, piping, pumps, high pressure heaters, etc. At the same time, reductions in size of equipment due to decrease in steam volume at the higher pressures will offset this increase to some extent.

Again, in the high pressure reheat cycle, the same steam used on the high pressure turbine is exhausted to the low pressure machine. This means a large reduction in overall station water rate, and therefore a decrease in the required steam generating capacity. For example, a 45,000 K.W. station having installed 10,000 K.W. of high pressure capacity at a 35 pound water rate, and 35,000 K.W. of low pressure capacity at a 10 pound water rate, would require 350,000 pounds of steam at an overall water rate of $350{,}000 \div 45{,}000 = 7.8$ pounds, as compared with 10 pounds for a strictly low pressure station. This is a decrease of 22% in steam requirements. Furthermore, the high pressure machine operates non-condensing. This eliminates the

use of condensing equipment for a considerable portion of the station capacity. This decrease is offset, however, by the necessity of installing reheaters.

In general, it may be stated that the equipment affected by decreasing capital costs with increasing operating pressures is as follows: Land, canals, foundations, buildings, fuel handling equipment, miscellaneous mechanical and electrical equipment, condensers, air preheaters, low pressure heaters, hotwell and circulating pumps and motors; while equipment affected by increasing capital costs with increasing operating pressures is: Boilers and boiler apparatus, economizers, feed pumps and motors, high pressure heaters, station piping, high pressure turbines, etc.

Maintenance and Operating Costs.

Maintenance and operating costs of generating stations have kept pace with the general downward trend of costs, and show reductions nearly in proportion to fuel cost reductions.

With regard to maintenance in particular, this has been brought about by the use of better materials in the manufacture of equipment, a more understanding knowledge of the use of such equipment and the limitations to which they may be subjected, the introduction of technical knowledge from an engineering standpoint in the care and protection of such equipment, and the practical experience gained by years of constant observation.

The Hydro-Electric Generating Station.

The development of the hydro-electric generating station has also advanced rapidly during the past decade and a half, so that at present the output from such stations represents a fair proportion of the total electric energy generated in this country.

The use of water as a motive power to lift the burdensome tasks from the shoulders of mankind antecedes its use in the strictly electrical generating field by some 3000 years. Although the origin of the water wheel is lost in the shadows of the past, history tells us of its use over thirty centuries ago in the waters

of the Nile, the Euphrates, and other rivers of the then civilized world. From those free current wheels, depending almost entirely on steam velocity, there has been a slow and gradual transition to the modern day turbine used as a prime mover in hydro-electric stations, in which turbine, head and velocity are combined to produce power at a maximum of efficiency.

The development of the water wheel turbine was begun long before the advent of the steam turbine. Many of the fundamental principles of the present day turbine can be distinguished in water wheels constructed as early as the sixteenth century. The real period of development, however, may be said to date back to the early part of the nineteenth century, and during this century the names of Fourneyron, Howe, Francis, Atkins and Pelton are linked with a rapid advance in water wheel design and efficiency. This was also the beginning of an era of industrial activity in this country.

The first great water power development in the United States was made on the Merrimac River in 1822 near Lowell, Mass., followed by similar developments on the same river at Manchester, N. H., and Lawrence, Mass. Those development had capacities of 10,000 to 12,000 H.P., each using a great number of wheels installed at factories along the various canals. Other developments were at Cohoes, N. Y., in 1828; Holyoke, Mass., and the Fox River, Wis., in 1848; Lewiston, Me., in 1849; Rochester, N. Y., in 1856, and the Mississippi River at Minneapolis, in 1857. The motive power derived from these sources was used principally in the textile, flour milling, and paper industries. The year 1861 saw the beginning of the development at Niagara Falls, and in 1881 a central powerhouse was built, the energy being transmitted to a number of factories by means of shafts, ropes and belts. The utilization of water power continued to increase, there being in excess of 1,000,000 H.P. installed by 1870. This was, of course, before the inception of the commercial electric station.

In 1882, as we have already seen, the first hydro-electric station was installed at Appleton, Wisconsin, and in the following fifteen years some three hundred such stations were installed. The year 1895 marked the beginning of the modern

generating station era when the 5,000 H.P. units at Niagara Falls were put into operation.

In the past many hydro-electric plants were constructed as the sole source of power supply for a community or section. Such installations were in the majority of cases typical "stream flow" stations, depending entirely on the flow of water, without any consideration of storage facilities, seasonal trend of water run-off, or trend of load variation. In a case of this type the minimum flow of the stream must be sufficient to meet the maximum demand for power. This brings us to the three major classifications of hydro stations; that is, (1) Stream flow stations, (2) Storage type stations with natural water storage available, and (3) Storage type stations in which artificial storage must be created.

As previously stated, in the first type of installation capacity is limited to minimum stream flow. This naturally results in considerable wastage of water over dams during periods of excessive run-off of area drained. The "utilization factor" is necessarily low, by this factor being meant the power actually generated to the power that could have been generated by using all of the water available. Investment costs per unit of installed capacity were correspondingly high due to the large investment in dams, land, riparian rights, etc., and the relatively small investment in power generating equipment.

The second in classification is the storage type hydro station with natural storage facilities available. The most striking example of this type is Niagara Falls, with the five Great Lakes offering the greatest natural storage of water in the world, and the abrupt change in stream level at the Falls eliminating the necessity of even a dam. Other water power sites with natural storage facilities may be found principally in mountainous regions, where dams may raise stream level and increase head considerably without greatly increasing the area of storage lakes, ponds, rivers, etc. Or, if such increase in area is necessary, it may be acquired at a minimum cost in regions that are sparsely populated.

The third in classification is that of the storage type of hydro station in which artificial storage must be created. This

situation naturally occurs in semi-mountainous regions, requiring large areas of flooded land to provide the necessary storage facilities. In this type of installation the initial investment is also relatively high, due to the purchase of lands very often of an agricultural nature, the possible necessity of bridging highways, moving highways, railways, cemeteries, etc.

The "stream flow" hydro installation has little to offer in the way of future hydro developments. The installation of generating capacity at such sites must be kept somewhere in the range of minimum stream flow, and where the hydro capacity is depended on for base load operation, this load must be backed up by a standby steam generating station. Typical examples of such standby requirements are found in Plant Atkinson of the Georgia Power Company and Gorgas Station of the Alabama Power Company. One authority has stated that, "it is no longer economic to install hydro power as a sole source of power supply."

Again, it is only logical to assume that hydro developments of the second classification, that is with natural storage facilities available, were looked upon as first choice sites and have been developed to a large extent leaving only second choice sites, that is those with only artificial storage, available for future use.

Hydro-electric developments, however, as a source of power to augment existing distribution and transmission systems have, and no doubt will continue to offer, wide possibilities, particularly in connection with peak load operation. This brings us to the subject of hydro-capacity for "peaking purposes." To demonstrate this, let us consider an assumed case:

A hydro-electric power site is available within economic transmission distance to the center of gravity of the existing load. Now, in the development of any power site there are certain capital or investment costs which may be considered as "fixed." These are in general cost of dam, land for water storage, riparian rights, etc. At a definite location these costs will vary little regardless of the generating capacity installed. A survey of these costs has shown that they normally represent from 75 to 80% of the total investment.

The variable costs or incremental costs of a hydro-development are those resulting from the installation of generating capacity and include chiefly buildings, intake conduits, turbo-generators and auxiliaries, etc. The unit cost of these items does not vary greatly ($55 to $70 per K.W. capacity), but the total cost varies with the capacity of the installation.

Now at this power site let us also assume that there is 10,000 K.W. installed capacity at a total cost of $3,750,000 or $375 per K.W. This 10,000 K.W. of capacity is needed for base load operation, and is therefore contingent on or somewhere near minimus flow requirements. However, at this same site it might be possible to double the capacity at an additional cost of only $500,000. This would bring the total cost of the installation to $4,250,000 or a unit cost per K.W. of $212.

Now a study of the load curves of the system may show that additional capacity requirements are only needed during periods of peak demand, and that an installation of 20,000 K.W. will satisfy this demand and at the same time make use of all the water power available over and above minimum stream flow, also that water storage facilities are sufficient to take care of load variation, and seasonal water supply variation. We now have an installation that will operate at 100% utilization factor, and only during periods of peak demand. The annual K.W.H. output of the 20,000 K.W. plant will be considerably higher than that of the 10,000 K.W. installation, resulting in lower fixed charges, operating costs, etc., per unit of station output.

There are other advantages accruing from the use of hydro-stations for peaking purposes. The generating equipment of these stations may be put into use when demanded, simply by opening intake gates and adjusting governing equipment. In the steam station from one to two hours are required to bring equipment into service, often only to find that the equipment is not needed for peak demand. The incremental cost of generating this additional capacity is usually high in steam stations. Furthermore, during off peak periods hydro equipment may be operated as synchronous condensing equipment for the improvement of system power factor.

Steam Versus Hydro Generation.

In general, it might be said that there is a definite field for steam generation as well as for hydro generation, and that the two in combination very often approach closely the ideal arrangement. To state that steam generation is cheaper than hydro generation, or vice versa, is to show lack of familiarity with the subject. The well informed engineer or economist knows only too well that each case must be treated individually; that there are numerous circumstances incident to cost data; and that very often an exhaustive study will disclose the relative advantages of one or the other form of generation. Let us compare some of the data incident to a study of this type.

INVESTMENT COMPARED: We have already shown that with modern construction and manufacturing methods, high efficient steam plants have been built on a decreasing cost trend. There is no disagreement that the hydro development represents ordinarily a much higher initial investment, in many cases amounting to 1.5 to 3.0 times the cost of the same capacity steam station. It is only logical to assume that the ideal sites, that is those representing hydro stations built in the lower cost range, have already been developed, while those remaining must come under the classification of second choice sites and, therefore, in the higher cost range.

Furthermore, the superimposing of high pressure capacity over existing medium pressure steam plants offers wide possibilities for future expansions at a minimum of total investment, and at very high incremental efficiency rates. The possibility for expansion in hydro stations is practically negligible, since these stations are nearly always built up to full capacity. This is due to the large investment in fixed capital cost (75 to 80%) and the small remaining investment in generating equipment.

FIXED CHARGES COMPARED: By fixed charges on any project is ordinarily meant the sum of interest, taxes, insurance and depreciation, all of which depend directly on investment cost. While some authorities disagree as to the actual rate of such charges, it is generally assumed, however, that the charges will

be about 3% lower for the hydro development, this lower rate resulting from reduced depreciation charges since only a small portion of the investment is in machinery, and some reduction in taxes due to location.

Using an average capital cost per kilowatt installed for the steam station, and assuming the average cost per kilowatt of a hydro station 2.5 times this amount, but with the lower fixed charge rate shown above, and also assuming 50% station capacity factor in each case, we find that the fixed charges per K.W.H. of annual output will equal about 2.9 mills for steam and 5.7 mills for hydro.

In addition to the fixed charge resulting from investment, there are other charges which depend chiefly on the capacity of the installation and for this reason may also be considered as fixed for any given development. These are chiefly operating labor, some materials and maintenance labor. With regard to the labor item and maintenance charges of a hydro station, these are so small a proportion of the total charges as to be almost negligible. A fair charge for a steam station over and above that for hydro should be in the range of 0.8 mills per K.W.H. output.

This leaves a balance of 2.0 mills per K.W.H. in favor of the steam plant, against which must be set the fuel charges. At a 15c per million B.T.U. fuel rate, which is about the average fuel charge throughout the country today, a steam station would have to operate at an efficiency of 13,300 B.T.U. per K.W.H. output to equal the hydro development. There are, however, a great many steam plants which operate with a fuel cost below 15c per million B.T.U. and a number can operate on a B.T.U. rate below 13,300. Again this study is based on a 50% station capacity factor for both hydro and steam and does not include transmission and substation costs or line losses in the hydro set-up.

Efficiency Compared: The efficiency of the hydro-electric station is today practically at a maximum. Refinements of design can only alter the overall efficiency to a very small degree. An average of wheel efficiency may be considered about 85% under varying load conditions, and for the generator about 93%.

In the steam electric station the efficiency is chiefly thermal and has reached a maximum of about 35%. This means that the losses in a steam plant still account for the larger portion of the heat input. Having viewed the rapid changes in the past, it would seem that the future still holds possibilities for additional improvements.

TRANSMISSION COMPARED: Transmission costs ordinarily make up only a small portion of a steam plant investment cost. The location of these plants is dependent only on a fuel cost consideration and an available condensing water supply. In the majority of cases they can be located near load centers, since fuel resources are fairly well scattered over this country.

The hydro-electric site is fixed by nature and is often remote from the load center. A recent survey of the United States shows that 72% of the available water power projects are located west of this river.

There is little doubt in the mind of anyone that hydro development and transmission development have advanced hand in hand. The economic distance for transmission of electricity has been greatly increased by the use of higher voltages. Starting with the first transmission line in Southern California in the early nineties, a 10 K.V. single phase line 28 miles long, and followed a little later by the Niagara Falls-Buffalo line, an 11 K.V. 3 phase project, the voltage has been increased at an almost constant rate of 6 K.V. per year for the past forty years until at present a 275 K.V. line, some 300 miles long, is now reaching completion.

The cost of these transmission projects and the accompanying substations has, therefore, reached a considerable portion of the total investment. Let us consider two typical cases:

A 110 K.V. single circuit, wood pole line, might be expected to cost $6,000 per mile. The economic distance of transmission of such a line would be 150 miles from the source of power. The kilowatt capacity of this line would be in the range of 30,000 K.W. The fixed charges on this investment, assuming a load factor of 50% and the full distance of transmission, would be about 0.83 mills per K.W.H.

A 220 K.V. steel tower line, 500,000 cm. copper equivalent, single circuit line might be expected to cost somewhere between $20,000 and $25,000 per mile. The economical transmission distance of the line would be about 250 miles and the economical capacity of the line about 150,000 K.W. The fixed charges on this investment, assuming a 50% load factor and the full distance of transmission, would be about 1.15 mills per K.W.H.

In addition to these charges, the cost of a step-down substation at the far end of the line (step-up substations are usually included in the cost of the plant) might be between $12 and $20 per K.V.A. From this it can readily be seen that the carrying charges on transmission lines might be greater than the total operating cost (exclusive of fuel and fixed charges) of a steam electric station.

Serviceability and Availability Compared: Serviceability of steam electric generating equipment has been improved to the extent where a survey of all equipment shows boiler availability to be well over 80% and for turbine equipment over 90%. Steam stations may, therefore, be called upon to deliver energy continuously at high load factor and without interruption except in rare cases. Furthermore, outage of major equipment for overhauling and inspection purposes can be regulated to comply with seasonal or weekly variations in load demand.

Many hydro stations operate at low load factors because of uncontrollable variations in available water power. The power supply from these stations is by no means fixed, but is to a large extent dependent on seasonal run-off of the area drained and the vagaries of Mother Nature. This holds true even where large pondage and storage areas are available. We can all recall the excessive drought of a few years ago, when in some sections industry was forced to curtail activity, and in other sections the generating equipment of ships was tied into the distribution system of several municipalities.

For this reason in any dependable utility system a large portion of the base load must be generated by steam power; or, as an alternative, steam standby plants must be constructed. The cost of such plants is entirely chargeable to hydro generation.

Summary.

In summarizing briefly the foregoing data and comparisons, we find:

HYDRO:

1. That the initial investment in a hydro station is one and one-half to three times greater than that of a steam station.
2. That the output is variable even with large storage areas, unless steam standby stations are included.
3. That investment costs are increasing as less choice sites remain available.
4. That locations of hydro stations are fixed and often unfavorable, requiring additional high transmission costs.
5. That the possibility of increasing efficiency is negligible.
6. That the chances of increasing capacity at existing water power stations is small, since they are usually developed to full capacity originally.
7. That little labor is required for operation and maintenance of hydro stations. This is an important point in view of the present unemployment situation.
8. That the largest portion of the charges against generation are fixed.

STEAMS

9. That the steam station can be located anywhere, and consequently close to the load center.
10. That increase in efficiency still offers wide possibilities.
11. That generating costs are continually being reduced.

12. That full plant capacity is available according to consumer demand.

13. That existing steam plants can be added to on a high incremental efficiency basis by superimposing high pressure steam or other vapor cycles.

Future Trend of Development.

There is no doubt that the utilities of this country are entering a period of expansion with regard to generating capacity. The total investment today in public utility properties is 13 billion dollars. Of this amount, 7½ billion, or 56½% of the investment, was made in the decade of 1921 to 1931. Beginning with the depression and continuing to the present day, utility construction has been practically at a standstill. Surplus capacity was available, and station output was decreasing.

During the last week of December, 1935, however, the load curve showing output for the country as a whole reached a point 7½% higher than the all time previous weekly peak which occurred in 1929. This increased demand will naturally be followed by a demand for additional generating capacity. Will the greater portion of this expansion be in steam or hydro generation?

In view of the facts and data presented above, it would appear that the future trend in the construction of new generating stations will result in this capacity being built to a larger extent in steam raher than in hydro development.

DISCUSSION

FRANK E. JOHNSON, JR.: The present paper by Mr. Frost, I believe, an excellent opportunity by study, for bringing up to date the knowledge of the average engineer concerning the subject matter of steam versus hydro generation. For the specialist in this field of engineering, it should serve to fix firmly in his mind the basic factors affecting a choice between the two for any individual case under consideration.

The trend toward "generation at the load," with steam, mercury vapor, or some other as yet undiscovered source for the

prime mover, will have an important bearing on the future function of the transmission line. There is also the influence due to the tendency toward de-centralization of generation sources which has followed from a limitation in the economical size of the plants. That is, the over-all economics of the situation seem to favor several smaller stations, each to take care of the load in its immediate vicinity with a diversity of generating units to fit the diversified load, rather than one larger station with a network of transmission lines to the various load centers.

These factors, together with the increased reliability of the energy supply from the power plant, will curtail the importance of the interconnection of transmission lines for the interchange of power. Such interconnections, as will be provided, will be for emergency operation only. This should have considerable political importance where interstate interchange of power is now involved.

The above discussion has, of course, been directed toward other than hydro-generation, since hydro-generation is basically "removed from the load" as is brought out in this paper. However, when it is remembered that the amount of power available from hydro sources is limited, their influence on transmission line functions as a whole becomes relatively unimportant. I say this in spite of the present-day magnitude of such hydro sources in the United States as the Boulder Dam and the Grand Coulee project. Their significance in terms of the total amounts of electrical power in use at a not so distant date will be overshadowed by the vast amounts of power from other sources.

The transmission line will, therefore, become essentially "Distribution" in character, travelling for a relatively short distance at a voltage of the order of that generated and with such tie lines between separate plants as may be required for emergency operation, these tie lines having voltages commensurate with the distance involved.

INDUSTRIAL RESOURCES OF THE SOUTH

By C. S. Williamson, Jr. *

Read at the Annual Meeting, January 25, 1936.

If we look for a definition of the word resources we are informed that it is "That from which anything springs, hence that to which one resorts or upon which one depends." If we look further at what research creates and which chemical engineering achieves we must recognize some resource or resources from which this creation came or by which this creation was made possible. Resources, therefore, become a **sine qua non** to any creative advancement we have made or hope to make in the realm of physical things.

Let us look back a little in order that we may see whether progress has been made in this line of creation and development. In 1874, the year in which Ex-President Hoover was born, the furthest distance which one could throw the sound of the voice was what a good pair of lungs could do toward vibration of the vocal chords; yet, in 1928, when he accepted the nomination for Presidential candidate, his voice was magnified by three with twenty-three ciphers after the three, and was heard around the world. Or, let us examine the electrical power situation in 1900, at which time we find one electric power plant generating as much as five thousand horsepower, but thirty years later we find over fifty stations generating more than one hundred thousand horsepower each.

In 1900 we had, in the United States, one telephone for every sixty--six people, one pair of silk stockings for every two thousand people, no radios, very few picture shows, and less than ten miles of paved roads, except in towns and cities. Thirty years later, in 1930, we find ourselves with a telephone for every six people, a pair of silk stockings for everyone in the United States, radios galore, a good picture show at almost every cross road village, and forty thousand miles of paved roads through the country. The production of Portland cement for the whole of the United States during the decade of 1890

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to 1900 increased from three hundred and thirty-six thousand to eight million four hundred and eighty-two thousand barrels, the production in the South in 1900 being about thirty thousand barrels, which rose by 1911 to eleven million barrels. In 1929 the cement mills in the United States produced one hundred and seventy-one million barrels of Portland cement, the South rendering between twenty-five and thirty million of this total production.

Lest we have not made clear that progress has taken place, let us go back to the days of McKinley. We find that he rode to his inauguration in a chariot differing from that of the Ben Hur days only by having springs, rubber tires, a seat and no visible swords projecting from it. In 1900, the fastest speed of general travel possible, except by train, was ten miles per hour, yet thirty years later we find workmen going to work at a rate of thirty to forty miles per hour. We find an exceptional few traveling by automobile in 1900, that is, those who were fortunate and bold enough to possess as a luxury one of the eight thousand automobiles in the United States, while in 1929 we find that there had been produced in this thirty-year period fifteen million Fords alone, and that in addition there were eight thousand aeroplanes in the United States.

The United States is the first industrial nation of the world, the rise to first place having taken place over a period of fifteen years previous to 1929. As much progress in the dyestuff industry alone was made during this period as was made by Germany in the forty years previous to 1914. What may happen in the next fifteen years no one can with certainty predict, but certain factors may be recognized as directive in influence and from them some conclusions drawn which may seem to indicate that industrial development will continue to take place though possibly not at the boom rate of the fifteen years previous to 1929, but at a more steady rate and on a sound basis. Some of these factors are: the growth of the population in the United States; the increasing tendency of labor to become capitalists; the growing demand of the masses for better and more conveniences and luxuries of life; the purchasing power of the masses, which is not so potential since

the panic of 1929 but which is gradually returning and will return to a considerable degree of what it was at the recent peak of boom times; likewise, the savings of the masses. Indications are that in about twenty years the population of the United States will have reached one hundred and fifty million people, despite restricted immigration.

Today in the United States we have six percent of the world's population, six percent of the land areas, more than one-third of the accumulated wealth, one-half of the coal and iron of the world, two-thirds of the cotton, three-fourths of the sulphur, sixty-five percent of the naval stores, ninety-five percent of the phosphate, seventy percent of the petroleum, over forty percent of the railway mileage, and over fifty percent of the gold supply of the world which is above ground.

The entire wealth of the United States was estimated to be in 1850 seven billion dollars and the Civil War cost four billion, which latter the South had to pay. In spite of this handicap and the great panic of 1873, either one of which would have, it looks like, daunted the stoutest hearts, in 1880 we find that of the ninety-three thousand miles of railway trackage in the United States, twenty-five thousand were in the South, and of the fifty million people, eighteen million six hundred thousand were in the South. In this same year the South had an agricultural capital of two billion seven hundred and sixty-two million dollars; produced agricultural products having a value of seven hundred and fifty-six million dollars; had an investment in manufacturing establishments of three hundred and thirty million dollars; and had a mineral production of eighteen million dollars. Despite the handicap of the Civil War, the South had, in fifteen years after the close of this war, not only survived the panic of 1873, but had begun to come into her own.

The South has been and still is thought of from the agricultural standpoint mainly and yet, from 1880 to 1909, the capital invested in manufacturing plants in the South increased nine hundred percent and the value of manufactured goods increased four hundred and seven percent. From 1900 to 1911, eleven southern manufacturing industries increased the amounts of their annual production ranging from two hundred

and fifty to twenty-three hundred and eighty percent, the increased value of products from ninety-two leading industries being from one billion two hundred and eighty-eight million dollars to two billion six hundred and ninety-six million dollars, or one hundred and nine percent. Investment in factories in Texas alone rose from sixty-four million to two hundred and seventeen million dollars in this period, and in 1912 Missouri produced factory products to the amount of six hundred and eighty-eight million dollars, which latter almost equalled the total value of southern agricultural products in 1880. In 1911 forty-two percent of the lead and forty-one percent of the zinc production in the United States was in the South, the largest pyrite producing plant being in Louisa County, Virginia.

In 1912, thirty-two years after the South began to come into her own, we find her with a population of thirty-three million four hundred and seventy-five thousand people and a railway trackage of ninety thousand nine hundred and thirty miles. From 1890 to 1915 sixty-five percent of the cotton spindles installed in the United States were installed in the Southern cotton mills, which in 1915 operated twelve million spindles and spun almost three million bales of cotton, two Southern states spinning more cotton than they produced, whilst the Northern mills spun two and one-half million bales.

Thirty-five years after 1880, or in 1915, of the two hundred and sixty-two different lines of manufacture listed in the whole of the United States, two hundred and thirty-six were in the South, and the value of manufactured goods for the South exceeded the agricultural products in value by nine hundred million dollars. Much stronger in industrial position was the South in 1915 than the whole of the United States was in 1880, since: it cut more lumber, mined almost twice the amount of coal, produced four times the amount of petroleum, and six times the amount of spelter, had more looms and spindles in operation, could boast of the largest sulphuric acid plant in the world, which was at Copper Hill, Tennessee, sold fifty percent more farm products, made almost as much pig iron, and twice as much coke as the whole of the United States did in

1880. The period from 1915 to 1929 witnessed enormous industrial development over the entire United States and numerout enterprises were scrapped after the closing of the great war as munitions and war materials were no longer a necessity, but even after scrapping such war-baby industries we find in the South that substantial growth of permanent nature had taken place in such industries as textiles, paper making, cellulose industries, chemical plants, iron and steel, and oil plants, both vegetable and petroleum, and even during the panicky days from 1929 to 1934, over one hundred million dollars was set aside as investment in chemical manufacturnig plants in the South, two of which came to the State of Louisiana, and one to Texas. The expenditure of this one hundred million dollars for chemical plants spells further development and may be taken as a good omen that the chemical industry has its eye on the South for greater development of chemical industries from the basic raw material within our own confines and especially is the State of Louisiana in for its contribution toward development, as she possseses all the basic raw materials and many others which fit into the fabric of chemical development. Louisiana is potentially a chemical manufacturing state.

Essentials for industrial development in any section are: transportation, power, and raw materials together with a market.

Transportation by water of enormous potentiality is possessed by the South, the State of Louisiana having forty-eight hundred miles of navigable water and the whole South has fourteen thousand miles of navigable water to and through the Missisippi River. Transportation by other means will not be discussed in this paper as they do not fall under the head of natural resources.

Electrical power is a potent factor in any industrial program, especially in chemical and metallurgical enterprises, the possible development in the South being greatly due to the natural topography. In 1908 it was estimated that two million eight hundred thousand electrical horsepower could be developed on the streams of the watershed from the Appalachian Mountains, the State of Georgia being capable of developing

five hundred thousand primary horse-power. Estimates were made in 1915 that five million horse-power may be developed on the streams of the South. What the estimate is now we are unable to say although in addition to development already made and contemplated by private enterprises, great expectations have been aroused as to what the activities of the Tennessee Valley Authority may result in from a power standpoint if not interrupted by the courts. Other sources of electrical power are today and will in the future be worth noting, on account of cheap fuel.

The South, with its coast line of five thousand miles, has an area of nine hundred and forty-five thousand square miles, in which lies the richest mineral territory in the world. Of the fifty-seven useful minerals found in the United States, fifty-five are found in the South, platinum and borax being the two missing ones. Removal of these minerals from the ground will disturb only a very small amount of the land area and there will be left sufficient soil to produce foodstuffs for any population resulting from the fullest industrial expansion.

The basic raw materials for the chemical industry are salt, sulphur, and limestone, which, when coupled with fuel and power to other raw materials such as natural gas, petroleum, coal, iron ores, lignite, ochres, bauxite, lead ores, zinc ores, mica, quartz, asbestos, baryta, phosphates, gypsum, fullers earth, naval stores, tung oil, timber, agricultural cellulosic products and other agricultural products such as corn, wheat, oats, rye, rice, potatoes, citrus fruits, soja beans, cotton and cotton seed, all of which the South produces or possesses, presents a veritable front for a chemical industry capable of producing almost anything producable by chemical means, and when sufficient development takes place, the South will dominate industrial conditions of the United States, if not elsewhere.

All of the available aluminum ore, bauxite, of the United States, lies in the States of Tennessee, Georgia, Alabama, and Arkansas, there being a small deposit in Arizona which is unworkable.

Iron ore deposits in the South amount to over fifty percent of such ore in the United States, not including in this amount even larger deposits of low grade ore which is not yet utilized. Birmingham, Alabama, has come into prominence as an iron producing city, beginning to boom in the early eighties as a result of the announcement of the Siemens-Martin basic open hearth process for the production of steel. Not only can as good steel be produced by this process from pig iron resulting from ores high in phosphorus and sulphur as from those low in these two elements, but deposits of iron ore in Birmingham lie in rifle shot distance of the deposits of coal and limestone required for smelting, transportation costs of raw materials therefore being small in comparison to the cost of shipment of ore from the Mesabi district to Pittsburgh.

Eighty-eight thousand square miles of coal deposits lie in the South, seventy-five percent of the coking coal of the United States being in these deposits. The coal area of the South is fifty times that of Germany, seven times that of great Britain, and twice that of all Europe including Russia, or five times that of Europe excluding Russia. This area does not include the area of low grade coal and lignite of the South which is as great as that of good bituminous coal. West Virginia has a greater coal area than Great Britain and Germany combined, and by 1915 had mined less than one-sixth of one percent of her deposit despite the fact that in 1912 she mined sixty-seven million tons, which was fifty percent more than the whole of the United States mined in 1880.

Although little mined and used at present, the enormous deposits of lignite in the South are not to be overlooked, on account of the potentiality of this coal for either fuel or by-products. One ton of lignite when retorted will produce ten thousand cubic feet of combustible gas, seventeen pounds of ammonium sulphate, one gallon of oil, fifty gallons of tar, and one-half to two-thirds of a ton of carbon, which last mentioned when briquetted makes a good household fuel. Application of hydrogenation under high pressure to lignite and chemical treatment of products from lignite will bring forth a series of compounds which will serve as raw materials for other indus-

trial products. One product which is produced at Marshall, Texas, from lignite is the decolorizing carbon known as Darco, the process for the production of this product having been started at Columbia University and completed at Tulane University.

In the United States, fifty percent of the petroleum lies in the South; sixty percent of the natural gas; ninety-nine percent of the available sulphur; all of the naval stores; one-half of the standing timber; inexhaustible deposits of limestone; and enormous salt deposits, of which the State of Louisiana has the second largest deposit in the States. The South produces ninety-nine percent of the phosphates produced in the States; all of the cotton, hence all the cotton seed oil; forty-five percent of the natural graphite which comes from the State of Alabama; one hundred percent of the naval stores; fifty percent of the petroleum and natural gas; forty-eight percent of the asbestos; eighty-nine percent of the carbon black; one hundred percent of the fullers earth which is used in bleaching oils, both vegetable and petroleum; forty-five percent of the lead; forty-two percent of the zinc; one hundred percent of the aluminum ore; ten percent of the salt; twelve percent of the sucrose; all of the sucrose from cane sugar, that from Hawaii and Porto Rico excluded; and in addition sizable quantities of baryta, mica, copper, quartz, gypsum, asphalt, sand, gravel, clays (all of the clay for production of chemical porcelain were utilized by one company coming from the States of Georgia and Texas), lithographic stones, ochres, corundum, and building stone such as granite, marble, and limestone. The State of Arkansas has a sufficiently complete line of minerals deposited to make it an independent state mineralogically, including some of the radioactive metals and diamonds. North Carolina has an enormous deposit of low-grade nickel ore awaiting development, and Louisiana and Texas have a developed capacity of three hundred thousand tons of soda ash per year.

Among the many interesting and fascinating stories in the history of chemical industrial development, that of the process for metallic aluminum stands out. Despite the fact that this element is one of the most universally distributed elements

known, being in every portion of the earth's crust, in 1855 the cost of it was ninety dollars per pound, and it is related that the first commercial article made of it was a rattle for a king's baby. The Castner process brought the price to four dollars per pound in 1889, the same year in which a carload of the aluminum ore, bauxite, was shipped from Rome, Georgia, to Pittsburgh, the shipper thinking he was shipping a white iron ore. After 1889 there followed simultaneously the Hall and the Heroult processes for obtaining the metallic aluminum from bauxite, after the installation of which the price dropped and at present aluminum is one of the most useful and necessary metals. Within the past year a process has been perfected for electroplating this metal on other metals, which process will doubtless have its influence on the can industry as well as many others.

Another one of the fascinating stories is that of the Frasch process for taking sulphur from the ground, which process is now operated at Freeport, Texas, and Grand Ecaille and Jefferson Island, Louisiana. Not only was this process one of the wonders of the age, but it made available a large supply of sulphur in the South not previously available, and rendered the United States independent, as long as the sulphur lasts, of outside sources for elemental sulphur which is necessary for production of sulphuric acid by the contact process.

Petroleum and natural gas are both well known to us all as such, and we commonly think of them in terms of fuel, lubricating oils, road materials, cleaning fluids and solvents, and for the major part stop with mentioning gasoline, fuel oil, lubricating oil, paraffin, and asphalt. Modern methods have increased the yields of gasoline, produced different types of lubricating oils, differing from what we had ten years ago, but research is going further and producing compounds of great value from the gases and wastes of the petroleum refinery. Natural gas is being utilized for the production of wood alcohol and formaldehyde, the former being employed in the paint industry and the latter among its other uses being one of the basic chemicals for producing synthetic resins, Bakelite being one of the most widely known, which is produced by combining

formaldehyde and carbolic acid. The great advances which have been made in the paint and lacquer industries in the last few years may be ascribed to the synthetic resin and nitrocellulose industries. Even the most fastidious golfer may have his golf stick today with the head made of synthetic resin, in fact, these sticks have been on the market for several years.

The great deposits of salt, natural gas, and petroleum are potential bases for an organic chemical industry of varied products, many of which are at present produced and utilized as such, or as raw materials for production of other compounds, from the same hydrocarbons which are obtainable from petroleum and natural gas. Butane is an example of a by-product from natural gas, out of which valuable compounds are produced. The high pressure hydrogenation process has made considerable change in petroleum technology and may be utilized on coal with promising results. Any further enumeration of products from natural gas and petroleum is useless in this paper for the purpose of showing that great value of these two raw materials, and a prediction of the producable compounds which are, or will be, of industrial importance is useless for the reason that many are already well known and research at the rate it is going will doubtless evolve others and make possible an organic chemical industry right in our midst which will continue to multiply values as those produced in the past have done, if not to a greater degree.

From the industrial standpoint we have thought of raw materials as being of mineral origin, and have considered the main business of the South as agricultural. Agriculture is a great business in the South, and doubtless always will be, yet as far back as 1915 the value of its manufactured products exceeded the value of agricultural products by nine hundred million dollars. Agricultural products have come to have a value other than that of food and raiment, as many of them are now raw materials for chemical manufacturing, well defined processes being in operation which utilize such raw materials for the production of their output. Some of these raw materials may be mentioned, such as: Cotton, cotton-seed oil, cotton-seed hulls, sugar cane products, corn stalks, Irish and sweet po-

tatoes, soja beans, tung oil which has just been started, citrus fruits, wheat, rye, and corn. The development of the cotton-seed oil industry, as far as it has gone, is most interesting, when we consider that as far back as 1915 this industry added twelve to fourteen dollars to the value of a bale of cotton, or about two hundred million dollars to the value of the year's crop, the products from the seed alone being worth more than the entire cotton crop of 1860.

The development and steady growth of the industries dependent upon cellulose has made a demand for cellulosic materials which will yield alpha cellulose in greatest quantity. Such industries are the artificial silk industries, by which there are four varieties of artificial silk produced, the adhesive industry, and those producing: photographic films, artificial ivory, artificial tortoise shell, celophane, water-proofing materials, explosive, fancy lacquers seen on every new automobile, and a number of other products. Cotton contains the highest percentage of alpha cellulose of any natural raw material we have and from it, or from alpha cellulose, we have over nine hundred different useful products produced by chemical means. Other sources of alpha cellulose are: bagasse from sugar cane, corn stalks, and wood pulp, the two former being produced annually by the farmers. Without the line of industries utilizing this class of agricultural products we would be without the moving picture industry, and Micky Mouse would be unknown, nor would we have the attractive dress goods displayed and purchased from the counters of our merchant houses. Elephant hunting and tortoise persecution have ceased to be either a pastime or a necessity in order to have the fancy toilet articles and expensive rims for spectacles, both of which are no longer the pride of the well-to-do only, but may be had by anyone of the most moderate means. The change in wearing apparel, especially of the female sex, was brought about by development of the cellulosic industries, and in 1912 lead a Chicago dramatic critic to reprove what seemed to him unusual brevity of skirts by stating that "the human knee is a joint and not an entertainment," and during the twenties of this century the older generation did a lot of sermonizing of

all female clothing, both of which sights were novel to them but are commonplace to the generation of today. Abe Martin remarked in 1928, "They say beauty is skin deep but I now know it is knee high" and "I used to think all women were alike, but now I can see there's quite a difference in 'em." Although it may seem that the question of the hour with reference to feminine dress is what to cover up and what to leave bare, the results of investigations on clothing, which were published within the past year, show that the feminine sex, which has adopted the fancy clothing resulting from researches on cellulose products, are dressed sanely and sensibly from the standpoint of efficiency, while the male sex is still content to go around with about fifteen clothes on the back of each man. It is needless to say that the industries producing cellulosic materials by chemical means have not only come to stay but will be on the increase as time goes on and new products are developed, and in so doing will call for corresponding increases in chemicals with which to treat alpha cellulose, as well as those for separating alpha cellulose from other impurities associated with it.

From cellulose as a raw material, however new the industries mentioned may be, others are yet to come, and when the constitution of the cellulose molecule is determined, there will spring up an industry larger than the organic chemistry industry from coal tar (commonly thought of as the coal tar dye industry), with its five thousand or more compounds, because of the fact that the molecule of cellulose is larger than that of benzol. An ever-present supply of cellulose may be on hand from recurring crops and from reforestation, which latter is already making strides in the South. Louisiana is utilizing bagasse from sugar cane for the production of the commercial product Celotex only, but in this refuse material from the sugar house is yieldable quantities of alpha cellulose. The cornstalk has already run the gauntlet and been proven valuable for paper production, and within a year data will be available as to the cost and yield of alpha cellulose from bagasse. The gathering problem of cornstalks is one yet to be better perfected, but in the case of bagasse this has been solved. Optimism may

well be expressed for this source of raw material because there is no crop grown in the South which produces the tonnage which the sugar cane does, and it may well be said the Louisiana and some of the other southern states are in a strategic position when this development comes through.

A few other of these nine hundred useful products made from alpha cellulose may be mentioned: Fabricoid for upholstering, tontine for washable window shades, coralite for rain coats, doltex for suede effect cloth, ventube for mine ventilation, velvetex for cushion base for rugs, smokeless powder, dynamite, and cel-o-glass, which is cellulose acetate and after being moulded on wire screening is used for window panes through which ultra violet light will pass.

To lay stress on any particular agricultural product may seem out of place as so many of the agricultural products are raw materials for the production of merchantable chemical compounds, yet there is the well known sugar industry, for which Louisiana is famous, to which attention should be given. This industry has produced wealth, has suffered fluctuations and backsets due to neglect of by-products among other things, yet refuses to die either of senility, tariff irritation, crevasses, or climatic fluctuations. The production of sugar, syrups, and molasses has received the major attention of the planter, but this agricultural crop can furnish raw material for several industries, such as the grain alcohol, fusel oil, celotex, industries employing cellulose as faw material including the white paper industry, the solvent, and rare sugar industries. Visualize the production of grain alcohol from black-strap molasses, acetic acid from the alcohol, acetic anhydride from acetic acid, then the combination between acetic anhydride and alpha cellulose resulting in the production of cellulose acetate, or acetate silk. Cellulose acetate is used for producing, in addition to the artificial silk, non-inflammable photographic films and finishing aeroplane wings. Had the X-ray films of the hospital in Cleveland, Ohio, been made of this non-inflammable material, the catastrophe, which, with such dire results, took place there in the last year or so, would not have taken place, and if the photographic films of the movie industry were of this materials

the asbestos booth would be unnecessary. Such a visualization is not dreaming, but is the realization of what is actually being done at present. Another line of useful compounds, which may be taken from, or produced from, the refuse of the sugar industry, are such highly technical sounding, yet just hoi polloi, compounds of organic chemistry as xylose, xylans, pentoses and pentosans, which last named compounds are the basic compounds for the production of furfural, which compound is used extensively as a solvent in the organic chemistry industry. When the sugar industry looks more to its by-products than it does at present, some of the fluctuations will be taken care of and some of the losses which have been taken for granted will be turned to profits.

Grain alcohol is another chemical which has become indispensible in the organic chemistry industry, touching industrial products from explosives to hospital equipment. It is produced: from molasses from the cane sugar industry; from starches from potatoes, corn, rye, rice, and wheat; from cellulose from waste wood, and has been produced commercially from hydrocarbons, from petroleum. Twenty-five percent of the grain alcohol produced in the United States is produced in the New Orleans vicinity from blackstraps. The process from cellulose is also a proven fact commercially and sufficient alcohol could be produced from the yellow pine wastes of the South to dominate the industrial alcohol market. Twenty gallons of ninety-five percent alcohol can be produced from a cord of yellow pine sawdust or wood chips. Not only do we produce alcohol from blackstraps, mainly from the tropics, but the residues, left after distilling the alcohol from the beer in the process of manufacture, are at present utilized for production of fusel oils, potash, and a filler for cattle food, which cattle food is made by mixing the gums from this residue with cornstalks and rice hulls and sells for about twenty-seven dollars a ton. The ability of the South to produce starch bearing crops, her enormous amount of waste wood, and large deposits of petroleum, place her in an advantageous industrial position when utilization of these raw materials for alcohol becomes a necessity.

The paper industry is one which is logical for the South, and one which is gradually moving southward on account of the high cost of raw materials and high cost of installation and production in the north, and doubtless will receive greater impetus in its southward travel, when it is realized that white paper can be produced from pine of six to eight years of growth as has been shown by Dr. Charles H. Herty in his recent researches. Already one corporation, with mills from Florida to Arkansas, produces thirty percent of the pulp produced in the United States, and the largest book publishing house in the United States is located at Kingsport, Tennessee, where the log enters one end of the factory and the bound copy of the book comes out at the other. Comparative costs of installation and production are given as follows: In Canada the investment cost per day-ton is thirty-two thousand dollars not including power, while in the South the installation cost per day-ton is twenty-nine thousand dollars including power. The production cost of Canada is twenty-seven dollars per ton and that of the South nineteen dollars. Wood costing eighteen to twenty dollars per cord is utilized in the North for pulping as against a cost of four to six dollars in the South. Of so much interest are the paper industrial possibilities in the South, the United States government has set aside a forest reserve of six million acres distributed between the states of Florida, South Carolina, North Carolina, Mississippi, Louisiana, and Texas. Reforestation is being done at a good rate in some sections of the South, and had we good fire patrol and prevention as the State of New York has, reforestation would take place naturally and take care of a great deal of the cutover land which at present lies idle and is inflicted with forest fires by carelsss tourists and hunters.

No mention has been made of the sea-food industry, which in the State of Louisiana alone amounts annually to more than the entire purchase price of the Louisiana territory from Napoleon. Doubtless Jefferson would not have opposed this purchase had he known or visioned the one fact of revenue. Louisiana is the largest fur-bearing state in the Union.

Two other factors which contribute their share of influence to industrial development, of which the South is possessed, are

a goodly supply of labor already living here, the labor turnover being less here than in other parts of the United States, and a climate conducive to good and cheap living, to more work days per year than in colder climates, to less investment for housing both the workers and plant equipment, and less cost of supplying heat during the winter months.

We acknowledge that the enumeration in this paper of the industrial resources of the South is incomplete, but in the time allotted on the program of this meeting one can only with temerity attempt to do more than mention the most outstanding ones and may even omit some of the most outstanding ones.

Therefore in summing up we may partially enumerate the "Industrial Resources of the South" as follows: deposits of fifty-five useful minerals forming the richest mineral territory in the world; forest timber for supplying lumber and raw materials for industrial products; annual agricultural products for food and raiment, and for raw materials for products made by chemical methods; potential electrical power from water falls and cheap fuel; transportation by both rail and water to say nothing of truck haulage; port facilities on a coast line of five thousand miles; good climate conducive to cheap and comfortable living and maximum work days per year; sufficient soil for food production; and good stable labor.

Possessed of natural resources which will fit into the fabric of industrial development and expansion, blessed with advantageous climatic conditions, embedded upon a soil sufficient to take care of food requirements, the South, which in the memorable words of the late Senator Carmack of Tennessee has been known as "a land which has known sorrows, a land that has broken the ashen crust and moistened it with tears, a land scared and riven by the plowshare of war and billowed with the graves of her dead, a land of legend, a land of song, and a land of hallowed and heroic memories," will be a dominant factor in the social and industrial life of America, when we recognize the great potentiality of her resources so abundantly bestowed and in the march of time bring to fruition this recognition.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY

Regular Meeting of the Society Held in Baton Rouge, May 11, 1936.

The dinner in the Venetian Room at L. S. U. opened the meeting. This dinner was tendered to the Society by the University, 85 members and guests were present. Col. A. M. Shaw gave a brief talk on the advantages of membership in an engineering society.

President Hackett awarded Life Memberships to Mr. M. V. Haulard and Mr. John Riess.

This was followed by a short address by Dean Lassalle, who called upon a number of prominent engineers present.

The technical paper of the evening was delivered by Prof. Craft of L. S. U. on "The Petroleum Industry in Louisiana." Excellent charts and slides served to illustrate the points in his paper.

Appreciation was expressed to those in Baton Rouge and at L. S. U. who made this meeting possible, and a rising vote of thanks was tendered the speaker.

The meeting then adjourned.

ARTHUR M. HILL, Secretary.

Minutes of the Board Meeting, June 5, 1936.

The meeting was called to order by Vice-President Williamson. Present: Grehan, Godat, Ricker, Hill.

The minutes of the last meeting were read and approved.

Mr. Horace E. Crump was voted a Life Member, having been elected June, 1906. The names of M. C. Abrahm, C. B. Dicks, Jr., H. H. Levey, John Middleton, were approved for membership, subject to the approval of the Membership Committee.

A letter from Mr. M. E. Crettet was read, in which he asked to be dropped from the Society.

One year Junior Memberships were awarded to Mr. C. P. Siess of L. S. U. and Mr. A. J. Brodtman, of Tulane, upon the recommendation of the Deans of the respective colleges of Engineering.

A letter from Mr. W. S. Henning was read, in which he asked that his status be changed from Member to Non-Resident Member.

It was voted to make up the deficiency on the Golf Tournament-Smoker in the amount of $103.00.

The Secretary was requested to make a semi-annual report on the finances of the Society, and supply each Board member with a copy of it.

It was suggested that if possible another Board meeting be held on June 8, at which time Mr. Todd would tell us what progress had been made in the bill for Registration of Engineers.

Adjournment.

Minutes of the Regular Meeting, June 8, 1936.

The meeting was called to order by President Hackett, 58 members and guests were present.

The minutes of the last meeting were read and approved.

The report of the Employment Committee was read and accepted.

It was announced that the Junior Membership award had been presented to Mr. Chester P. Siess of L. S. U. and Mr. A. J. Brodtman of Tulane.

The meeting was then turned over to Mr. S. J. Netherwood, Chairman of the Local Section of A. S. M. E., since this was a joint meeting with them.

Mr. Netherwood introduced the speaker of the evening, Mr. D. T. McIver, Assistant General Manager of the Freeport Sulphur Co. The title of the address was "The Sulphur Industry." Mr. McIver gave an extremely interesting talk, supplemented by motion pictures.

A rising vote of thanks was tendered the speaker, and the meeting adjourned to the usual collation.

ARTHUR M. HILL, Secretary.

Minutes of the Board Meeting of June 8, 1936.

The meeting was called to order about 7:15 P. M. by President Hackett. Members present: Bres, Godat, Grehan, Moses, Ricker, Williamson, Hill. Mr. Todd was present by invitation.

Minutes of the previous meeting were read and approved.

It was voted that it is not desirable to have memberships in the various societies awarded to the same student. This matter is to be referred to the Committee on Awards.

Mr. Todd led the discussion in connection with the bill for Registration of Engineers.

It was voted to have the present bill mimeographed and copies sent to each member of the Board of Examiners and officers of various local sections.

Mr. Todd stated that this bill was the same as passed in 1934 with the exception that one Tulane professor and one L. S. U. professor are to be on the Board.

The meeting then adjourned.

ARTHUR M. HILL, Secretary.

Minutes of the Board Meeting, July 15, 1936.

The meeting was called to order by the President. Members present: Hackett, Grehan, Williamson, Hill. By invitation Prof. Derickson and Mr. J. M. Todd were present.

The minutes of the last meeting were read and approved.

A letter from Mr. F. P. Hamilton was read concerning soil load tests suggested by Mr. Culbertson of Delgado Trades School. The following committee was appointed to discuss the matter with Mr. Hamilton and Mr. Culbertson: J. F. Coleman, Chairman; Donald Derickson, B. H. Grehan, John Riess.

A letter from Mr. J. M. Todd concerning the Engineers' Registration Bill introduced into the past Legislature was read. It was voted to send Mr. Todd and his committee a letter of appreciation for their time and effort spent in connection with this bill.

The matter of turning in a portion of stock of certain homesteads was discussed. Action on this matter was deferred.

At the request of Dr. J. F. Thomson, his name was dropped from the rolls of the Society.

It was voted that about five hundred envelopes of the "pay-as-returned" type envelopes be printed for use in connection with balloting.

The matter of the hospitalization plan for members was discussed, and the Secretary was directed to gather more information along this line.

A letter was read from the American Engineering Council concerning an exhibit and the Secretary was directed to take necessary action.

It was voted to appoint a vice-chairman of the Membership Committee, Division "A."

Adjournment.

ARTHUR M. HILL, Secretary.

ACTIVITIES OF LOCAL SECTIONS

President,
CLIFFORD H. STEM

1st Vice-President,
H. A. SAWYER

2nd Vice-President,
W. H. RHODES

Secretary-Treasurer,
A. J. NEGROTTO
4037 Banks Street



STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

ANNUAL MEETING

Second Tuesday in January.

A letter was recently sent to all members in Louisiana asking them to vote on the amendments to the constitution which were proposed at the last annual meeting.

A meeting of the Board of Directors was held on Monday, August 24th, and this vote was canvassed and it was found that the amendments were unanimously adopted.

It was decided by the Board that the scholarships at Tulane and L. S. U., which were discontinued last year on account of insufficient funds, should be renewed this year and the secretary was instructed to so advise the presidents of the two institutions and ask for recommendations of students to whom these scholarships might be awarded.

It was also decided by the Board that at the joint meeting of the Section with the Louisiana Engineering Society in September, Major V. J. Bedell should be invited to address the meeting on behalf of the Louisiana Section.

The resignation of Mr. Charles M. Kerr was received and the Board accepted the resignation with many regrets.

The following directors were present:

President, Clifford H. Stem.
Second Vice-President, William H. Rhodes.
Secretary and Treasurer, A. J. Negrotto.
Past President, John H. O'Neill.
Past President, F. P. Hamilton.

Guests in attendance by invitation were:

Professor Donald Derickson.
Colonel Edward S. Bres.
Major V. J. Bedell.

If you have not paid your annual dues please mail your check for $2.00 at once as this is very important if the activities of the Section are to be maintained.

PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

VOL. XXII. OCTOBER, 1936 NO. 5

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EDITORIAL NOTES AND COMMENT

The Traffic Problem. In America the automobile kills yearly more people than does any single disease. This slaughter, one of the concomitants of modernity, is the result of an almost complete unwillingness to recognize some of the factors which enter it. When it comes to providing remedies, this unwillingness amounts very nearly to intellectual dishonesty.

The whole automobile situation is a battle between two great opposing forces. The constructive creed of the automobile manufacturers, complying with the dictates of modern progress, is "Speed 'em up. Build 'em to go faster and faster." The destructive creed of the traffic politicians (should we have said enforcement agencies?) is "Slow 'em down and keep 'em

slowed down." And between these opposing creeds the slaughter goes merrily and bloodily on.

Let us note this in the beginning. Speed is not a matter of modern development. *It is an innate and fundamental human desire.*. It started away back in the Garden of Eden when "old man Adam an his chillun" found it necessary to develop running speed in order to save himself from meat-eating animals that went wild because Eve ate an apple.

Progress of man himself has been inextricably bound up with the development of higher and higher speed. The development of swift human runners; man's greatest invention, the wheel; the use of animals swifter than man; the development of swifter animals; the development of swifter and swifter mechanical means of transportation; the premium on speed everywhere, in business and in sport, all bear sufficient and eloquent testimony to the fundamental human passion for speed. Speed—all kinds of speed, including speed in transportation—is body and soul a part of human nature and not a modern development.

It seems evident, therefore, that any system of traffic enforcement must recognize this fundamental human desire. Foredoomed to failure is any traffic system which does not provide for pretty nearly the highest speeds of which modern automobiles are capable.

Why not stop fooling ourselves? Why not admit that the problem is not how to slow down a 100 mile an hour car to 45 miles in the country and a crawl in the city, but rather to make conditions in both city and country reasonably safe for a speed something near the car's maximum? When *every one* wants to go fast, speeding can not be stopped by police dictum. The eighteenth amendment did not stop the consumption of alcohol.

The traffic problem is, therefore, one of safety *with* speed. This is essentially an engineering problem. Until it is recognized as such and engineers (not politicians and policemen) employed to work it out, we are afraid that not much progress will be made towards its solution.

No greater service to our community could be rendered than for our Society to get wholeheartedly behind a movement which

would induce the authorities to recognize the problem as largely one of engineering with education and enforcement as corollaries (perhaps subordinate).

Engineering can make high speeds safe. No amount of illogical policing will slow down human nature from 100 to 15 miles per hour. Signs such as "Be quiet, be careful, or be arrested," "Drive slow and see our town, drive fast and see our jail" are the results of small time thinking by small town politicians. They are not only offensive to the large majority of drivers who are careful but are not heeded by the small minority of the negligently careless. Such signs are the surest evidence that the problem has been attacked from the wrong end. Engineering can accomplish wonders; policing human nature, not so much.

Our Employment Committee. The very effective work done by Mr. R. H. Baumbach, genial chairman of our Employment Committee, reflects credit upon him and his committee. Members of the Society in search of opportunities should register their names with the committee.

A file of all applications is maintained, and vacancies are filled from this file as quickly as possible. So far, in the year 1936, seven vacancies have been filled.

More power to Mr. Baumbach and his committee for the good work they are doing!

The New Orleans Public Belt Railroad. In this issue we print an article on "a strange and peculiar animal with nothing like it in captivity."

The author, Major Victor J. Bedell, Chief Engineer of the Public Belt, gives a most interesting and illuminating account of the beginning and development of that public enterprise.

This enterprise, culminating finally in the great bridge across the river, is a lasting visible tribute to the courageous doggedness of a few men. They had far-seeing civic vision and self-sacrificing tenacity of purpose. A still greater tribute to the effectiveness and integrity of these men is the fact that "having

been operated for 28 years, (it) has been able to keep itself clear of any intimation of scandal or political preferment.''

The ensuing discussion makes interesting reading, too. Particularly illuminating are the answers to questions as to whether or not settlement has taken place in the bridge piers.

Certificates of Membership. Members of the Society are advised that they may obtain from the Secretary the certificate of membership in the Louisiana Engineering Society. This certificate of membership is printed on heavy paper, measures 12″ x 14″, and is suitable for framing, so that it may be hung in the office or other place of business.

The price of the certificate is fifty cents and they may be obtained by addressing the Secretary.

PAPERS AND DISCUSSIONS

NEW ORLEANS PUBLIC BELT RAILROAD

By Victor J. Bedell *

Read before the Society, September 14, 1936.

After an intensive study of its organization and management, a member of the Interstate Commerce Commission characterized the Public Belt Railroad as "A strange and peculiar animal with nothing like it in captivity." My object this evening will be to show you as briefly as may be, the reasons underlying such a statement. In order to fully understand the situation giving rise to the construction of the Belt Railroad, we must first transport ourselves in fancy to the New Orleans of the 1890's and early 1900's.

The city had conquered its yellow fever epidemics, and had built or had under construction the jetties at the mouth of the river. These works were to insure the continuance of uninterrupted deep water shipping and establish for all time its position as a world port.

During the period of intensive railroad construction in the 1880's and 90's, the railroads entering New Orleans had received grants in aid of construction of one sort or another, from the city of New Orleans. Many of these grants had to do with right-of-way adjacent to the river front. Now with the development of New Orleans as a world port, these grants, which were of a more or less revocable character, became very valuable to the railroads, but to some extent stood in the way of the proper development of the port, the situation being that cars originating on one railroad which did not have access to the river front, were not handled as quickly and expeditiously as cars on the railroad which had such access, this in reality establishing a private port for such roads as were fortunate enough to have secured these rights.

* Chief Engineer, New Orleans Public Belt Railroad.

This monopoly was abused as were all monopolies at that time, very much to the detriment of the Port of New Orleans as a whole. Fortunately for the welfare of the port, a body of able public-spirited and influential citizens, constituting what is known as the Municipal Affairs Committee, had sufficient breadth of vision and farsightedness to oppose many of the proposed grants and thus retain at least a part of the river front for unified development.

Prominent among the members of this Committee were Mr. Wm. B. Bloomfield, Col. Jas. D. Hill, Mr. Jas. W. Porch and Mr. Thos. F. Cunningham. With this group was started in about the year 1896, the movement for a unified service to the port by a Belt Railroad traversing the entire water front. Various private railroad interests attempted to establish this Belt Railroad for their own purposes. This movement of the railroads was consistently blocked, largely through the interference of the Municipal Affairs Committee, which had in mind a Belt Railroad Water Front Service, owned and operated by the city of New Orleans. which would give an impartial service to railroads, shippers and steamship companies, regardless of the origin of the freight which was destined for foreign or coastwise shipping.

The whole story of the preliminaries leading up to the construction of the Public Belt Railroad is one of a farsighted group of citizens, loyal to their city and determined that its commerce should be free from corporation monopoly on one hand and political interference on the other.

In 1896 one of the major obstacles standing in the way of the construction of the Public Belt Railroad was removed. The Texas & Pacific Railroad had many years before been granted a franchise to construct a road along the river front from Protection Levee to Henderson Street, but had not availed itself of this franchise and had done nothing toward the construction of the road. The city took this matter up in court and the Lower Courts held in favor of the Texas & Pacific Railroad. The Supreme court, however, ruled for the city, thus opening up a large portion of the river front for Public Belt purposes.

A claim was also set up by the L. R. & U. Railroad to a franchise covering this same territory; of this claim however, more will be said later.

The agitation for a Public Belt Railroad finally crystallized in the form of Ordinance No. 147 of August 7, 1900, which provided for the establishment of a Public Belt Railroad to be controlled by a Commission composed of the Mayor and certain members of the City Council, and the appropriating of the amount of $10,000 per year for a period of four (4) years, for the construction of the railroad. This ordinance was a step in the right direction, but due to the probable political control under such a set up, was not considered a satisfactory method of constructing or operating a railroad. The appropriation, of course, was too absurdly small to be seriously considered as a construction fund; however, the Public Belt was now a legal entity which proved to be of considerable advantage.

About this time the Illinois Central Railroad was attempting to reach the river front from the rear of the city and an agreement was reached whereby it, the Illinois Central Railroad, at its own expense, should open up a street adjacent to the levee from Protection Levee to Peniston Street. This street, now known as Leake Avenue, was to be 110 ft. wide, in which was to be established a neutral ground 55 ft. in width, to be set aside for railroad purposes, and in addition to the purchasing of the necessary land, the Illinois Central Railroad was required to construct two tracks, which would be the property of the Public Belt Railroad, from Protection Levee to the lower side of Audubon Park; this in addition to the purchase of the land and the construction of their own trackage.

The necessary land purchases were made to provide for the street and tracks constructed at the cost of approximately one-half million dollars, to the Illinois Central Railroad; thus, without actual cost to the city, the first Public Belt tracks came into being. But these tracks were then (as critics characterized them in contemporary editorial items,) "Two streaks of rust which started nowhere and ended nowhere."

Messrs. Bloomfield, Hill, Cunningham, Behrman, and their associates however, had not been idle, and on October 4, 1904, a new Public Belt Ordinance was passed by the Council, in the form of Ordinance No. 2683, amending and re-enacting Ordinance 147 of August 7, 1900. This ordinance was a masterpiece in its organization scheme, as has since been proved. Under this ordinance the control of the Public Belt Railroad was vested in a Board of Commissioners which was "to be known and styled as the Public Belt Railroad Commission, for the City of New Orleans, to be composed of the Mayor of the city of New Orleans and sixteen taxpayers of the city of New Orleans, who shall be duly qualified electors and shall have resided in said city for a continuous period of five years prior to their appointment, to be appointed by the Mayor of the city of New Orleans, by and with the approval of the Council of the city of New Orleans, and as follows: Three members of the New Orleans Board of Trade, upon the recommendation of the said New Orleans Board of Trade; two members of the New Orleans Cotton Exchange, upon the recommendation of said New Orleans Cotton Exchange; two members of the New Orleans Sugar Exchange, upon the recommendation of the New Orleans Sugar Exchange; two members of the New Orleans Progressive Union, upon the recommendation of said New Orleans Progressive Union; and two members of the Mechanics, Dealers and Lumbermen's Exchange, upon the recommendation of said Mechanics, Dealers and Lumbermen's Exchange; and five members to be appointed from the citizens of New Orleans at large, three of whom shall be from that portion of the city above Canal Street, and two of whom shall be from that portion of the city below Canal Street; should any of the foregoing organizations cease to exist or be without legal successor, the members appointed therefrom shall serve out their allotted terms, and their successors shall thereafter be appointed by the Mayor, by and with the consent of the City Council.

The first Commission nominated under this Ordinance consisted of—

Martin Behrman (Mayor), President,
Jas. W. Porch, President Pro Tem.,

Hy. B. Schrieber, J. Hy. Lafaye, Jas. W. Porch,	Representing the New Orleans Board of Trade.
Jos. L. Love, Wm. B. Bloomfield,	Representing the New Orleans Sugar Exchange.
Thos. F. Cunningham, Albert Godchaux,	Representing the New Orleans Progressive Union.
Norman Eustis, Sol. Wexler,	Representing the New Orleans Cotton Exchange.
Thos. M. Thompson, Gaspar Cusachs,	Representing the Mechanic's Dealers & Lumbermen's Exchange.

and for the City At Large, Jas. D. Hill, John B. Meyers, Wm. P. Ross, Louis Cucullu and Jas. F. Thibaut, Samuel L. Gilmore as City Attorney, or Attorney for this Board and Arthur McGuirk, Special Counsel. Mr. A. S. Phelps was appointed Superintendent, Frank H. Joubert, Secretary-Treasurer, and Hampton Reynolds, Assistant Engineer.

This ordinance also provided for the extension of the $10,000.00 annual appropriation up to the year 1915, this appropriation being for the acquisition of property and for expenses incident to the construction of the railroad.

After having perfected the right-of-way, a plan to finance the construction of the Public Belt Railroad seriously confronted the Commission.

On application of the Public Belt Railroad Commission the City Council adopted an ordinance to provide credits for Public Belt Railroad purposes with various banks aggregating $100,000, the city obligating itself to refund to the banks such amounts as they might advance for Belt Railroad purposes out of the reserve fund appropriations for the years 1906 to 1915 inclusive, which

appropriations were made in the ordinance creating the Public Belt Railroad Commission.

With the total sum of $140.000, the Commission completed its survey and constructed a single main line along the river front from the upper line of Audubon Park to Press Street, the commencement of construction being celebrated by appropriate ceremonies on July 1, 1905.

Construction now proceeded, not without its difficulties, for a period of four years. Mr. Hampton Reynolds, who as you know, is now engineer in charge of all P. W. A. work, was engineer in charge, with Mr. A. F. Barclay, now General Manager of the Public Belt Railroad, as instrument man. The engineering difficulties of the work were many and varied; remember that the tracks to be built were almost entirely on the levee and the grades had to conform to the levee slopes with no cuts below the crown or line of slope of the levee. The tracks had to be built so as to serve both the wharves at the top of the levee and public team tracks and industry tracks at its base and in the adjacent streets. The sub-grade of New Orleans is uncertain enough at best, and the establishment of a substantial railroad grade on the levee, many parts of which were of comparatively recently construction, presented a difficult physical situation. The necessity of providing for future development in the restricted space allowed for construction, was recognized, and that the planning was excellent, is evidenced by the fact that in increasing the mileage of the Belt Railroad from its original twenty (20) miles in 1908 to its present one hundred fifteen (115) miles, and in providing for the establishment of industries and wharves since its construction, practically no relocation has been necessary in the original tracks.

Physical obstacles, however, were not the only ones to be overcome. The L. R. & N. Railroad, as has been previously noted, claimed certain rights in conflict with the right-of-way of the Belt Railroad, and on one occasion attempted to forcibly interfere with the construction of the Belt Railroad. The engineer

and various officers and workmen of the L. R. & N. were arrested and the physical obstacles which they had placed in the way of construction were removed. This brought the matter of the rights of the L. R. & N. Railroad into court, which held that the L. R. & N. Railroad had no valid claim for this right-of-way.

This was not the only obstacle of this kind which had to be overcome; construction was begun on a warehouse, (on property claimed by another railroad) which would have been directly across the line of the main tracks as projected. At this time the Public Belt Railroad had no material on hand to continue the construction of its trackage across the site of this warehouse. The President of the Commission, Mayor Behrman, ordered that material be secured from some source regardless of how and the track immediately constructed. After intensive search of the city, a sufficient quantity of scrap rail was found in one of the junk yards; this was procured and the track was built over the week end across the property in question.

In August of 1908, the trackage had been completed, a locomotive purchased, and the railroad was physically ready to be opened to traffic.

A great celebration was arranged for this formal opening on August 3rd. The Public Belt engine with gondola cars, in which had been placed seats for the guests, was brought to the foot of Canal Street. The guests having entrained, the party moved to the lower extremity of the Belt Railroad at Mandeville, thence doubling back to the upper extremity at Protection Levee, thence to the Leyland Line Wharf, where a luncheon was served on board the Steamship Colonial.

An editorial in the contemporary press of August 3, 1908, reflects the public feeling at the time of the opening of the Belt Railroad: "The opening today marks a new era in the commercial history of New Orleans. This we believe, the only seaport city in the world, owning and operating a Belt Railroad connecting all railroads with the publicly owned wharves and factories and warehouses giving cheap and easy communication with ocean shipping at our docks. The Belt Railroad will destroy the power

of the trunk railroads to discriminate in the manner of switching cars and it will offer upon equal terms to all, the advantages of cheap and expeditious handling of freight."

Thus, the loyal and strenuous efforts of the little group of men who first started the agitation for the Public Belt Railroad in 1896, were brought to fruition. The press at that time resounded in the praises of Mayor Behrman, Messrs Porch, Bloomfield, Cunningham and Hill. When it came time to award the Times-Picayune Loving Cup for the greatest service rendered during 1907, the committee stated that there was no great difficulty in deciding what the greatest public service in 1907 was—the completion of the Public Belt Railroad; but, the difficulty was in deciding which of the men who had done so much work to secure this, should be given the cup. It was decided that for continuity of effort, Mr. Bloomfield deserved it.

The opening of operation of the Public Belt Railroad on August 3rd, 1908, however, proved to be an opening in name only. Legal counsel for the Belt Railroad had held the opinion that the Public Belt Railroad was not a common carrier under the meaning of the Interstate Commerce Act, and that it should not be subject to the rulings of he Interstate Commerce Commission with regard to filing of tariffs, or keeping of car and interchange records. No tariffs had been filed with the Commission, and now with the Belt Railroad physically ready for service, the trunk line railroads refused to place their cars on the Belt Railroad for its handling, unless it would file tariffs and acknowledge itself subject to the rulings of the Interstate Commerce Commission. This brought on a deadlock in the movement of traffic in the port; the public wharves, now served by the Public Belt tracks, had no other means of railroad access. Cars destined for ships in the harbor, could not be placed except through the service of the Public Belt, so in the interest of the port, but against the advice of Special Counsel McGuirk, arrangements were made to bring the Belt Railroad under the jurisdiction of the Interstate Commerce Commission, and actual operations were begun on August 17, 1908.

The accumulated business of the port was quickly disposed of any from the very first, the switching business of the Belt Railroad was heavy.

On September 24th of the same year, Mr. Hampton Reynolds resigned as engineer to become a member of the contracting firm of Reynolds & Company, and Mr. A. F. Barclay was appointed to act in his place.

Engineering problems immediately presented themselves to Mr. Barclay, for on October 10th, about 300 feet of the river bank between Fourth Street and Washington Avenue, caved in, carrying with it the levee and about 250 feet of Public Belt main track. This track had to be immediately rebuilt in a temporary location, pending the reconstruction of the levee.

The construction of the Public Belt Railroad from its initial total trackage of 20 miles to its present 115 miles of track, has been an almost continuous operation, and has not cost property owners of New Orleans one cent in tax money, other than the original appropriation, as provided for in Ordinance 2683.

Developments have taken place which called for the Public Belt to build service, both in the construction of docks and in the service to industries; these calls have been promptly met by the construction of necessary trackage.

During the World War, the Public Belt Railroad enjoyed the unique position of not being a part of the United States Railroad Administration. The railroad being a public service, and after a long record of successful terminal operation, was considered better able to handle its operations independent of the Federal control.

The construction of the Inner Harbor Canal (Industrial Canal) and the Army Supply Base was greatly facilitated by the Public Belt in the construction of temporary and permanent trackage to and along the Canal and serving the ship yard of the Foundation Company near Galvez Street.

That the service of the Public Belt has been one of the greatest factors in the development of industrial New Orleans is shown

by the fact that there is hardly an industrial site which is available to the trackage of the Public Belt Railroad, which is not and has not been, almost continuously occupied and operated.

The Public Belt Railroad to serve the water front having become a fact and a successful going concern, the question of the elimination of another great obstacle in the development of New Orleans came up. This obstacle was the separation of the east from the west bank, with no adequate means of transportation between them.

The people of the state had declared on three occasions the necessity of the bridge; twice by direct vote of the general electorate of the state and once through their representatives in the Constitutional Convention of 1921.

It had been generally recognized for many years that the method of handling trans-river traffic in the New Orleans harbor, by ferries, was antiquated and that constantly increasing traffic would require more expeditious movement than could be accorded by any improved method of ferry service. Car ferry operation was subject to suspension by reason of extreme low or extreme high water at transfers; by collision, damage to inclines. fogs and damage to equipment by storms. The handling of traffic by car float equipment by the Southern Pacific, the Texas & Pacific and the Missouri Pacific Railroads was uneconomic and cumbersome.

The traveling public necessarily experienced delays and inconveniences and freight traffic was subjected to heavy detention not in keeping with the otherwise general effective movement of the industrial and commercial business of the City and Port of New Orleans.

The interchange of traffic between the Belt Railroad and all its connections, between the railroads on the east bank and those on the west bank, and the handling of inbound and outbound traffic of the west-of-river lines, originating at or destined to points on their own rails, should have been effected as quickly and economically as possible. Only through means of the river crossing could adequate rearrangement of terminal facilities be provided for the effective handling of traffic.

More obstacles were thrown in the way of the construction of the bridge, even than in the original construction of the Public Belt Railroad. By far the greater majority of the people of New Orleans considered that it was one of those things that could not possibly be done and indeed at many times during the negotiations leading up to the construction of the bridge, it seemed that an impossible barrier had been arrived at. In fact these *were* impossible barriers but for the resolute determination of a few men, outstanding among which were Mr. Thos. F. Cunningham, now President Pro Tem. of the Public Belt Railroad Commission, and the late Mr. Frank H. Joubert, who served the Commission as Secretary-Treasurer and General Manager, from the time of the inception of the idea to the day of his death in the year 1934. When everyone else had given up hope of surmounting some apparently insurmountable obstacle. Mr. Joubert and Mr. Cunningham still hung on with that tenacity of purpose which characterized both of these men. "The bridge must be built," was for years Mr. Joubert's slogan, and nothing was ever permitted to shake his faith in the ultimate construction of the bridge.

The bridge, which as you know was completed and placed in successful operation on December 16, 1935, completes another dream of these men who have done so much directly and indirectly for the growth of the city.

As has been noted public recognition was given Mr. Bloomfield for his efforts in the original construction of the Public Belt Railroad.

It is interesting to note that the same honor, namely, the award of the Times-Picayune Loving Cup, was conferred upon Mr. Thos. F. Cunningham, for the greatest achievement of the year 1935, namely, the completion of the Mississippi River Bridge.

Now a word as to the organization and operation of the Public Belt Railroad itself.

Governed in all its policies by the acts of the Commission, the Public Belt Railroad is managed by a General Manager who has general supervision over the operations, construction and maintenance of the Public Belt Railroad. The Office of Assistant

General Manager and Chief Engineer are combined, for the Belt Commission has always given due recognition to the engineering profession. The Chief Engineer has charge of all construction and maintenance of tracks, bridges and buildings and all physical property.

The operation of the railroad is in direct control of the Superintendent of Transportation, who has charge of the handling of cars on the Belt, establishment of schedules and the handling of the personnel directly connected with transportation.

The Mechanical Department is directly under the Master Mechanic, who maintains and operates the 16 locomotives which now furnish power for the movement of cars on the Public Belt Railroad is in direct control of the Secretary-Treasurer, who, like the General Manager, is an officer elected by the Commission.

The financing of the Public Belt Railroad as has been indicated, has never cost the tax payers of New Orleans one cent in tax money. The construction has been covered by bond issues which have been and are being paid off through earnings of the Public Belt Railroad.

The cost of switching cars which arrive in New Orleans from competitive points on trunk lines is absorbed by the various railroads which deliver the cars to the Public Belt. Intra-terminal switching is, of course, paid for by the consignor and on this switching the rate is as low, if not lower, than rates for like service on any other terminal railroad throughout the country.

A schedule has been established of traffic movements on the Belt whereby cars entering New Orleans and delivered on interchange of the trunk line railroads prior to 8:00 A. M., are placed for unloading at the wharves and industries, not later than 1:00 P. M. of the same date and frequently these cars are being unloaded at industries and wharves within an hour after their arrival on interchange. Special service is frequently rendered for shippers who have cars arriving in New Orleans on the same date as the sailing of the boat on which the contents of the cars are to be handled, and on application by the consignee or by the railroad handling these cars, special service is rendered and cars are placed immediately for unloading.

This class of operation, of course, results in additional cost to the Belt Railroad and it probably would not be accorded by any privately owned carrier interested solely in earning dividends for its stockholders; but, other than sufficient to take care of the cost of extensions and leave a fair operating surplus, the Public Belt Railroad is not operating for profit, consequently, it is possible to accord service which could not be accorded by a corporation owned railroad.

The pay-roll of the Public Belt Railroad which gives employment to 420 people at the present time and amounts to some $50,000 per month, is not an inconsiderate factor in the commerce of New Orleans. To sum up the situation, "this strange and peculiar animal" is the only municipally owned and operated terminal railroad in the United States, which, having been operated for twenty-eight (28) years, has been able to keep itself clear of any intimation of scandal or political preferment; serving all railroads equally, there has never been any charge of discrimination brought against the Public Belt Railroad.

We can account for this peculiar condition in only one way, namely, the character and integrity of the men who have at all times formed the Public Belt Railroad Commission; men, who leaders in their own business, have sufficient public spirit to serve without pay and to sacrifice a really considerable amount of their time to this public function.

I do not think the people of New Orleans have sufficient appreciation of the work of this Commission or understand the work that has been done in giving to the city this remarkable utility. I felt the same way about the Public Belt Bridge and was moved to write the following verses upon the event of its dedication:

I span the Fathers of Waters
With my trusses high and wide,
And deep in the mighty river
My strong piers breast the tide;
Fading in each far distance,
My webbed approaches blend
With the fog and shadows of forest,
Strong membered from end to end.

Know ye aught of my borning,
Ye who my back shall bear
On errands of joy or sorrow,
To the land of everywhere?
Know ye aught of my forefathers,
Or the minds that gave me birth,
Ye who will travel o'er me
To far places of the earth?

You call me a structure of steel,
Of iron and concrete and stone;
Little ye know of my birth
If ye think I am these alone;
Steel and concrete ye see,
What is beyond your ken
Is the blood and the sweat and the toil,
And the brains and the lives of men.

Think ye I was brought to this form
In the span of three years or four?
My conception was decades past,
By men who are no more,
Joubert, Bloomfield and Behrman,
Porch and Simpson and Hill;
That which they gave me stands,
And in me they are living still.

I span the Fathers of Waters
With my trusses wide and high,
And deep in the mighty river
My strong foundations lie;
And whether ye travel by highway,
Or over my gleaming rail,
Give a thought to the men who built me,
The men who would not fail.

DISCUSSION

MR. MALOCHEE: Are you still under the control of the Interstate Commerce Commission?

MAJOR BEDELL: Yes, we are strongly under the control of the I. C. C. We perform all of the functions of a common carrier. I did not go into the statistical data, but perhaps left a guess in the minds of some as to just what the Public Belt Railroad is worth. We have an expenditure in the Public Belt Railroad of $3,000,000 and in the Mississippi River Bridge of $6,000,000. The book value of our property today is $17,300,000. So you see out of $9,000,000, we have a book value, an actual expenditure of $17,000,000. The Interstate Commerce Commission, in their valuation, placed the value of the land at $15,000,000, so we are somewhat better than a $32,000,000 corporation at no cost to the tax payers of New Orleans except the initial $140,000.

MR. FROST: I am wondering if you exchange passes with a trunk line railroad.

MAJOR BEDELL: We do. Rather the trunk line railroads furnish us passes but we cannot reciprocate very well.

QUESTION: Is it correct to say that this railroad is the only municipally owned railroad in the United States?

MAJOR BEDELL: It is not correct to say that this is the only municipally owned railroad in the United States. The San Francisco Belt Railroad is owned and operated by the city, but it is owned and operated in conjunction with operation of the port. Miami also has a little terminal railroad of its own and so has Cincinnati. When the statement as quoted was made, it was the only one.

COLONEL SHAW: With regard to the exchange of passes, the president of a very small road asked the president of a very extensive system if they would exchange passes. The president of the shorter system remarked that it was hardly a fair exchange. "Well," said the president of the longer system, "there is no

comparison between the lengths of our roads, but there is a comparison between our width."

COLONEL BRES: There has been a rumor that a considerable settlement has taken place in the bridge piers. What steps are you taking to determine the amount of settlement, if any, and what do you find?

MAJOR BEDELL: Almost every month since the bridge was built levels have been taken across the piers, and excepting for the settlement during the construction which was the designed settlement, no appreciable settlement has taken place; however, a peculiar condition has been noted. The piers not only settle but they rise. The piers settle during high water and rise when the water is down. The variation is from three hundredths to eight hundredths feet as between the low and high water periods. That is an inconsiderable movement. I referred this matter to the "Soil Mechanics," sub-committee of the American Society of Civil Engineers. It has been the subject of considerable debate. I have not yet received the report of this conference.

COLONEL BRES: There is a noticeable dip in the roadway at one point near the New Orleans end of the bridge; why is that?

MAJOR BEDELL: We all know that there is such a thing as a camber. When two cambers get together you are going to get something like that; namely, an appreciable dip. The five hundred twenty-five moot (525′) through truss span has a camber of about nine inches. The next span to it, the anchor arm and cantilever, has a rise of something like four feet (4′) in the center. When the two curves come together there is an appearance of a dip.

MR. SCALES: Were the remarks true that were heard on the street that this end pier had settled or gotten out of line and returned to place before the work which was stopped for some sixty days could be resumed?

MAJOR BEDELL: No there was no truth in the rumors that the end pier had settled or gotten out of line. It is true that work of erecting the steel was stopped for sixty days due to high water which would not permit erection of the necessary

false work. The rumor was probably due to the fact that at the east and west highway approaches the steel towers supporting the railroad deck had settled two and one-half inches (2½″). This was due to the additional load placed on the footings by the overburden of earth in the highway fill. This fill was of river sand and was very heavy.

The condition was corrected by removing the embankment an dextending the steel structure about two hundred feet (200′) further.

COLONEL BRES: Why do trains move so slowly over the bridge?

MAJOR BEDELL: The track structure of the bridge is designed for speed of twenty-five miles per hour, but we did not consider it advisable to operate more than fifteen miles per hour for the first period. This was done on recommendation of consulting engineers. The trains now travel at speeds up to eighteen miles per hour, and though we have watched it very closely, we do not find any bad condition occurring.

We fully expected that we would get considerable settlement in the approaches for the bridge, but our levels do not show that we have had more than one-eighth to one-fourth inch settlement in any of the approach foundations.

MR. SCALES: What will be the ultimate speed at which the trains will be allowed to pass over the bridge?

MAJOR BEDELL: The ultimate speed will be about twenty-five miles an hour. Fifteen miles is the general speed now and very often the Southern Pacific passenger trains do not go as fast as that in crossing the bridge. The reason being that they may come into West Bridge Junction ahead of time and they have to observe the schedule in entering upon the Illinois Central Railroad's main tracks at the end of the bridge. This slow running, sometimes about six miles an hour, allows the passengers to get a good view from the bridge.

MR. SCALES: Are there any other railroads using the bridge other than S. P.?

MAJOR BEDELL: There are no other railroads now, but it is possible that the T. P. and M. P. may.

MR. BERNHARD: If it is true that the Public Belt has made so much money in the past years, can it not be expected that the rates will now be lowered?

MAJOR BEDELL: That would be true but for the burden of the bridge—the additional operating expenses that we are being put to. Remember that we have not raised the rates to the West Side. We are now operating a twenty-five mile haul for the same rates that we are operating a five or six or seven mile haul.

MR. RHODES: Do you operate across the river?

MAJOR BEDELL: Yes.

MR. RHODES: Do you charge the same for interchange across the bridge as for interchange in the city?

MAJOR BEDELL: The interchange rates are exactly the same from the West Bridge Junction to any point in the city as, say for instance, from the T. P.-M. P. at Race Street to the Southern Railroad at Press Street. There has been a great deal of agitation from time to time to establish zone rates. Under that method short hauls would get a low rate and long hauls would get a high rate. That would react to the detriment of the city. The people near here in the middle of town would have great deal better rates to the wharves and interchanges than would industries in the outlying districts. The uniform rate is for the purpose of developing industries in outlying sections of the city, giving them the same advantages as in the congested districts.

PROFESSOR DERICKSON: Major Bedell has spoken about the piers in the river. It seems only natural that there should be a movement somewhat in accord with the stage of the river. I understand that in the vicinity of the lake formed by Boulder Dam, that the burden of water thus imposed has caused some sinking of the adjacent terrain which, after all, is only reasonable and in accord with the latter developments in soil analysis and the science of foundations which considers the earth as a somewhat elastic solid subject to many of the laws of elasticity associated with the more familiar materials of construction. Even though I once was on the payroll of the Public Belt Railroad,

like many others, I knew little about this unique public facility. The history of the Public Belt Railroad, as Major Bedell has explained it to us is very much like the history of our city. Both have grown great through many difficulties. I would like to express my appreciation by moving a rising vote of thanks to Major Bedell.

Definitions.

AN ENGINEER is said to be a man who knows a great deal about very little and who goes along knowing more and more about less and less until finally he knows practically everything about nothing, whereas

A SALESMAN, on the other hand, is a man who knows a very little about a great deal and keeps knowing less and less about more and more until he knows practically nothing about everything.

Now one of our Purchasing Agents comes along with the following additional description (which sounds logical, assuming the truth of the above):

A PURCHASING AGENT starts out knowing practically everything about everything but ends up knowing nothing about anything due to his association with engineers and salesmen.

MINUTES OF MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Board Meeting August 17, 1936.

The meeting was called to order by President Hackett. Members present: Bres, Grehan, Godat, Ricker, Williamson, Hill. Mr. J. M. Todd was present by invitation.

A discussion of the proposed "Service Fee" by the city government was led by Mr. Todd. President Hackett appointed the following committee to meet with committees representing other interested professions:

GEO. P. RICE, Chairman;	N. S. HACKETT,
E. S. BRES,	J. M. TODD,
J. F. COLEMAN,	LEON WEISS,
GEO. EARL,	C. S. WILLIAMSON, JR.

The chairman of the Finance Committee, Mr. Grehan, requested that all possible economies be effected for the remainder of the year, because of the expense of the Annual Meeting. It was specifically recommended that the remaining issues of the Proceedings should not run over $125 per issue.

Adjournment.

Minutes of the Board Meeting September 14, 1936.

The meeting was called to order by President Hackett. Members present: Bres, Godat, Williamson, Hill.

The minutes of the last meeting were read and approved.

It was asked that Mr. D. W. Godat investigate the possibility of increase in salaries to engineers employed by W. P. A.

It was voted that the lights recently installed in the rooms be accepted, and the bill for them paid.

There being no further business, the meeting adjourned.

ARTHUR M. HILL, Secretary.

Minutes of the Regular Meeting September 14, 1936.

The meeting was called to order by Vice President Williamson, eighty members and guests present. The minutes of the last meeting were read and approved.

The July and August reports of the Chairman of the Employment Committee were read and accepted.

This meeting was a joint meeting with the American Society of Civil Engineers, and the chair was turned over to Mr. W. H. Rhodes, 2nd Vice President. Mr. Rhodes introduced the speaker of the evening, Major V. J. Bedell, Chief Engineer of the Public Belt Railroad. His talk was entitled "The Public Belt Railroad." The paper was extremely interesting and a discussion followed.

After tendering the speaker a rising vote of thanks, the meeting adjourned to the usual collation.

ARTHUR M. HILL, Secretary.

ACTIVITIES OF LOCAL SECTIONS

President,
CLIFFORD H. STEM

1st Vice-President,
H. A. SAWYER

2nd Vice-President,
W. H. RHODES

Secretary-Treasurer,
A. J. NEGROTTO
4037 Banks Street



STUDENT CHAPTERS

Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

ANNUAL MEETING
Second Wednesday in
January.

A meeting of the Board of Directors was held at Arnaud's restaurant on September 28th, at which time the action of the Committee on Scholarships was approved in the award of the Tulane Scholarship for 1936 to James Ross Eustis, and the L. S. U. Scholarship to Stanley J. Lewis.

President Stem was instructed to appoint a committee of 5 to formulate rules and regulations to govern the award of scholarships in the future. The following committee was appointed:

Professor Donald Derickson, Chairman
Professor B. W. Pegues
Edward S. Bres
W. H. Rhodes
F. P. Hamilton

The award of a Junior Membership in The Society was made to Louis Bisso, a graduate of Civil Engineering at Tulane University, he having attained the highest scholastic standing of his class for the four year period. No one has been recommended for a similar award at L. S. U.

On October 23, Professor Daniel W. Mead, President of the Society was a guest of The Section at a dinner at Galatoire's restaurant. This was a very interesting meeting with more than 40 members and guests in attendance, and a talk by President Mead in his own genial and interesting style was enjoyed by all.

Officers and some others of The Section are indebted to the Texas Section for a copy of their new monthly publication, "The Texas Engineer", which was found to be very interesting and creditable.

The Board of Directors, at the September meeting were pleased to have as guests Professor B. W. Pegues of Baton Rouge, and Mr. J. T. Bullen of Shreveport.

The year is nearly ended. Dues for 1936 to the local Section have been paid by 94 members, passing last year's record, but it is still hoped that the century mark will be attained. If you have not paid, please send your check at once to the Secretary and Treasurer. This is the means by which we award scholarships and prizes.

ANNUAL MEETING SECOND WEDNESDAY IN JANUARY

THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

LOUISIANA-MISSISSIPPI SECTION

Officers and Members

C. S. Williamson, Jr., Chairman, Tulane University, New Orleans, La.
W. R. Stryker, Vice-Chairman, Southport Mills, New Orleans, La.
E. A. Gastrock, Secretary-Treasurer, Celotex Co., Marrero, La.
H. A. Levey, Director, American Products Co., New Orleans, La.
J. J. Ganucheau, Director, Southern Co·ton Oil Co., Gretna, La.

E. Bache, Bogalusa Paper Co., Bogalusa, La.
R. M. Boehm, Masonite Corp., Laurel, Miss.
M. W. Boyer, Standard Oil Co., Baton Rouge, La.
C. E. Coates, Louisiana State University, Baton Rouge, La.
J. T. Cox, Jr., Himalaya Refinery, Tallieu, La.
C. B. Dicks, Jr., Tulane University, New Orleans, La.
H. S. Foote, Bay Chemical Co., Weeks, La.
H. H. Hewetson, Standard Oil Co., Baton Rouge, La.
G. K. Hickin, Freeport Sulphur Co., Port Sulphur, La.
P. M. Horton, Louisiana State University, Baton Rouge, La.
A. G. Keller, Bunkie, La.
W. B. Logan, Newport Co., Lake Charles, La.
G. P. Meade, Colonial Sugars, Gramercy, La.
H. J. Molaison, Jefferson Lake Oil Co., Barba, La.
E. S. Rothrock, Louisiana Chemical Co., Baton Rouge, La.
W. R. Schuler, Mathieson Alkali Works, Lake Charles, La.
J. H. Thickens, Masonite Corp., Laurel, Miss.
E. Wander, Bay Chemical Co., Weeks, La.

Regular meetings are held on the first Friday in February, May, October and December in the Richardson Chemistry Building, Tulane University, New Orleans, La.

PROCEEDINGS
OF THE
LOUISIANA ENGINEERING SOCIETY

VOL. XXII. DECEMBER, 1936 NO. 6

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EDITORIAL NOTES AND COMMENT

Attend the Big Two-Day Annual Meeting. Once more an energetic committee is hard at work with preparation for the annual meeting. The success of the two-day meeting last year with its attendance from all over the state has spurred the present committee to even greater efforts.

The committee has labored long and earnestly to make the coming annual meeting a success. A greater attendance is expected than was at last year's meeting. Rumors of the pleas-

ant time and entertaining features of last year's meeting have gone far and wide.

We print herewith the tentative program as far as it has been arranged. The program will be replete with papers and discussions of interest to all. Any engineer, no matter what his interest or what his work, will find something in the program of value to him. In addition to the papers and discussions, inspection trips and entertainment will be available. And for the ladies ample provision has been made. The Woman's Auxiliary has left no stone unturned to make the visiting ladies feel at home.

We hope that many, many ladies from outside the city of New Orleans will grace our meeting with their presence.

The meeting has been planned, keeping in mind the comfort and entertainment of the ladies as well as the men. Ample opportunity will be provided for shopping tours, interesting historical trips, et cetera, which will be attractive to the ladies.

Members should immediately mark the date of the annual meeting on their calendars. Friday, January 22 and Saturday, January 23 are the days set aside.

Begin your preparation *now* to attend the meeting and don't let any subsequent event interfere with such attendance. Come and meet your fellow engineers from all over the state.

PROGRAM FOR THE ANNUAL MEETING

January 22nd and 23rd, 1937

St. Charles Hotel **New Orleans, La.**

Friday, January 22:

8:30 a. m.—Registration begins, St. Charles Hotel.

10-11 a. m.—Sectional meetings of parent societies.

11:15-12:15—General Meeting. Convention Hall. Address of welcome by State and City Officials; election of Officers .Address by J. M. Todd. Buffet luncheon follows meeting.

1:30—Inspection trips covering Lone Star Cement Co., Flintkote Roofing Co., Jones & Laughlin Steel Co.



One of the Technical Sessions of 1936 Annual Meeting



Registration at the St. Charles Hotel, 1936 Annual Meeting

2:00—The Auxiliary will entertain visiting wives with a tour of the French Quarter followed with tea in the Court Yard Kitchen.

8:00 p. m.—Colonel Richard Park, District Engineer with U. S. Army at Mobile, will give an address "Military Engineering in Panama."

Saturday, January 23:

9:30 a. m.—"Chemical Engineering in the Sugar Industry," by George P. Meade, Superintendent of the Colonial Sugar Company's Gramercy Refinery.

10:30 a. m.—"Mass Transportation" by L. K. Silcox, Vice-President of the New York Air Brake Co.

At noon the Auxiliary will provide a luncheon for the visiting women. This will be followed by an automobile tour of the city.

1:00 p. m.—"Some Operating Features of the Electrical System of the Sewerage and Water Board" by Louis T. Frantz, Electrical Engineer, Sewerage and Water Board.

2:30 p. m.—Paper to be announced later.

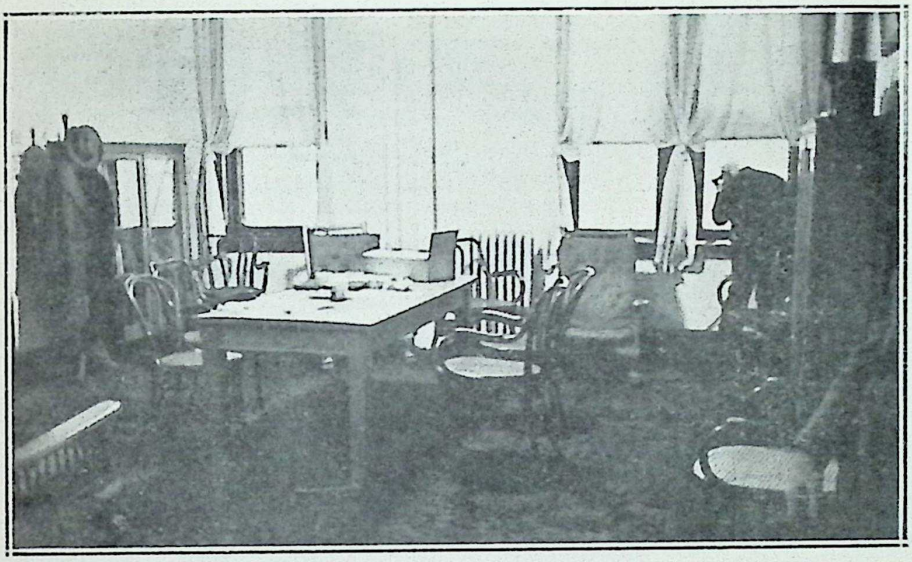
7:00 p. m.—Banquet, dance, installation of officers at La Louisiane Restaurant.

The final form of the program will be printed and will give the names of the officers of the Society, of the Auxiliary, Committee Members, and a short history of the Society.

ENTERTAINMENT OF VISITING LADIES BY THE WOMAN'S AUXILIARY TO THE LOUISIANA ENGINEERING SOCIETY

Plans for the entertainment of visiting ladies by the Woman's Auxiliary include: Tour of the French Quarter followed by tea in the Court Yard Kitchen, a complimentary luncheon for visiting ladies, automobile tour of the city.

On request of groups of sufficient size other visits of any special interest will be arranged.



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Committees on Arrangements for the 1937 Annual Meeting

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C. S. Williamson, Jr., V.-Chairman
D. S. Elliott
D. W. Godat
L. J. Lassalle
B. W. Pegues
H. L. McLean
A. M. Hill
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C. C. Crawford
R. H. Quinlan
C. W. Ricker
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SOCIETY	REPRESENTATIVE ON GENERAL COMMITTEE
American Society of Civil Engineers	C. H. Stem
American Institute of Chemical Engineers	C. S. Williamson, Jr.
American Institute of Electrical Engineers	C. W. Ricker
American Society of Mechanical Engineers	C. C. Crawford
American Society of Municipal Engineers	P. H. Quinlan
Society of American Military Engineers	S. B. Wilby
Student Branches of A. S. C. E., A. S. M. E., A. I. E. E.	

From Rags to Roofs. This issue of the Proceedings contains a paper under the above title read by Mr. Robert L. Nall before the Society on December 14. We modern human beings are apt to take such unromantic things as composition roofing more or less as a matter of course. The paper of Mr. Nall explaining the technique of manufacture of composition roofing is interesting.

To those of us who are accustomed to thinking of a rag as something with which to dust off the furniture or polish the automobile, it is somewhat of an interesting shock to realize that the composition roofing industry alone consumes about four hundred thousand tons of rags each year for this purpose.

Some Practical Applications of the Column Analogy. The paper under the above caption is written by Mr. Wayne Paul Wallace, a young engineering instructor at Louisiana State University.

For those who are interested in fixed-end and continuous structures, and the analysis thereof, this paper will prove interesting to read. Mr. Wallace did both his graduate and undergraduate work at Tulane University under our good friend and fellow member, Professor Derickson.

Death of Miss Edna Doll. With profound sorrow and regret we announce the untimely death of Miss Edna Louise Doll, Assistant to the Editor of the Proceedings since the beginning of the publication.

Always genial, happy, and energetic in her work, she gave a full measure of her ability to the Proceedings. Her untimely death occurred while the preparation of this issue was in progress. Hence the delay in publication.

She will be missed as a personality by all who came in contact with her. The Proceedings has lost a genial, loyal worker and a faithful friend.

Papers by Younger Members. We were glad to note at the December meeting three papers, all of which are by the younger members of the Society. Two of these papers are published

in this issue of the Proceedings. The third will be published at an early date in the future.

Why can't we have more papers and discussions by the younger members of the Society? After all, the Society belongs to them just as much as it does to the older men. It is not only good practice but very good business for the younger men to take some part in the activities of the Society. Let us hope that now that the ice is broken others among the younger members will come forward and also take part. It is not only for the benefit of the Society but redounds immensely to their own benefit.

Amendments to the Constitution. It is to be noted that several amendments to the Constitution were adopted at the regular meeting in November. These amendments as adopted are printed elsewhere in this issue. Every member should read these amendments in order that he may be fully informed as to the progress the Society is making in its own government.

New Members. We welcome to the ranks of membership in the Society a considerable number of new members. We hope that they will find their membership in the Society both pleasant and profitable. The new members who have been elected are as follows:

RESIDENT MEMBERS

CHARLES D. EVANS. 2108 Broadway, New Orleans. Endorsed by A. M. Shaw, H. J. Malochee, E. S. Bres. Age 57. Transitman and level man, railroad location and construction 1899-1901. Instrument man railroad maintenance of way, 1901-05. Asst. Engineer, railroad maintenance of way, 1905-11. Private practice engineer and surveyor 1911-21. Consulting engineer 1921-30. Commissioner of Streets and Parks of Shreveport 1930-34. Resident engineering inspector PWA 1935-date. Bachelor of Science in Civil Engineering Texas A. & M. College 1899.

JOHN D. FORD, 2431 State Street, New Orleans. Endorsed by R. T. Burwell, F. G. Frost, K. P. Kammer. Age 34. Marine

Engineer 1922-27. 1927 to present date, inspector of boilers, pressure vessels, engines and turbine for the Hartford Steam Boiler Inspection and Insurance Co.

Louis T. Frantz. Endorsed by Wade Barnett, W. B. Gregory, J. N. Wilson. Age 48. Electrical engineer, Sewerage and Water Board, City of New Orleans. Address: 8735 Apricot St., New Orleans.

Numa J. Helwick. 809 Greenwood St., New Orleans. Endorsed by L. V. Cressy, J. J. Friedler, Jr., L. S. Aleus. Age 36. Sixteen years experience in heating, oil burning, refrigeration, ventilation and air conditioning.

George W. Hill, 2800 Audubon St., New Orleans. Endorsed by F. G. Frost, G. R. Hammett, J. M. Todd. Age 45. Bach. of Science in M. E. and E. E. 1912. Sales engineering work with Westinghouse, 1912 to date.

F. Noel Kammer. 1453 Arabella St., New Orleans. Endorsed by G. H. Hammett, K. P. Kammer, D. W. Stewart. Graduated from Univ. of Detroit with degree of Bach. of Architecture, 1929. Three years in civil engineering dept. Solvay Process Co., Detroit; 6 years engineering and construction dept. of Pan American Pet. Corp. of New Orleans; two months with Flintkote Co. Age 30.

Lee W. King, 2107 Broadway, New Orleans. Endorsed by Donald Derickson, W. B. Gregory, John Middleton. Age 43. Graduate of Tulane University in Civil Engineering and has had 23 years of experience as follows: 4½ years as City Engineer of McComb, Miss.; 5 years as contractor on highway and municipal construction; 4 years as assistant engineer on railroad maintenance; 3 years as engineer on highway location and maintenance; 6½ years in general engineering, such as drafting, surveying, river and harbor work.

Charles J. Manney, 1932 Broadway, New Orleans. Endorsed by Dean J. M. Robert, H. M. Gallagher, C. W. Ricker. Age 26. Ohio State University, degree of Bach. of Mechanical Engineering, 1934; mechanical engineer with the Seagrave Corp., Columbus, Ohio., January, 1935 to September 12, 1936; at present instructor in Mechanical Engineering, Tulane University.

MICHAEL MICHEL. 323 Alix St., New Orleans. Endorsed by A. L. Dunlap, F. P. Hamilton, A. M. Hill for Junior Membership. Age 26. Graduate of L. S. U. Mechanical Engineering course in 1934. Engineer and draftsman W. P. A. January, '36 to June, 1936. Assistant engineer, Calmes Engineering Co. covering marine surveys, Diesel installation, power plants, both marine and industrial.

ROBERT L. NALL. 730 Dumaine St., New Orleans. Endorsed by J. J. Bulliung, G. R. Hammett, K. P. Kammer. Age 33. Graduated from Lafayette College in 1925. Student engineer Hudson Coal Co., 1925-26. Assistant chemist Marine Paint and Varnish Co. 1926-27. Structural steel draftsman, P. C. Dowell, 1927-28. Engineer, Flintkote Co. 1928-date.

C. BOYD NORRIS. Tulane University. Endorsed by D. S. Anderson, C. W. Ricker, J. M. Robert. Age 28. Graduated Univ. of Texas 1929, Masters degree in E. E. in 1934. Teaching electrical engineering at Tulane 1929 to date.

P. E. SEEPE. 5935 Freret St., New Orleans. Endorsed by P. F. Hoots, J. M. Todd, L. S. Weil. Three years of selling and supervising erection of heating and ventilating equipment. Three years of layout work of automatic control systems of all types. Two years of selling and supervising erection of automatic control apparatus.

NON-RESIDENT MEMBERS

O. H. ELVERUM. Winnsboro, La. Endorsed by H. B. Henderlite, C. A. Ives, Jr., N. E. Lant. Fourteen years of experience in Highway and Bridge Construction with the Louisiana Highway Commission.

STUDENT MEMBERS

WILLIAM H. BOHNE, LESTER I. BOONE, JOHN M. BOPP, HAMILTON J. BOUDREAUX, JR., HARWOOD I. BROWN, EUGENE J. CAZENAVE, JR., JOHN J. DEMAJO, HAROLD F. FAVRET, MARTIN GURTLER II, M. J. LASKEY, MARTIN W. MCDONOUGH, JR., EDWARD J. MCNAMARA, GEORGE H. MENEFEE, ALBERT B. PATTERSON, JR., MILTON E. PICK, LAWRENCE E. ROBINS, PERRY R. ROEHM, EDWARD J. WELSCH, JR. These students endorsed by various faculty members of College of Engineering, Tulane University.

PAPERS AND DISCUSSIONS

FROM RAGS TO ROOFS

By Robert L. Nall *

Read before the Society December 14, 1936.

The base of every type of asphalt roofing is a sheet of felt. Felt is the medium in which the saturating asphalt is placed and acts as the carrier for the coating asphalt and surfacing. The manufacture of it is in general the same as in the paper industry, with the exception that heavier and more rugged equipment is used. The felt base itself has little resistance to the weather because of the lack of waterproofing qualities. It must be saturated with asphalt, then coated with a harder asphalt and finally surfaced with some material such as slate.

In discussing the process in more detail the methods and equipment employed by the Flintkote Company at its New Orleans plant will be described. Especially will the data and statistics connected with this plant have greater local interest.

The manufacture of asphalt roofing should properly be considered as two separate processes—one being the manufacture of the dry felt and the other the manufacture of the roofing material. Owing to the larger investment required and to the necessity of continuous operation felt mills are fewer in number than roofing plants. At New Orleans we have both.

Felt is made from rags, but only certain types of rags meet the requirements for a good roofing felt. Rags containing too large a percentage of tough fibres such as wood or hemp produce a hard, stiff felt that cannot absorb the right amount of asphalt. The term "all wool felt" does not designate any advantage in roofing. This fibre is too soft and fluffy to form a satisfactory sheet if used by itself. Other rags must be mixed with wool to impart strength. The proper combination of rags, using a preponderance of cotton and wool, produces the right type of felt.

* Engineer, Flintkote Co.

Shipments of rags are received at the felt mill in bales weighing from 400 to 1000 pounds. Ten per cent of each shipment is set aside for testing of moisture, fibre content, foreign matter, and other qualities. If the shipment meets the standards the bales are stored and piled according to the grade.

The rag formula, consisting of the various grades selected to produce a felt of given specifications, is designated as the "furnish". After selection of the "furnish" for a specified felt, the rags are carried by a belt conveyor to the rag cutter. A rag cutter is constructed of a series of revolving knives which reduce the rags to a small uniform size. This is to provide for more ready reduction in the beating process.

A beater is a large iron vat in which a five-ton adjustable roll is revolved. This roll is approximately 60" in diameter and 48" wide, and has steel knife bars spaced around its entire circumference. Beneath the beater roll and imbedded in the bottom of the vat is a bed plate.

The dry cut rags are placed in the beater and sufficient water added to bring the charge to a consistency of 95% water and 5% rags. The revolving roll reduces the rags to a fibrous state known as stock. The stock continues through a series of six beaters until it has been sufficiently reduced.

From the beaters the stock goes through a Jordan where the stock is still further reduced to a consistency ready for the felt machine.

From the Jordan the stock is carried to storage chests from which it is pumped to the machine. Vibrating screens remove any unbeaten fibre or foreign material and from the screens the stock flows by gravity to the forming cylinder of the felt machine.

One might judge that so far the process of manufacture has been one of preparation. This is of course true from a processing point of view, but from a power viewpoint the worst is over. About one thousand horsepower has been required to produce the stock whereas only about three hundred horsepower will be used to finish the process on the felt machine.

The stock as it flows from the screen to the forming part of the machine is further diluted with water to a consistency of approximately one-half of one per cent of fibre content.

The function to be performed on the wet end of the felt machine is to separate the fibre from the water vehicle in which it is suspended, form it into a sheet, and extract the major portion of the water retained in the fibres.

The diluted stock from the screens flows into a half open cylindrical vat, in which revolves a close-meshed screened cylinder. As the cylinder revolves, the water of the stock passes through the screen surfacing of the cylinder depositing the fibres on the screen of the cylinder. The sheet as it forms is picked off the screen by a long travelling conveyor made of a woolen blanket-like material. Vacuum rolls and press rolls remove the water from the sheet while it is still on this conveyor. The sheet is now sufficiently formed and possesses enough strength to carry its own weight and it passes off the woolen blanket to a series of steam heated revolving drums or dryers where the sheet is dried and smoothed.

After passing over the dryers, the sheet is trimmed and slit into proper widths, ranging from 32″ to 72″ and wound into rolls weighing from 1000 to 2000 pounds. A number of different thicknesses of felt are made for the various classes and styles of roofing. It is also wound into small rolls weighing from 35 to 80 pounds, to form a finished product called deadening felt, which is extensively used for sound proofing and insulating . The New Orleans mill has one 72″ machine producing about 50 tons per day.

However, regardless of the size of the rolls produced, the felt is a finished product insofar as the felt mill operation is concerned. It will be put in our own felt warehouse for later use in the roofing plant, or may be loaded directly into cars for shipment to roofing plants which do not operate felt mills. No attempt is made to produce the weight of felt which the roofing plant happens to be using at any particular time. Roofing machines are much more flexible than felt machines and during an eight hour operation may use several different weights and sizes, without stopping, whereas the felt mill must

start the week on light weight felts and gradually proceed to heavier weights during the week.

The New Orleans roofing mill is equipped with two roofing machine—one manufacturing a sheet up to 40″ wide and the other a sheet up to 72″ wide. Each machine is about 300 feet long. The operation is a continuous one. At one end of a machine the rolls of felt are placed on an unwinding stand, and at the opposite end the finished roofing is wound into rolls or cut into shingles.

As the rolls of felt are unwound, the sheet is looped into continuous festoons, on what is known as a looper. This looper permits constant operation of the machine while one roll of felt has been unwound and another is being spliced to it. From the first looper the sheet is drawn into the saturation tank. The progress of the sheet through this tank is over a series of rolls at the top, and down under a series of rolls immersed in the asphalt in the tank. The tank contains hot saturating asphalt at a temperature of 425 to 450 degrees F. and when the sheet emerges it is saturated with asphalt. When properly saturated the sheet will absorb as much as twice its own weight of asphalt.

This is a very important step in the manufacture of good roofing. Unless all of the pores in the felt are filled with asphalt, some of the unfilled pores may later take up moisture, causing a fundamental weakness in the roofing. Various methods have been employed to increase the amount of asphalt which the sheet would absorb. The Flintkote Company developed a process called Supersaturation which has proven successful.

In the next step, the sheet passes to the coating section where hot coating asphalt is applied to both sides. Immediately after the coating process is completed, the surfacing materials are applied to the hot coating and then thoroughly imbedded by passing the sheet over a series of water cooled drums. The surfacing materials used will depend upon the type of roofing being made. The most commonly known roofing is the slate surfaced type which is surfaced with crushed

slate or stone of various colors. Other types are surfaced with talc, mica or a combination of both.

As the sheet leaves the cooling drums, it passes over a continuous weighing scale which indicates the weight. The weight of the sheet can be raised or lowered almost instantly by the application of more or less coating. The sheet then goes into a looper where it is cooled by blasts of air from a cooling system.

When roll roofing is made, the sheet is wound on mandrels to the proper length. They are wrapped with paper and placed on a belt conveyor where the lap cement and nails are inserted in the core and the ends sealed.

When shingles are made, the sheet runs through automatic cutters which cut the proper size and type and discharge to a conveyor. While on the conveyor the shingles are packed into bundles and finally carried through a tying machine which automatically wires the bundles for shipment.

Although felt is the most expensive material going into asphalt roofing, asphalt is used in larger amounts. Asphalt constitutes about one-half the weight of the roofing. In order to obtain asphalt meeting the specifications required for our purpose we must use both domestic and nondomestic crudes. At present the largest source of domestic crude is Texas; and for non-domestic crude, Mexico. These base asphalts must be further treated and blended in our stills. The asphalt which is used for saturation in roll roofing must be flexible because the material is packaged in rolls and is subjected to considerable bending stress. Although some flexibility is necessary in shingles, rigidity and strength are extremely important. To give this added rigidity in the felt for shingles, it is necessary to use an asphalt which has a higher melting point than that used as a saturant for roll roofings.

The coating asphalt must have a high melt point to resist slipping upon exposure to summer temperatures. This melting point must be in excess of summer roof temperatures because the pitch of the roof, coupled with the weight of the surfacing, increases the tendency of the coating to slip. Therefore asphalt

used in coating is much harder than the asphalt used for saturating.

These various properties are obtained by blending or blowing the asphalt in stills or both. The stills are tanks of about 10,000 gallons capacity heated by direct heat. The purpose of blowing is to temper the asphalt by forcing air through it. The still contains a number of pipes which have numerous holes. Air under pressure is forced through the pipes and comes out of the holes, passing through the asphalt. There are many theories about blowing as to what changes take place in the asphalt. It is generally thought of as a process of polymerization in which the oxygen molecules of the air combine with the hydrogen of the hydrocarbons, forming water, and the remaining portions of the hydrocarbon molecules join together to form a larger molecule. Blowing raises the melting point of the asphalt and decreases the penetration.

Another raw material which we process further before application is the stone or slate surfacing. We use many natural slates. Black slate from Pennsylvania. Buff stone from Missouri. Green from Georgia. Dull red from Vermont. Nature failed however to give us the highly colored granules such as the bright greens, bright reds and blues which have become popular. To obtain these we resort to artificial means. After many years of experimenting with various types of base rocks, color pigments and pigment vehicles, a process has been developed which will produce a non-fading color.

Of all the raw materials the lowly rag is perhaps the most romantic. There is used in the manufacture of roofing felt around 35,000 tons of rags every month or over 400,000 tons each year for the industry as a whole. These figures do not include the thousands of tons of rags used each year in the manufacture of writing paper, blotting paper or wrapping paper. Neither does it include the tonnage used by fibre mills in the manufacture of a product from which fibre barrels, pails, combs and gears are made. There is still another large tonnage of rags absorbed by the shoddy mills. These mills use large tonnages of woolen rags. It is impossible to obtain accurate data as to the exact tonnage of rags used by all of

these industries, but a conservative estimate would place the total consumption of rags in this country in the neighborhood of half a million tons annually.

As might be expected there is not sufficient tonnage of rags collected in this country to meet all of these demands. Large tonnages are imported annually through the ports of Boston, New York, Philadelphia, Baltimore, New Orleans and San Francisco. The better grade of rags which we bring into New Orleans originate in Holland, France and Scandinavia, while sizeable lots are also imported from England, Belgium and Germany.

As mentioned previously the rags are purchased on the basis of the grade. Although it might appear difficult, rags are sorted and graded by the rag dealer and sold to the felt manufacturer as a certain grade of rags. There is a felt manufacturers' association to which most felt manufacturers belong and which governs the specifications of the various grades. This is a benefit to the manufacturer and dealer alike, as otherwise there would be no uniformity. Manufacturers constantly report on the quality and condition of rags so that a rag dealer can establish a reputation of integrity for his product just as any other business man.

Although we may never have the pleasure of receiving a visit from all of you at our plant, it is quite possible that sooner or later the clothes which you are wearing will arrive at our felt mill in the form of rags to be converted into roofing felt. And it is also possible that that old overcoat which protected you from the rain and wind for so many years might return to you in the form of roofing to perform that same service again.

SOME PRACTICAL APPLICATIONS OF THE COLUMN ANALOGY

By Wayne Paul Wallace *

Read before the Society December 14, 1936.

For many years fixed-end and continuous structures were analyzed by the use of the Slope Deflection Method. This method incolced the simultaneous solution of several equations and was, indeed, a very laborious procedure. Today, with a knowledge of the column analogy, the structural engineer is no longer confronted with a difficult task when analyzing a fixed end or continuous structure but, rather, with a very simple and mechanical procedure.

Although the column analogy has not been in circulation very long it has received widespread acclaim and use.

Perhaps there are some here tonight who are not familiar with the column analogy so a brief explanation of its principle is necessary.

The column analogy was first published by Professor Hardy Cross, of the University of Illinois, and states that the analogy is a mathematical identity between the moments produced by continuity in a beam, bent, or arch, and the fibre stresses in a short column eccentrically loaded.

Engineers are familiar with the formula for determining the fiber stresses in a column eccentrically loaded and if the structure can be turned into an analogous column and the formula applied their work becomes a simple routine procedure.

In order to turn a bent or a narch into an analogous column, it is necessary to know only the dimensions of the elevation and the depths of the various members. The moments of inertia, I, may then be taken proportional to the cube of the depths. The column section must have the same dimensions as the elevation of the bent and its widths must be proportional to the quantity 1/EI of its respective members, I being determined as before.

* Junior Member, Faculty College of Engineering, L. S. U.

After the column section has been determined it must be loaded. This is accomplished by the use of an elastic load, which is nothing more than any curve of moments that is statically consistent with the loads on the structure. These moments are considered as intensities of pressures on the analogous column section. The centroid of the column section may be determined and from it the moments of inertia about the X and Y axes. With these quantities at hand the fiber stress at any point on the column section may be determined from the familiar column formula,

$$f = \frac{P}{A} \pm \frac{M_x X}{I_x} \pm \frac{M_y Y}{I_y}$$

These fiber stresses on the analgous column section are numerically equal to the moments on the structure. If, instead of external loads, the structure is stressed by internal linear deformations, due to shrinkage and temperature changes, a moment is applied to the analgous column section equal to the deformation and about its line of action.

If the members of the structure have varying cross-sections, such as a haunched beam or the deck of a rigid-frame bridge, they may be divided into small lengths and the section considered uniform over each small length, getting the total resultant load and its moment and the elastic properties of the section. It is not necessary to integrate as the precision will increase with an increase in the number of divisions taken, and since we do not know the value of the modulus of elasticity, E, exactly, it is a false accuracy to compute too closely.

The simplest practical use of the column analogy is in the analysis of haunched beams which are quite commonly used in buildings today. Formerly, haunched beams were analyzed by the use of tables that most closely fitted the subject and did not offer an exact solution. Today, we may analyze a haunched beam in a short time with an amazing degree of accuracy.

The column analogy is directly applicable to such structures as a simple bent, which may be analyzed very quickly

for dead load, roof and wind loads; to a bent with haunched girder and columns, such as are used to support viaducts and cranes.

The column analogy is used indirectly in analyzing continuous multiple span structures such as bents with side aisles, continuous arched bents, viaducts, and also in the computation of secondary stresses in trusses.

The column analogy may be applied to a simple arched bent or to a tied arched bent. It may be used to analyze closed elastic rings, such as culverts, sewer and tunnel sections of any shape that may be assumed, provided it is of one span.

The column analogy finds a large application in the construction of influence lines for continuous viaducts. For important viaducts such as those carrying railroad and highway loads, it is usually necessary to have a complete set of influence lines. These influence lines may be constructed by the combined use of the column analogy and the method of moment distribution.

1. The influence lines for the fixed-end moments for each span are determined by the column analogy.
2. A unit unbalanced force is distributed by moment distribution through the structure.
3. Then by placing a unit force at any point and with the use of the influence lines determined by the column analogy the fixed end moment at the ends of the beams are calculated.
4. These moments are then multiplied by the factors determined by the moment distribution. This will give the final moments in the structure for the unit load at the original point.

In analyzing continuous structures that are hinged, the elastic area of the column section becomes infinite since the moment of inertia of a hinge is zero and the area is concerned with the quantity 1/EI. Although hinges are not common in structures, some arches have been built with two hinges and some with three. Recently, in Tennessee, a rigid-frame bridge

was built in which hinges of cast steel were purposely placed in the footings to overcome the large moments due to fixed end supports. The bridge was analyzed by Mr. Alvin B. Auerbach, using the column analogy method.

In the analysis of an arch by the column analogy the arch rib is divided into segments whose projection on the X axis is always constant. Any curve of moments that satisfies the laws of statics for the given loads is used. Usually a simple curve such as one resulting from a consideration of the loads as being applied to a cantilever beam is the best to apply. The vertical centroid of the elastic column section is not evident at first, so it is necessary to compute the quantities to a convenient X axis and then correct to the centroidal axis. If the arch is symmetrical the general formula for flexure is used; if it is an unsymmetrical arch the values must be corrected for the dissymmetry according to set rules. When the analogous column section has been set up, it is routine work to find the moments at the crown and the springing due to dead load, live load, shrinkage and temperature changes.

The most useful application of the column analogy is in the analysis of rigid-frame bridges, which are fast gaining popularity as a means of grade crossing elimination and because of their adaptability to our modern architecture.

As in the arch analysis, the deck and legs of the rigid-frame bridge are divided into small segments of equal length. The analogous column section is determined and the elastic properties computed. Knowing these properties and selecting the most simple types of static curves for the loads on the bridge it is a simple matter to analyze the structure quickly and accurately.

So, with the advent of the column analogy, structures that formerly were analyzed by a long and tedious process that almost prohibited analysis because of the expense, may be analyzed in a very short time with simple mathematics and at a nominal cost.

AMENDMENTS TO THE CONSTITUTION OF THE LOUISIANA ENGINEERING SOCIETY

ADOPTED NOVEMBER 16, 1936

Present Form

ARTICLE III—Officers.

Section 1. The officers of this Society shall be a President, a Vice-President, a Secretary, (who shall also act as librarian), a Treasurer and four Directors, who shall constitute the Board of Directors in which the government of the Society shall be vested, and who shall be the Trustees.

Sec. 2. These shall be elected by letter ballot, by a majority of votes at the annual meeting of the Society, and shall hold office until their successors are qualified. The President shall be ineligible for immediate re-election. A Director shall be elected annually for a term of three years, except at the first election of Directors, when they shall be elected for terms of one, two and three years, respectively. The retiring President shall be a member of the Board of Direction for the year following his term as President.

Sec. 3. The Board of Direction shall select, an dthe President shall appoint, not later than the October meeting, three members of the Society to act as a Nominating Committee. The notices for the November meeting of the Society shall advise the membership of the personnel of this committee and that the Nominating Committee will consider suggestions for nominations for ten days following the November meeting. This committee shall report its nominations ,in writing, at the December meeting of the Society, which nominations, together with any other additional nominations ordered to be included by vote at the December meeting, shall

Amended Form

ARTICLE III—Officers.

Section 1. The officers of this Society shall be a President, a 1st Vice-President, a 2nd Vice-President, a Secretary-Treasurer (who shall also act as Librarian) and five Directors, who shall constitute the Board of Direction in which the government of the Society shall be vested, and who shall be the Trustees.

Sec. 2. These shall be elected by letter ballot, by a majority of votes at the annual meeting of the Society, and shall hold office until their successors are qualified. The President shall be ineligible for immediate re-election. Directors shall be elected annually for a term of two years, except at the first election of Directors—after the adoption of this proposed amendment, when one Director shall be elected for a term of one year and one Director for a term of two years. Thereafter, each year, two Directors shall be elected, each for a term of two years. The retiring President shall be a member of the Board of Direction for the year following his term as President.

Sec. 3. Unchanged.

be submitted to the Membership for ballot, as herein above provided.

Sec. 4. Any vacancy occasioned by resignation or otherwise shall be filled by the Board of Direction until such time as an letter ballot for such vacancy is taken.

Sec. 4. Unchanged.

ARTICLE IV—Management

Section 1. The President shall have general supervision of the affairs of the Society. He shall preside at the meetings of the Society, and of the Board of Direction, and shall be ex-officio member of all committees. He shall deliver an address at the annual meeting.

The Vice-President shall preside at meetings in the absence of the President and shall discharge the duties of the President in case of a vacancy in the office.

ARTICLE IV—Management

Section 1. The President shall have general supervision of the affairs of the Society. He shall preside at meetings of the Society and of the Board of Direction, and shall be ex-officio member of all committees. He shall deliver an address at the annual meeting. The 1st Vice-President shall preside at the meetings in the absence of the President and shall discharge the duties of the President in case of a vacancy in the office. In the absence of the President and 1st Vice-President, the 2nd Vice-President shall preside at meetings, and in the event of a vacancy in the office of 1st Vice-President, the 2nd Vice-President shall discharge the duties of that office.

Sec. 2. The Board of Direction shall manage the affairs of the Society, and shall act upon all applications for membership, take measures to advance the interests of the Society, and generally direct its business. The Board of Direction shall make annual report at the annual meeting, transmitting the reports of the Secretary, Treasurer and of other officers and of committees.

Sec. 2. The Board of Direction shall manage the affairs of the Society, and shall act upon all applications for membershpi, take measures to advance the interests of the Society, and generally direct its business. The Board of Direction shall make an annual report at the annual meeting, transmitting the report of the Secretary-Treasurer and of other officers and of committees.

Sec. 3. The Secretary shall be a member of the Society. He shall issue all proper notices, and shall keep a full record of all the transactions of the Society and the Board of Direction. He shall also conduct all correspondence appertaining to his office. He shall be custodian of the property of the Society. He shall acknowledge all donations. He shall issue warrants on the Treasurer for all bills approved by the Board of Direction, and deliver them to the parties to whom they are due; said warrants to be signed by himself and the President. He shall on the election of any member, inform him thereof in writing. He shall notify the member of all meetings through the public prints or otherwise.

Sec. 3. The Secretary-Treasurer shall be a member of the Society. He shall issue all proper notices, and shall keep a full record of the transactions of the Society and of the Board of Direction. He shall also conduct all correspondence appertaining to his office. He shall be custodian of the property of the Society. He shall acknowledge all donations. He shall, on the election of any member, inform him thereof in writing. He shall notify a member of all meetings through the public prints or otherwise.

He shall receive all moneys due the Society, and shall deposit same in the name of the Society in such a depository as may be selected by the Board of Direction.

He shall perform all other duties which may from time to time be assigned to him by the Board of Direction ,and shall be exempt from annual dues during his term of office.

Sec. 4. The Treasurer shall receive all moneys from the Secretary, and shall deposit the same in the name of the Society in such depository as may be selected by the Board of Direction. He shall pay all warrants signed by the Secretary and President, when accompanied by the approved bill for the payment of which said warrant has been drawn. He shall make an annual report, and such other reports as may be prescribed by the Board of Direction. He shall also give surety for the protection of the funds and securities of the Society in such amount as the Board of Direction shall determine, and the premium thereon shall be paid out of the funds of the Society.

He shall draw checks on the Society's depository, to be signed by himself and President, for all bills against the Society which have been duly approved by the Board of Direction, and deliver them to the parties to whom they are due. He shall give surety for the protection of the funds and securities of the Society in such amount as the Board of Direction shall determine, and the premium thereon shall be paid out of the funds of the Society.

He shall make an annual report, and such other reports as may be prescribed by the Board of Direction. He shall perform all other duties which may from time to time be assigned to him by the Board of Direction, and shall be exempt from annual dues during his term of office.

MINUTES OF THE MEETINGS AND BUSINESS OF THE SOCIETY

Minutes of the Meeting of the Board of Direction, October 12, 1936.

President Hackett called the meeting to order with Bres, Grehan, Moses, Ricker, Hill present.

The Minutes of the last meeting were read and approved.

The committee which President Hackett appointed to submit proposed constitutional amendments was approved by the Board. Members: A. T. Dusenbury, Chairman, E. S. Bres, John H. O'Neill, all past Presidents of the Society.

The Secretary was directed to send in a proxy to the Columbia Building & Loan Association.

The Board also approved the President's appointees to the nominating committee as follows: John Klorer, Chairman; John L. Porter, Frank G. Frost.

In discussing the routine of warrants and checks under the proposed amendment combining the offices of Secretary and Treasurer the following procedure was decided upon. The chairman of the Finance Committee and the Secretary are to sign the warrants; on the basis of these warrants checks will be drawn and signed by the President and Secretary.

The Board reviewed the amendments and voted to adopt them.

It was voted to admit Student Members from Tulane and L. S. U. at a fee of one dollar. No "Proceedings" would be sent to these members, but they would receive individual cards notifying them of the meetings. The membership period is considered from October to June. It was understood that this was a trial proposition.

The Secretary was directed to send registered letters to members who have not paid 1934 dues, stating they will be dropped if dues are not immediately paid.

The Board approved change in classification for Mr. J. Gentilich from Junior to Non-Resident Junior; that of Mr. David Stayer from Junior to Non-Resident Member.

Adjourned.

Regular Meeting of the Society, October 12, 1936.

The meeting was called to order by President Hackett; 62 members and guests were present. The reading of the minutes was dispensed with. The September report of the Chairman of the Employment Committee, Mr. R. H. Baumbach, was read and accepted.

President Hackett designated the following as constituting the Nominating Committee: John Klorer, Chairman; Frank Frost, John L. Porter.

The names of the members elected thus far in 1936 were read, those new members who were present were introduced.

Mr. Allan T. Dusenbury was called upon to explain the general considerations which led to the proposed amendments to the Constitution. The articles were read and were adopted by vote of the members present. It was understood that the following line be added to Article III, Section 2: "The retiring President shall be a member of the Board of Direction for the year following his term as President." This line was omitted through error. In Article IV, Section 3, the wording will be changed from "He shall notify a member . . . . " to "He shall notify members . . . . . ". The amendments will comeup for final vote at the November meeting.

Mr. A. J. Naquin made an interesting talk on the needs of a traffic engineer for New Orleans. He cited the rule laid down by the Safety Council that a city of 100,000 population should have a full time safety engineer. Some of the points suggested for study by such an engineer were the resurfacing of certain of the paved streets with a material having a higher coefficient of friction, particularly when wet; the correct placing of "STOP" and "SLOW" signs and their visibility. Mr. Naquin proposed that President Hackett appoint a committee, which after study of conditions would make recommendations to the City Government with the view of employing at least one full time safety engineer.

President Hackett expressed his interest in this matter and agreed to appoint a committee as suggested.

Dr. D. S. Elliott of Tulane University was called upon to describe some of the interesting and unique events in connection with the Third World Power Conference, which he attended as one of the official delegates from the Louisiana Engineering Society. One of the several features described was the arrangement of interpreters and the telephone system, whereby a listener, by wearing his head-phones and shifting a dial, could listen at will to any of the four languages while the speech was in progress. Dr. Elliott also stated that the submitted papers were not read at the Conference, but were printed in advance and placed on sale before hand, so that the delegates could study them. Discussion was confined to a summary of submitted papers and comments on them. Owing to the fact that power projects cannot be brought into the hall for inspection, the necessity for well organized tours was pointed out. The Third World Power Conference portrayed the interdependence between scientific and engineering activities, economic issues and governmental policies of various countries. As an illustration high tariffs on oil brought into a country stimulated research along the line of utilization of low grade oils and led to the invention of more efficient instruments for geophysical prospecting. Dr. Elliott pointed out that the increasing demand for oil as a fuel for power would probably lead to extensive research, with objectives of obtaining oils of higher octane value in order that the integrated storage capacity for oils be held within reason.

President Hackett next called upon Dean Lassalle of L. S. U. for his impressions of the Congress. He was a delegate from Louisiana.

Dean Lassalle pointed out the remarkable opportunity this Congress afforded the nations of the world to express and exchange their views on the subject of power generation and distribution. Reactions depend upon localities; he cited the Swiss and Italian delegates who were more interested in water power developments because of lack of fuel in their own country. Dean Lassalle said that he thought the delegation from England had the best general presentation of subject. It has been estimated that the coal supply will last for about 4,000 years and the attitude seemed to be "We should worry about future generations and their fuel supply." He emphasized the fact that this is not the usual engineering viewpoint, which is based upon conservation to the utmost degree.

President Hackett next called upon Mr. Karl Kammer, who was a delegate from New Orleans Public Service.

Mr. Kammer said that many points had already been covered, and as he was to speak at the A. I. E. E. on the subject he would merely relate here an amusing incident. At the inspection of the solar machine apparatus the English delegate said "This is a fine thing, but what we need in London is a fog machine."

President Hackett then threw the meeting open to questions and discussions of any kind.

Mr. Todd said that he understood the papers in connection with the Congress would be available at Tulane and L. S. U. libraries and asked that the membership be notified when these publications were received.

Mr. Todd also asked that the duties of the Nominating Committee be stated. The secretary read that portion of the constitution covering this point.

Mr. Klorer inquired what had been done about filling the vacancies on the State Board of Engineering Examiners, and asked that the Board of Direction of the Society submit additional names. A motion was passed to this effect.

There being no further discussion the meeting adjourned to the usual collation.

Through the efforts of Mr. McLean an amplifying system was obtained for this meeting, and was of great assistance.

ARTHUR M. HILL, Secretary.

Minutes of the Special Meeting of the Board of Direction, Oct. 19, 1936.

The meeting was called to order by President Hackett with Bres. Grehan, Hill present.

The minutes of the last meeting were read and approved.

The question of vacancies on the Board of Engineering Examiners was discussed. It was recommended that the Governor be petitioned to re-appoint those members whose term had expired, namely Donald Derickson, B. H. Grehan, B. W. Pegues. The six-year appointment is to run from date of expiration of former appointment.

It was voted that the following names be submitted to the Governor as suggestions for a member to fill the vacancy caused by the death of Frank Muth: V. J. Bedell, E. S. Bres, John Klorer.

A letter was read from Allison Owen in connection with the proposed Eads Memorial. The Secretary was instructed to advise Mr. Owen that the Louisiana Engineering Society representative is James M. Todd.

The Traffic Survey Committee appointed by President Hackett to make recommendations to the city for a full time safety engineer was approved by the Board. Members: A. J. Naquin, Chairman; John H. Bernhard, John K. Mayer.

Col. Bres discussed the plans of the Society of American Military Engineers in connection with the joint meeting with the Louisiana Engineering Society. It will be necessary to hold this meeting the third Monday in November instead of the second Monday. To avoid confusion as to dates, it was decided to send out two sets of announcements, one to reach members about October 27, the other notice to reach them about November 6.

There being no further business, the meeting adjourned.

ARTHUR M. HILL, Secretary.

Minutes of the Meeting of the Board, November 30, 1936.

The meeting was called to order by Vice-President Williamson, with Godat, Ricker, Hill present.

The minutes of the last meeting were read and approved.

A quotation on an amplifying system was read. It was decided to receive other quotations before definite decision was made.

A letter giving prices on pins for the membership was read. It was decided to canvass the members to determine how many would be willing to buy a pin.

It was voted that Mr. Hock be given a year's membership in the Society. Mr. Hock gave an address before the Society on the manufacture of industrial alcohol.

The resignation of Mr. J. P. Ewin was accepted with regret. At their own request, Mr. J. J. Steadham and Mr. Charles David were dropped from the rolls of the Society.

The following changes in grading were approved: Mr. C. J. Peirce, Jr., from Junior to Member; Mr. J. S. Gentilich from Junior to Non-Resident Junior; Mr. David Stayer from Junior to Non-Resident Member.

The following persons who have applied for membership since the last ballot were approved: A. R. Boelte, J. O. Dyal, F. S. Borden, W. N. Tuller, J. B. Gates, F. M. Stone, J. H. Frederickson, Geo. P. Robbins, Jr., R. W. Ziifle.

Adjourned.

ARTHUR M. HILL, Secretary.

MINUTES OF THE JOINT MEETING OF THE LOUISIANA ENGINEERING SOCIETY WITH THE SOCIETY OF AMERICAN MILITARY ENGINEERS

November 16, 1936.

The meeting was called to order about 3:30 p. m. by Vice-President Williamson, President Hackett being unable to attend. Two hundred sixty members and guests were present.

It was moved and seconded that the reading of the minutes be dispensed with.

The amendments to the Constitution were voted upon and passed. Professor Williamson then turned the chair over to Mr. H. A. Thompson, Principal Engineer and Chief of Operations of the Second New Orleans District.

After a few introductory remarks Mr. Thompson took up the discussion of the work of the District. By means of colored slides he showed the locations of the various projects either proposed or actually under construction by the U. S. Engineers. Consolidation of work areas as projects were completed was portrayed by slides also.

About 4:20 p. m. the barges and tugs passed under the Public Belt bridge, and a few minutes later were at the mixing plant. Before arriving at the asphalt mixing plant Mr. Thompson explained the method of making the mix and the ingredients. One of the boats was equipped with a loud speaker and his remarks could be clearly heard over the barge.

A number of engineers from the office were on board, each wearing a red arm band with numeral attached. Members of the party were given mimeographed sheets showing the names corresponding to the numbers.

After pausing a few minutes and watching the plant operate, while Mr. Thompson made additional remarks about its operations, the boats swung down the river to the point where the mats were being laid.

At this point most of the members took advantage of a very delicious and complete buffet supper arranged conveniently on long tables.

Arriving at the mat laying plant, the boats again paused, and Mr. Thompson explained in detail the forming of the asphalt mat around the re-enforcing steel and lowering it to the levee.

About 6:10 p. m. the boats were again docked at the wharf, foot of Prytania St.

The trip showed forethought and careful planning, and this coupled with ideal weather made it a great success.

ARTHUR M. HILL, Secretary.

ACTIVITIES OF LOCAL SECTIONS

President,
CLIFFORD H. STEM

1st Vice-President,
H. A. SAWYER

2nd Vice-President,
W. H. RHODES

Secretary-Treasurer,
A. J. NEGROTTO
4037 Banks Street



STUDENT CHAPTERS
Louisiana State Univ.
Baton Rouge

Tulane University
New Orleans

ANNUAL MEETING
Second Wednesday in
January.

There is some doubt as to what benefit is derived from this page or whether it is worth what it costs the Section. If members who may read this will drop just a note to the Secretary-Treasurer and say whether they make a practice of reading the page and whether they think it worth the price, it would let the Section officers know how you feel about it.

No important news event has broken since our last issue. The Tulane Student Chapter seems to have been quite active. We do not have any news items from the L. S. U. Chapter.

Remember that the Annual Meeting is set for the night of the second Wednesday in January but you will get a formal notice later.

This is not a meeting for New Orleans members but a meeting for all members in the State. The meeting is always interesting, first through a paper or lecture by some speaker on a subject of interest to engineers. This is always followed by a jollification meeting with plenty of good things to eat and drink, and your annual dues of two dollars is all that you have to pay.

Mark it on your calendar—January 13th, 1937.

Ninety-eight paid members to date. Who will make it ninety-nine?

The Section activities, or promotions, consist in awarding one scholarship each to deserving students at Tulane University and Louisiana State University and the award of a Junior Membership to the outstanding graduate in Civil Engineering in each University.